

# PROCEEDINGS

**Virtual International Conference**

**on**

**Multidisciplinary Research-2022**

**[VICMR-2022]**

**01-05-2022**

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**Jointly Organized  
by**



**Association of Global Academicians and  
Researchers (AGAR)**

**&**

**Association of Indian Biologists (AIB)  
Tamil Nadu, India**

**ISBN: 978-93-94198-04-3**

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## **MESSAGE FROM EDITOR-I**



It is truly a joy and an honour to participate in the combined Virtual International Conference on Multidisciplinary Research-2022 [vICMR-2022] organised by the Association of Indian Biologists (AIB) and the Global Academics and Researchers' Association (AGAR) Tamil Nadu. This continues to be a history because of its great global response. I am certainly grateful to the association members that they have provided me with an opportunity and that they have trusted me. With their leadership, all this was made possible. I thank the academics and students who attended the conference. I am very thankful for guiding me in times of need for other Editors and Associate Editors. I am incredibly lucky and grateful to participate in this distinguished conference.

I hope that everyone had pleasant experiences in their efforts to concentrate research in a variety of fields of nanotechnology. The attendees of vICMR-2022 will have an entertaining, scientific virtual gathering with potential resources, and I wish them all the best.

With Regards,  
**Dr. Atul Kumar**  
**Professor,**  
**Dr. D. Y. Patil B-School, Pune,**  
**Maharashtra**

## **MESSAGE FROM EDITOR-II**



Dear friends,

It is fantastic to see the Indian Biologists' Association (AIB) Tamil Nadu embodies a vital experimental education and research strategy as well as a major problem in society through its Virtual International Conference on Multidisciplinary Research-2022 [VICMR-2022]. The topic of education and research provides ample scope for the quest for recent developments in crucial educational roles and developing research methodologies. The knowledge gathered throughout the seminar would reach the student community to help directly society to receive the education we receive. We need a more strategic and holistic approach to education and research to integrate issues in the various fields of research. Such a conference will expand the imaginations of young scientists to seek innovative solutions to real life methods. I wish this important scholarly activity every success to the seminar organising group and associations. Congratulations and Bless God You're Striving.

With Regards,  
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### **MESSAGE FROM EDITOR-III**



The conference provides an excellent forum for academics, aspiring experts, and students from across the country to explore and update their creative notions and academic experiences across a wide range of study topics. It is open to anybody interested in academics, aspiring experts, or students. This vICMR-2022 conference lays the theoretical groundwork for multidisciplinary research that is both contented and aspirational in nature. This event will feature paper and poster presentations, as well as awards for the best presentation. Each contributing article was reviewed by at least one other author before being accepted for publication in this session. Publications were accepted on the basis of their interest, relevance, originality, and overall execution. I am pleased that all participants took advantage of the chance to share their expertise, experiences, and ideas, as well as to make new contacts and build new collaborative relationships. During the discussions among coworkers in this pandemic circumstance, this educational programme, which was jam-packed with activities, created a more relaxed mood.

I am hoping that we will be able to meet at the next conference, which will have more active issues and more notable specialists.

With

Regards,

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### **MESSAGE FROM EDITOR – IV**



Informed that the Association of Global Academicians and Researchers (AGAR) in Andhra Pradesh and the Association of Indian Biologists (AIB) in Tamil Nadu have jointly organised the Virtual International Conference on Multidisciplinary Research-2022 [VICMR-2022], I am overjoyed to learn of this. Please accept my heartfelt congratulations on behalf of all of the participants on their unwavering zeal and enthusiasm in disseminating information to the student community.

A decent education broadens our perspectives and provides us with a better opportunity of achieving our goals in life. People can grow and influence their circumstances as a result of their knowledge. Education is a passport to the future, for those who prepare for it today will have a better chance of success in the future. "It is your attitude, not your ability, that will decide your level of success." If you think education is expensive, try living in ignorance for a while. I would like to express my heartfelt gratitude to the members of the organising committee for their efforts in putting together this Virtual International Conference on Multidisciplinary Research-2022 [VICMR-2022]. I am delighted to wish the seminar's organisers every success in their endeavors.

With Regards,

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## **MESSAGE FROM EDITOR-V**



As the proceedings of the Virtual International Conference on Multidisciplinary Research-2022 [VICMR-2022] released by the Association of Global Academicians and Research (AGAR) and the Association of Indian Biologists (AIB) on May 1, 2021, with an exciting and inspiring flow of in formations, it gives me great pleasure and privilege to present the proceedings of this conference.

Academicians, young researchers, and students from all across the country will be able to exchange and update their new ideas and research experiences in a wide range of diversified subjects at the conference. This event will feature paper and poster presentations, as well as awards for the best presentation in each category. Before being accepted for publication in this proceeding, each contributed article was subjected to a peer review process.

I sincerely thank the authors for their contributions, as well as the reviewers for their tireless efforts, which have been ongoing for years. Thank you very much to the Keynote speakers, who were a tremendous complement to the virtual conference in every way. For their effective participation in and presentation about the recent developments in the scientific programme of Nano-world, I would like to express my gratitude to All listeners.

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## MESSAGE FROM ASSOCIATE EDITOR - I



Dear Friends and Colleagues,

Indeed, it is a privilege and an honour to be a part of the jointly organised Virtual International Conference on Multidisciplinary Research-2022 [VICMR-2022] by the Association of Indian Biologists (AIB), Tamil Nadu, which has been organised with great magnitude during the COVID-19 period and is a privilege and an honour. This remains a truth due to the huge outpouring of support it has received around the world. Everything that has happened has been made possible by the generosity of the members of the association who have given me the opportunity and restored their faith in me. I am truly grateful to them for their assistance. I'd like to express my gratitude to the staff members and students who came to this meeting and shared their ideas. I owe a debt of gratitude to my colleagues for providing transportation when I was in need. I consider myself fortunate and fortunate to be a participant in this renowned meeting.

The keynote speakers were a tremendous asset to the virtual gathering, and we are grateful for their contributions. Various Scientists participated in the scientific gatherings and gave presentations that were very informative. I am grateful to both of them for their contributions to the event.

With Regards  
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## MESSAGE FROM ASSOCIATE EDITOR - II



Virtual International Conference on Multidisciplinary Research-2022 [vICMR-2022] is being organised by the Association of Indian Biologists (AIB), which is based in Tamil Nadu. I am pleased that all participants took advantage of the chance to share their expertise, experiences, and ideas, as well as to make new contacts and build new collaborative relationships. During the discussions among coworkers in this pandemic circumstance, this educational programme, which was jam-packed with activities, created a more relaxed mood.

As a member of the Association of Indian Biologists (AIB), Tamil Nadu, it is a privilege and an honour to be a part of the Virtual International Conference on Multidisciplinary Research-2022 [vICMR-2022], which was organised with great magnitude by the Association of Indian Biologists (AIB). This continues to be a reality as a result of the massive global response. To be sure, I am grateful to the members of the association for providing me with an opportunity and for helping me to reestablish trust in myself through their support. I am hoping that we will be able to meet again at the next conference which will include more active issues and more eminent experts.

With Regards,

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### MESSAGE FROM ASSOCIATE EDITOR - III



That the Association of Indian Biologists (AIB) in Tamil Nadu has arranged the Virtual International Conference Multidisciplinary Research-2022 [VICMR-2022] is exciting news to me. Please accept my heartfelt congratulations on behalf of all of the participants on their unwavering zeal and enthusiasm in disseminating information to the student community.

A decent education broadens our perspectives and provides us with a better opportunity of achieving our goals in life. People can grow and influence their circumstances as a result of their knowledge. Education is a passport to the future, for those who prepare for it today will have a better chance of success in the future. "It is your attitude, not your ability, that will decide your level of success." If you think education is expensive, try living in ignorance for a while. As the saying goes, "The only person who has been educated is the one who has learnt how to learn and adapt."

I would like to express my heartfelt gratitude to the members of the organising committee for their efforts in putting together this Virtual International Conference on Multidisciplinary Research-2022 [VICMR-2022]. I am delighted to wish the seminar's organizers every success in their endeavor.

With Regards,  
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## MESSAGE FROM ASSOCIATE EDITOR – IV



Please accept my greetings and welcome to the Virtual International Conference on Multidisciplinary Research-2022 [VICMR-2022]. For the fifth Virtual International Conference, catalyzed by the Association of Indian Biologists (AIB) in Tamil Nadu, it gives me great pleasure to serve as conference chair. Educators and practitioners from around the world came together to address a wide range of critical issues in education and research at this conference, which was full of energy and enthusiasm.

The fact that everyone used the opportunity to contribute their knowledge, viewpoints, and ideas while also building new connections and establishing new avenues of collaboration makes me very happy. During this pandemic circumstance, the more event-rich teaching programme created a more pleasant environment for colleagues to gather in. I hope that you will take advantage of the opportunity to engage with your peers to discuss your ideas for research and practice, as well as the opportunity to ask questions of the presenters, when you are at the conference. Several chances for collaboration will be presented to attendees. We all benefitted from our Virtual International Conference on Multidisciplinary Research-2022 [VICMR-2022], which was takes place online.

With Regards,

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## MESSAGE FROM ASSOCIATE EDITOR – V



I am pleased that all participants took advantage of the chance to share their information, experiences, and ideas, as well as to make contacts and develop new collaborations in the process. When colleagues were meeting in this pandemic circumstance, this education programme, which was packed with activities, provided a more relaxed atmosphere.

A good education broadens our horizons and provides us with a long and healthy life. Individuals develop as a result of information, which also determines their state. Traineeships are the future visa, and the future belongs to those of us who are preparing for it right now. The only one who has been educated has learned how to continue to learn and grow. I am hoping that at the next vICMR meeting, we will be able to meet with lively subjects and more eminent expertise.

My sincere gratitude to my colleagues at the Virtual International Conference on Multidisciplinary Research-2022 [vICMR-2022], as well as to the writers, technical crew, review committee, and everyone else who contributed to the successful completion of this book with an ISBN. We look forward to seeing more of AIB's thought-provoking work in the future.

With Regards,

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**BIOPLASTICS**

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**ABSTRACT**

Bioplastics are plastic materials produced from renewable biomass sources, such as vegetable fats and oils, corn starch, straw, woodchips, sawdust, recycled food waste, etc. Some bioplastics are obtained by processing directly from natural biopolymers including polysaccharides (e.g. starch, cellulose, chitosan and alginate) and proteins (e.g. soy protein, gluten and gelatin), while others are chemically synthesised from sugar derivatives (e.g. lactic acid) and lipids (oils and fats) from either plants or animals, or biologically generated by fermentation of sugars or lipids. In contrast, common plastics, such as fossil-fuel plastics (also called petro-based polymers) are derived from petroleum or natural gas. Bioplastics are sustainable, largely biodegradable, and biocompatible. Today, bioplastics have become a necessity in many industrial applications such as food packaging, agriculture and horticulture, composting bags, and hygiene. Bioplastics have also found their use in biomedical, structural, electrical, and other consumer products. With increasing demand for global plastic consumption, a lot of research is being dedicated toward exploring green materials and new ways to process them.

**INTRODUCTION**

Bioplastics are set to emerge as the world becomes increasingly conscious of the necessity of building green and sustainable economies. They encompass a diverse set of materials and uses-however, Polylactic Acid bioplastics figure to be one of the most attractive alternatives to replace PET plastic in day-to-day use.

The first known bioplastic, polyhydroxybutyrate (PHB), was discovered in 1926 by a French researcher, Maurice Lemoigne, from his work with the bacterium *Bacillus megaterium*.



Bioplastics currently make up an insignificant portion of total world production of plastics. Commercial manufacturing processes are plagued by low yields and are expensive. However, improvements in metabolic and genetic engineering have produced strains of microbes and plants that may significantly improve yields and production capabilities while reducing overall costs. These factors, when added to increasing oil prices and growing environmental awareness, may expand the market for bioplastics in the future.

### **1.BIOPLASTICS**

Bioplastics are a large family of materials that can be used to make a wide variety of consumer products. A bioplastic is a plastic that can be biodegradable, has biobased content, or both. Bioplastics is a term which encompasses two categories:

1. Bioplastic made from renewable resources. Here the origin of the raw materials used to make bioplastics, typically from biomass including industrial sugars and starch, is considered biobased.
2. Bioplastic that is biodegradable and compostable according to the ASTM International industry standards of D6400 and the related European EN 13432. Here the source material can be either biobased (new carbon) or non-renewable (old carbon including natural gas and oil).

Bioplastics are a family of materials with differing properties and applications. A material is defined as a bioplastic if it is either biobased, biodegradable or features both properties.

In short, contrary to conventional fossil-based plastics, bioplastics are (partly) bio-based, biodegradable, or both.

### **2.TYPES OF BIOPLASTICS**

Bioplastics cover a wide range of bio-based polymers that have a variety of unique attributes and applications. New materials continue to be discovered and experimented with. The 5 most common types of bioplastics include:

Starch-Based

Cellulose-Based

Protein-Based

Bio-derived Polyethylene

Aliphatic Polyester

## 2.1 STARCH BASED BIOPLASTICS

Thermoplastic starch represents the most widely used bioplastic, constituting about 50 percent of the bioplastics market.<sup>[15]</sup> Simple starch bioplastic film can be made at home by gelatinizing starch and solution casting. Starch is cheap, abundant, and renewable.

Pure starch is able to absorb humidity, and is thus a suitable material for the production of drug capsules by the pharmaceutical sector. However, pure starch-based bioplastic is brittle. Plasticizer such as glycerol, glycol, and sorbitol can also be added so that the starch can also be processed thermo-plastically.

The characteristics of the resulting bioplastic (also called "thermoplastic starch") can be tailored to specific needs by adjusting the amounts of these additives. Conventional polymer processing techniques can be used to process starch into bioplastic, such as extrusion, injection molding, compression molding and solution casting.

Starch based plastics are complex blends of starch with compostable plastics such as PLA, PBAT, PBS, PCL and PHAs. Blending of starch with plastics improves water resistance, processing properties and mechanical properties. Starch based trays are not transparent. Other packaging products. Starch based materials are frequently used in loose fill foams for transport packaging. Another application is in service ware like cups, plates and cutlery. Biodegradable films, with starch as a matrix, were developed and reinforced with wheat and corn hulls. It was observed that the addition of hulls enhanced the modulus, tensile strength, and impact strength of the starch matrix at the expense of its elongation.



Packaging peanuts made from bioplastics (thermoplastic starch)

In general, starch-based plastics are more cost competitive than alternative bioplastics. They can accommodate a wide range of physical properties that alternative bioplastics lack, such as tensile strength and heat tolerance. Starch composites can also incorporate recycled plastics. starch can be used to reduce the carbon footprint of traditional resins because they can replace petroleum-based polymers with natural ones. It is also highly degradable, meaning it can be used alongside a compostable polymer without interfering with the degradation process.

*Example:* Green Dot Bioplastics has successfully developed cell phone cases from compostable, starch-based plastics. Additional opportunities are expected in compostable yard and kitchen bags, food service disposables and various types of packaging.

## 2.2 CELLULOSE BASED BIOPLASTICS

Cellulose bioplastics are mainly the cellulose esters, (including cellulose acetate and nitrocellulose) and their derivatives, including celluloid. Cellulose can become thermoplastic when extensively modified. An example of this is cellulose acetate, which is expensive and therefore rarely used for packaging. However, cellulosic fibers added to starches can improve mechanical properties, permeability to gas, and water resistance due to being less hydrophilic than starch.

Cellulose must be broken down, or solubilized, before it can be made into functional products. However, the same characteristics that give cellulose its sturdy structure also prevent it from dissolving in water.

A group at Shanghai University was able to construct a novel green plastic based on cellulose through a method called hot pressing.

Cellulose itself is both crystalline and hydrogen bonded, so is insoluble and cannot be melted. In order to process cellulose, it must be reacted to produce cellulose esters or ethers. Alternatively, it can be modified to become soluble, then converted back to cellulose, when it is known as regenerated cellulose, and used for films or fibers. Esters (e.g., cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, and cellulose propionate) are also unprocessable, and hence are modified with plasticizers. Their properties depend on extent of esterification, molar mass, and, particularly, plasticizer level. Applications are in those areas where appearance and

toughness are important, such as ophthalmics, toys and sports goods, and spectacle frames. Ethyl cellulose is the only ether used as a plastic material.



*Example:* Major applications for cellulose plastics include thermoplastics, extruded films, eyeglass frames, electronics, sheets, rods, etc. Molding materials is the most dominant application segment for cellulose plastics and the trend is expected to continue. Plastic is produced mainly using nonrenewable resources such as crude oil and its several derivatives owing to which, the carbon footprint is high in the production of cellulose plastics.

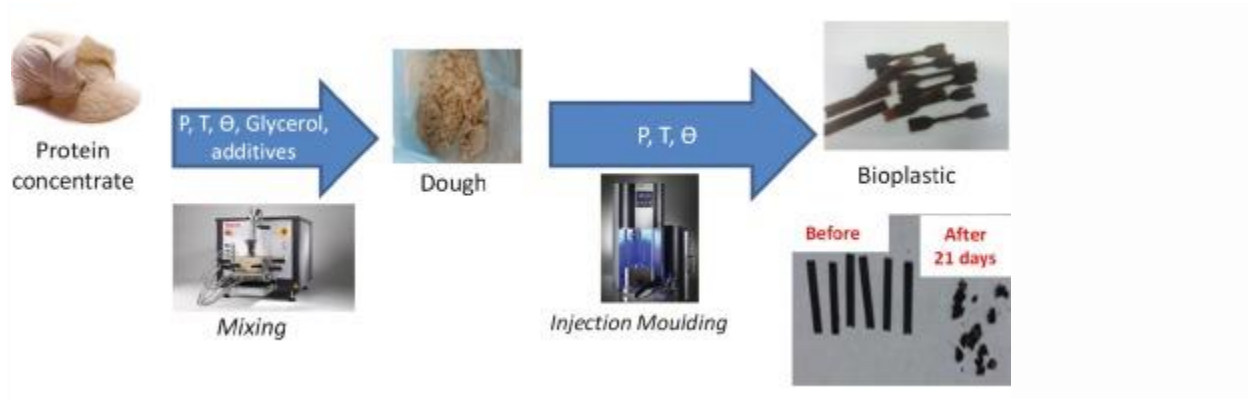
### 2.3 PROTEIN BASED BIOPLASTICS

Bioplastics can be made from proteins from different sources. For example, wheat gluten and casein show promising properties as a raw material for different biodegradable polymers. Proteins consist of amino acids and are built up and broken down by enzymes. Depending on the protein source, they differ greatly in their composition. Proteases are enzymes that cut up other proteins. Through cross-linking of amino acids by a certain enzyme, water-resistant protein bioplastics can be created. Plasticisers, such as glycerol, can be used to control and adapt material properties and textures. The spectrum of potential raw materials suitable for the production of protein plastics is very wide. They can be of animal origin (casein, fibroin, collagen, keratin) or of plant origin (gluten, algae, oil).

The protein-based bioplastics studied in this work present a high capacity for thermosetting modification because of protein denaturation that may favour the development of a wide variety of materials. The use of albumen or rice protein allows the reduction in both protein

concentration and thermosetting temperature, leading to linear viscoelastic moduli values similar to those of synthetic polymers such as LDPE and HDPE.

Even though proteins have been used for the development of plastic materials for a long time, their use has not proliferated when compared to other plant materials, such as starch or cellulose. Moreover, the current trend in the bioplastic market is based on polylactic acid or polyhydroxycarbonates, such that a feasible and globally accepted formulation of protein-based bioplastics is still pursued. The physical instability along time, together with the need of using non-food resources are drawbacks for the development of protein-based materials. Since lots of biowastes from the industry contain a considerable amount of proteins, the application of these natural polymers in the production of biodegradable materials would seem to benefit from a revalorisation of those resources, in agreement with a circular economy.



*Example:* Biopolymers that are protein-based have become a leading alternative for food packaging. There have been major advances in protein-based films and coatings for food packaging made from plant and animal proteins.

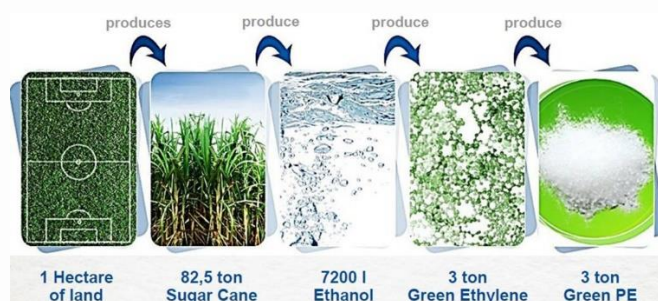
## 2.4 BIO-DERIVED POLYETHYLENE

The basic building block (monomer) of polyethylene is ethylene. Ethylene is chemically similar to, and can be derived from ethanol, which can be produced by fermentation of agricultural feedstocks such as sugar cane or corn. Bio-derived polyethylene is chemically and physically identical to traditional polyethylene – it does not biodegrade but can be recycled. The Brazilian chemicals group Braskem claims that using its method of producing polyethylene from sugar cane ethanol captures (removes from the environment) 2.15 tonnes of CO<sub>2</sub> per tonne of Green Polyethylene produced. The basic monomer of the polymer polyethylene is ethylene.

Ethanol which is a very similar chemical product to ethylene can be produced by the fermentation of agricultural feedstocks such as corn or sugar cane - hence the expression bioderived polyethylene.

Polyethylene that has been produced from the fermentation of raw agricultural materials like sugarcane and corn rather than fossil fuels.

Bio-based polyethylene offers the advantages of being one hundred percent recyclable and carbon positive, a benefit that North American businesses can use in their marketing for new packaging as well as to boost their corporate social responsibility. Prior to having this substitute, most bio-based products were thrown into the garbage which was then incinerated at waste plants, contributing heavily to global warming. By switching to this recyclable material and packaging, businesses can help reduce greenhouse gasses by up to 35%.



Example: High Density Polyethylene is used in several packaging applications including crates, trays, bottles for milk and fruit juices, caps for food packaging, jerry cans, drums, industrial bulk containers etc.

## 2.5 ALIPHATIC POLYESTERS

The aliphatic biopolyesters are mainly polyhydroxyalkanoates (PHAs) like the poly-3-hydroxybutyrate (PHB), polyhydroxyvalerate (PHV) and polyhydroxyhexanoate (PHH). They are all more or less sensitive to hydrolytic degradation, aka they are sensitive to water, and can be mixed with other compounds.

Aliphatic polyesters can be considered as representatives of synthetic biodegradable polymers. Synthesis of aliphatic polyesters by polycondensation of diols and dicarboxylic acids was reported as early as 1930. The commonly used monomers for the synthesis of aliphatic polyesters for biomedical applications are lactide, glycolide, and caprolactone. Polyglycolic acid



(PGA) was one of the initially investigated biodegradable polyesters for biomedical applications. It is a highly crystalline polymer with a melting point greater than 200 °C and a glass transition temperature around 35–40 °C. PGA was used to develop the first biodegradable synthetic suture, DEXON, in 1970.

It is shown that aliphatic polyester structures made of repeating units that can generate metabolites upon degradation or biodegradation like poly( $\beta$ -hydroxy alkanate)s and poly( $\alpha$ -hydroxy alkanate)s are of special interest. Their main characteristics are confronted to the specifications required by various potential sectors of applications, namely, surgery, pharmacology, and the environment. It is shown that degradation, bioresorption, and biorecycling that are targets when one wants to respect living systems are also drastic limiting factors when one wants to achieve a device of practical interest.



Mulch film made of polylactic acid (PLA)-blend bio-flex

*Example:* Some bio-based polyesters that have gained commercial use or that are currently being investigated are polylactic acid (PLA), polyglycolic acid (PGA), poly- $\epsilon$ -caprolactone (PCL), polyhydroxybutyrate (PHB), and poly(3-hydroxy valerate). However, only a small number of them are commercially available.

### **3.APPLICATIONS OF BIOPLASTICS**

Biodegradable plastics, that had until now found application in packaging, are slowly capturing newer markets, particularly medical products. One reason for the rise in implant use is the performance and outcome advantages over alternative treatments, such as drugs. Another reason is the constant improvement and innovation of devices that keep getting smaller. Applications of biodegradable plastics have gained market acceptance in the medical sector in Medical Implants.

In search of new material solutions and proceeding an eye on the goal of sustainable production and consumption, bioplastics have various (potential) advantages. Advances in how they are produced is allowing bioplastics with controllable physical properties to be produced enabling uses which mimic those of oil-based plastics. The properties of some bioplastics allow novel functions to be carried out.

Bioplastics can also be processed in very similar ways to petrochemical plastics such as injection moulding, extrusion and thermoforming. To improve their tensile strength, bioplastic polymers can be blended with their co-polymers or with other polymers.

### **3.1 CURRENT END-USE SEGMENTS OF BIOPLASTICS – BIODEGRADABLE AND SHORT-LIVED PRODUCTS –**

1. Packaging
  1. Shopping bags
  2. Compostable waste collection bags
  3. Trays and Punnets for vegetables, fruits, meat and eggs.
2. Disposable catering servicewares
3. Medical applications
  1. Implants such as screws, pins or plates
  2. Material for pills and capsules
4. Mulch films
5. Non-Biodegradable and durable products –
6. Automotive interiors like seats, head rests or arm rests
7. Mobile phone cases

### **3.2 EMERGING END-USE SEGMENTS OF BIOPLASTICS**

1. 3D printing
2. Metalized Biaxial oriented -PLA films for food packaging
3. Baby products – Toys and Teethers
4. Modified PLA for durable applications – Interiors and under the hood automotive parts.

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**MARINE TOXINS**

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**ABSTRACT**

Seafood products are important both nutritionally and economically. Generally, these are toxins from toxic microscopic algae which accumulate through the food-chain. Marine toxins are naturally occurring compounds that can contaminate some types of seafood. The seafood may not show any signs of contamination, but, if eaten, it can cause various human illnesses. . Although seafood is rarely implicated in food poisoning, compared to other food sources, it does provide some specific human health hazards unique to this particular resource. The occurrence of seafood toxins seems to be increasing and new potential food poisoning hazards are arising.

**Keywords:** Neurotoxic, Osmotic, Epinephrine, Hepatotoxins, Livestock.

Marine toxins are naturally occurring chemicals that can contaminate certain seafood. The seafood contaminated with these chemicals frequently looks, smells, and tastes normal. When humans eat such seafood, disease can result. The most common diseases caused by marine toxins in United States in order of incidence are scombrototoxic fish poisoning, ciguatera poisoning, paralytic shellfish poisoning, neurotoxic shellfish poisoning and amnesic shellfish poisoning.

Diagnosis of marine toxin poisoning is generally based on symptoms and history of recently eating a particular kind of seafood. Laboratory testing for the specific toxin in patient samples is generally not necessary because this requires special techniques and equipment available in only specialized laboratories. If suspect, leftover fish or shellfish are available, they can be tested for the presence of the toxin more easily.

There is no specific antidote for ciguatoxin or maitotoxin poisonings. Treatment is generally for specific symptoms and includes supportive care. Intravenous mannitol has been reported in uncontrolled studies to reduce the severity and duration of neurologic symptoms, particularly if given within 48 hours of the appearance of symptoms.

From 2002 to 2009, these species caused eight paralytic shellfish poisoning-positive events which temporarily stopped commercial trade of mussels. The statistical analysis indicated that some taxa exhibited temporal increasing trends in their abundance (e.g. *Pseudo-nitzschia* spp.), significant decrements (e.g. *Dinophysis* sp.), or both increasing and decreasing significant trends (e.g. *A. minutum*) at different sites, indicating the necessity of further in-depth studies, especially on certain taxa. Overall, the statistical elaboration of the long-term data provided useful signals for early detection of shellfish contamination by different potentially toxic HAS in defined sites. These signals can be used to develop best management practices.

There are three main types of marine toxins

1. Those caused by eating fish, including:
  - Scombrototoxic fish poisoning
  - Ciguatera poisoning
  - Tetrodotoxin poisoning (fugu or pufferfish poisoning)
2. Those caused by eating shellfish, including:
  - Paralytic shellfish poisoning (PSP)
  - Red tide/neurotoxic shellfish poisoning (NSP)
  - Diarrheic shellfish poisoning (DSP)
  - Amnesic shellfish poisoning (ASP)
3. Those caused by contaminated water, including:
  - brevetoxins
  - Blue-green algae (Cyanobacteria)
  - *Pfiesteria* and the *Pfiesteria*-like organisms (PLOs)

## **SCOMBROTOXIC FISH POISONING**

Also known as histamine fish poisoning is caused by bacterial spoilage of certain finfish such as tuna, mackerel and other fish. As bacteria break down fish proteins, byproducts such as histamine and other substances that block histamine breakdown build up in fish. Eating spoiled fish that have high levels of these histamines can cause human disease. Symptoms begin within 2 minutes to 2 hours after eating the fish. The most common symptoms are rash, diarrhea, sweating, headache, and vomiting. Burning or swelling of the mouth, abdominal pain, or a metallic taste may also occur. The majority of patients have mild symptoms that resolve within a few hours. Treatment -antihistamines or epinephrine.

### **CIGUATERA POISONING**

Ciguatera is caused by eating contaminated tropical reef fish. Ciguatoxins are actually produced by microscopic sea plants called dinoflagellates. Dinoflagellates are single-celled marine organisms that are extremely diverse. The toxins become progressively concentrated as they move up the food chain from small fish to large fish that eat them, and reach particularly high concentrations in large predatory tropical reef fish. Barracuda are commonly associated with ciguatoxin poisoning, but eating grouper, sea bass, snapper, mullet, and a number of other fish that live in tropical oceans has caused the disease. Ciguatoxin and the closely-related maitotoxin are both produced by dinoflagellates and cause symptoms by interfering with ion channels on cell membranes. Ciguatoxin opens sodium channels and maitotoxin opens calcium channels, disrupting the signaling between nerves and muscles. Common nonspecific symptoms include nausea, vomiting, diarrhea, cramps, excessive sweating, headache, and muscle aches. Treatment is generally supportive; mannitol (an osmotic diuretic) may be used to increase urine output

### **TETRODOTOXIN POISONING**

Tetrodotoxin causes this type of poisoning. It is found in the liver, gonads, intestines and skin of pufferfish (fugu), as well as in less-commonly eaten animals like parrotfish, frogs, octopus, starfish, angelfish and crabs.

The disease is potentially deadly. Symptoms include numbness of the lips and tongue, tingling in the body, and a sensation of lightness. Nausea and vomiting, diarrhea, and belly pain may occur. Treatment is supportive, and may include giving the person charcoal, pumping the stomach, giving IV fluids, and placing them on a ventilator in severe cases. There is no antidote.

### **PARALYTIC SHELLFISH POISONING**

Paralytic shellfish poisoning is caused by a different dinoflagellate with a different toxin than the one responsible for ciguatera poisoning. These dinoflagellates have a red-brown color, and can grow to large numbers that they cause red streaks to appear in the ocean called "red tides." This toxin is known to concentrate within certain shellfish that typically live in the colder coastal waters of the Pacific states · Shellfish that have caused this disease include mussels, cockles, clams, scallops, oysters, crabs, and lobsters. *Saxitoxin* is the poisonous molecule in these organisms that causes paralysis by blocking sodium channels necessary for muscles to contract.

#### **Red Tide/ Neurotoxic shellfish poisoning:**

- Is caused by a type of dinoflagellate.
- Is usually found in oysters, clams, and mussels from the Gulf of Mexico and the Atlantic Coast of the southern United States.
- Cause symptoms in 1 to 3 hours. They include numbness, loss of coordination, an upset stomach, and tingling in the mouth, arms, and legs. They usually last 2 to 3 days.
- Cooking does not destroy the toxins, so buy your fish from a good source.

#### **Diarrhetic shellfish poisoning (DSP):**

- Is caused by toxins produced by certain microscopic plants.
- Is found in shellfish.
- Causes symptoms within 30 minutes to 6 hours. Symptoms include diarrhea, nausea, vomiting, headache, abdominal cramps, and chills. In healthy people, these symptoms usually go away in a few days.



- Cooking does not destroy the toxins, so buy your shellfish from a good source.

### **Amnesic shellfish poisoning**

Amnesic shellfish poisoning is a rare syndrome caused by a toxin made by a microscopic, red-brown, salt-water plant, or diatom called *Nitzchiapungens*. The toxin produced by these diatoms is concentrated in shellfish such as mussels and causes disease when the contaminated shellfish are eaten. The active molecule involved in amnesic shellfish poisoning is *domoic acid*, and works by stimulating glutamate receptors in the central nervous system. Patients first experience gastrointestinal distress within 24 hours after eating the contaminated shellfish. Other reported symptoms have included dizziness, headache, disorientation, and permanent short-term memory loss. In severe poisoning, seizures, focal weakness or paralysis, and death may occur.

### **BREVETOXINS**

The dinoflagellate *Karenia brevis* annually blooms. These blooms are called red tides. When it does so, it releases brevetoxins into the air. This leads to fish and marine mammal deaths as well as irritation of the respiratory tract in humans. These are the same brevetoxins that lead to neurotoxic shellfish poisoning in contaminated shellfish. Brevetoxins are known to bind to site 5 of voltage-gated sodium channels in nerve cells, leading to channel activation. This leads to disruption of normal neurological processes and causes the illness clinically described as neurotoxic shellfish poisoning (NSP).

### **Blue-green algae (Cyanobacteria)**

Blue-green algae are actually a type of bacteria called cyanobacteria. Ex. : *Anabaena*, *Aphanizomenon* and *Microcystis* species produce toxins sporadically, while *Cylindrospermopsis* produce it all the time. These algae, also known as pond scum, have been known to kill livestock that drink the water in which the algae are growing. Blue-green algae can produce both neurotoxins, which affect the nervous system, and hepatotoxins, which affect the liver. These toxins can quickly kill livestock who drink contaminated water.

### **Pfiesteria and Pfiesteria – like organisms (PLOs)**

Ambush predator (*Pfiesteria piscicida* and toxic *Pfiesteria* complex) toxins come from members belonging to this group of organisms that were first identified in 1991 from estuaries in North Carolina. They were believed to produce a toxin that has been implicated in several large fish kills and is suspect in causing adverse human health effects.

The dinoflagellate *Pfiesteria* spp. is believed to produce and release into the environment potent extracellular toxins, or exotoxins, referred to generally as *Pfiesteria* toxins (PfTx) that have been linked to mass fish mortalities and human disease in mid-Atlantic estuaries.

The adverse health effects have been termed Possible Estuary-Associated Syndrome, symptoms of which include cognitive and visual contrast sensitivity deficits, pulmonary impairment, gastrointestinal disruptions, and immunologic dysfunction.

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**A CONCEPTUAL STUDY OF RECKONING THE EFFECT OF THE NOVEL  
CORONAVIRUS ON THE EDUCATION SECTOR IN INDIA "**

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**ABSTRACT**

The Covid-19 has spread across the globe, forcing humanity to maintain social distance. The pandemic has wreaked havoc on several facets of human life, including Education. It puts education to the test in a way it's never been done before. Outbreak of this virus has impacted more than 120 crores of students and youths across the globe. In India, more than 32 crores of students have been influenced by the countless restraints and the nationwide lockdown for pandemic. Campuses have been closed at numerous educational institutions around the world, and teaching and learning has shifted to the internet. Change is unescapable, as the onset of pandemic had shown us. Despite these obstacles, Educational Authorities have responded well and have been able to sustain teaching-learning, research, and societal service with the help of some tools and strategies during the epidemic. This endeavor highlights steps taken by educational authorities to ensure that educational services are provided in a consistent manner throughout the country. Many new ways of learning, new viewpoints, and new trends have evolved as a result of the pandemic. Thus, certain post-pandemic tendencies that may allow for new approaches of teaching and learning in higher education in India are discussed. Further, some useful tips for carrying out educational activities during COVID 19 crisis are deliberated.

**Keywords: Coronavirus, Effect, Education Sector, Initiatives etc.**

## **INTRODUCTION**

With 1.35 billion inhabitants, India is the world's second-largest functioning democracy after China (Census Report of India, 2011; Pew Research Center, 2018) via the people of India's inherent right to education (Wikipedia.org). Despite the fact that the education sector faces a number of challenges, including ineffective educational infrastructure, an unequal teacher-student ratio, a lack of current teaching technology, a lack of interest in education among rural people, pessimism and laziness about learning, and so on, with these challenges, the country is currently dealing with the worst crisis of the novel (COVID-19) pandemic, which originated in China's Wuhan city. Covid-19 was declared a pandemic on March 11, 2020 by the World Health Organization. With over 4.5 million people have been afflicted by Covid-19 globally (WHO). The epidemic has wreaked havoc on all sectors, notably education, around the globe, affecting people's socioeconomic conditions.

According to a UNESCO estimate, Covid-19 has impacted about 68 percent of the entire global student population as of the first week of June 2020. The severe restrictions and the nationwide lockdown for Covid-19 have affected over 32 crores of pupils in India (Wikipedia). In an effort to limit the spread of the pandemic, most governments throughout the world have temporarily closed educational institutions. The global student population has been severely harmed by this shutdown. Governments all around the world are attempting to mitigate the acute impact of educational institution closures, particularly for more vulnerable and underprivileged groups, by facilitating the continuation of education for all through various online teaching approaches.

Even if the economy has adapted to the new learning, there seems to be a roadblock in the way of complete success because only 45 crore people out of the country's total population have access to the internet/e-learning. Rural residents are still largely without access to technology, which is hampered the cause of online education. With technological innovation and developments, the pandemic has been propelling the education industry ahead. The epidemic has had a tremendous impact on higher education. In light of this, the study examines the impact of epidemic, highlights measures undertaken by educational authority to make sure that educational

services are offered consistently, as well as post-pandemic tendencies that may allow for new approaches to teaching and learning in education sector in India.

## **REVIEW OF LITERATURE**

**Bokde et al (2020)** in their research study highlights the impact of pandemic and lockdown on the educational institutions as well as on the students. Furthermore, the research suggested some measures to overcome with the impact of this adversity and concluded that some hygiene related factors and socio-economic are required to reshape the education sector.

**Jena (2020)** in his research study shows the core effects of Covid on education sector along with the steps taken by higher education authorities for the uninterrupted educational services. In addition to this, suggestions are provided to rebuilt the educational sector. The results of the study revealed that MHRD have launched many virtual platforms which helps in turn in the smooth educational services.

**Tari and Amonkar (2021)** in their research study discusses the pros and cons of the pandemic on the education sector accompanied by the measures taken by policymakers for the continuous educational services. Further, the study suggests some tips how to recover from this adversity.

**Tarkar (2020)** in her research study explains the influence of pandemic on education sector in a crisp manner along with the suggestive methods to overcome from this pandemic.

## **RESEARCH OBJECTIVES**

On the basis of the review of literature, the present study has the following objectives:

- To highlight the influence of pandemic on education sector.
- To outline the numerous growing Indian approaches to higher education.
- To Compile a list of trends in higher education Institutions following pandemic.
- To propose some useful tips for carrying out educational activities during COVID 19 crisis.

## RESEARCH METHODOLOGY

Research Design: The research design of the study is descriptive in nature.

Sources of Data Collection: To acquire data on the current study, researchers combed through many reports from national and international agencies on the Covid-19 epidemic. Information regarding the impact of Covid-19 on India's higher educational system was gathered from a variety of reliable websites, periodicals, and e-contents.

### Major impact of pandemic on education sector in India

Without a question, education is critical for people's socioeconomic progress in any country. As a result, there is stress on state education ministries and the education system in India to make education possible and accessible to all Indians as a matter of socioeconomic equity and fairness. Under such circumstances, the following are the major effects of the current pandemic, namely corona viruses, on the educational sector:

#### Effect on students, working professionals and parents:

- Due to the nationwide lockdown, admission procedures for numerous schools, universities, and educational institutions have been delayed.
- Exams at numerous academies, boards, and universities have been postponed or cancelled as a result of the pandemic's precautionary measures.
- Entrance tests for admittance to numerous colleges, research institutes, and educational institutions across India were impacted.
- Due to the lockdown and social alienation, competitive examinations for various government and non-government departments were accentuated during this period.
- Due to several concerns associated to the epidemic, Indian students and parents who are preparing to go overseas for specialized studies are panicking, and demand for admission to international institutions for higher education and specialized courses would've been reduced.

- Indian students studying abroad are concerned about the epidemic because most countries are impacted.

**Effect on educational institutions:**

- Job losses, wage cuts, and bonuses and increments may be delayed or decreased for some faculty and employees in the private school sector.
- Schools, colleges, and other institutions and universities may have delays in student admissions, internships, training, apprenticeships, and placements;
- The education sector may experience issues with low fee collection, which can complicate the operation and management of institutions.
- The challenges that education systems confront may have an impact on infrastructure development, teaching styles, assessment approaches, and educational quality.
- As a result of economic stagnation in the sector, certain educational institutions may have to slash positions or reduce workforces.
- Due to the industry's economic slump and crisis, some institutions may be forced to close entirely.
- According to the Centre for Monitoring Indian Economy, unemployment rose from 8.4% in mid-March to 23% in early April, with the urban jobless rate reaching 30.9 percent (ET Government.com, 2020).

**Numerous growing Indian approaches to Higher Education**

Covid-19 has numerous complications. Higher Education Institutions have reacted favourably to the epidemic and have implemented a number of measures to deal with the problem. The Ministry of Human Resources Development (MHRD) and the University Grants Commission (UGC) have made many arrangements by launching a number of virtual platforms that include online depositories, e-books, and other online teaching and learning materials. The MHRD's ICT effort is also a one-of-a-kind platform that brings together all digital educational resources. During COVID-19, the following are some of the UGC and MHRD's digital efforts for higher education:

- **e-GyanKoshis** an Indian Open and Distance Learning Institutions-developed national digital repository for storing and sharing digital learning content. All rights reserved by Indira Gandhi National Open University for items in eGyanKosh are protected by copyright (IGNOU).
- **Gyandarshanis** a web-based TV station dedicated to Open and Distance Learner educational and developmental requirements. A web-based television station dedicated to the society today developmental and educational requirements.
- **Swayam** offers Massive Open Online Courses (MOOCs) with credit transfer from 140 universities. SwayamPrabha provides excellent educational programming via 32 DTH channels that broadcast quality content. Postgraduate students can use e-PG Pathshala. E-books, online courses and study resources are available to postgraduate students through this platform.
- **e-Adhyayan (e-Books)** is an online portal that offers over 700 e-Books for Post-Graduate courses. The e-Books are all based on the e-PG Pathshala courses. It also allows you to create a video playlist.
- **The National Digital Library of India (NDLI)** is a multidisciplinary repository of e-content for all types of users, including students (at all levels), instructors, researchers, librarians, library users, professionals, differently-abled users, and all other lifelong learners. The Indian Institute of Technology at Kharagpur is working on it. It is intended to aid students in their preparation for entrance and competitive examinations, to allow people to learn and prepare from best practises from around the world. It's a searchable virtual library of learning resources with a single-window interface.
- **FOSSEE** stands for Free and Open Source Software for Education, and it was created to promote open source software for both educational and professional use.
- **e-ShodhSindhuis** a long-term access collection of electronic journals, archives, and books. There are over 10,000 e-journals and over 31,35,000 e-books available. It offers academic institutions discounted subscriptions to high-quality electronic resources such as full-text, bibliographic, and factual databases.



- **VIDWAN** is a renowned database and national research network that contains profiles of scientists/researchers and other faculty members from India's top academic institutions and R&D organisations.
- **SAKSHAT** is a one-stop education portal that caters to all of a student's, scholar's, teacher's, and lifelong learner's educational and learning needs. The portal contains the most recent news, press releases, accomplishments, and other information on the Ministry of Human Resources and Development.

### **List of trends in higher education Institutions following pandemic**

The prospects presented by the pandemic will lead to a brighter future. The education sector will be able to envisage new ways of teaching and learning as a result of the new trends, which include the following.

- **May promote holistic education:** Learning does not have to be limited to classrooms or predefined bounds. In the new age, pupils may be virtual learners, with one teacher instructing dozens of students. To fulfil the learners' objectives and needs, the learning modules can be adjusted to fit different learning styles and the learning contents can come from a variety of sources. Students may choose to continue their education under the new approach.
- **Attendance of students might be directly impacted:** Many parents may be hesitant to bring their children back to school/college immediately after the lockdown ends. Some impoverished parents who lost their jobs as a result of the pandemic may not be able to afford to send their children to institutions. This could lead to home schooling for a few more months.
- Student mobility for higher education on a national and international level may be constrained: Student safety and well-being are crucial decision considerations for students and their parents when considering whether or not to pursue higher education at an overseas university. New forms of social distancing will persist for some time, and they may have an impact on on-campus face-to-face teaching and learning. Due to the pandemic, most parents will want to locate workable alternatives closer to their homes

and may restrict migration within the country. The crisis has had an impact on foreign education as well. Many international higher education conferences have been cancelled or converted into a sequence of webinars.

- **Multiple schedules each day may be used by educational institutions:** Because of the necessity for social distance, there may be fewer pupils in each class. As a result, most educational institutions may work in multiple shifts throughout the day, putting additional pressure on the institution's teaching and administrative staff to manage.
- **Probably epidemic will widen the divide between rich and less fortunate students:** Students from poor families and socially disadvantaged are particularly vulnerable, as they may not be able to afford a high-speed internet connection or the necessary technical equipment for online learning. It will exacerbate the divide between rich and poorer students, resulting in inequity.
- **Conceivable that technologies will be used to facilitate teaching and learning:** For teaching, learning, entertaining, and communicating with the outside world, more students will rely on technology and digital solutions. Students will use the internet to communicate electronically with their teachers and classmates via E-mail, WhatsApp, Videoconference, Instant Messaging, Webinars, and other means.
- **Open and distance learning and online learning might get an upsurge:** Human society has been obliged to preserve social distance as a result of Covid-19. Maintaining social distance has made it more difficult to continue imparting learning. To tackle these issues, there is a growing demand for ODL and online education, and this trend is likely to continue in the future.
- **Blended learning could take the lead:** Blended learning presents the benefits of both face-to-face and online learning. Covid-19 has pushed the implementation of digital technology in education delivery and encouraged educational institutions to embrace a blended learning approach. Teachers and kids alike grew increasingly tech-savvy. The traditional face-to-face mode, combined with post-Covid-19 technology, will lead to a mixed mode of teaching and learning, potentially transforming the educational system.

**Some useful tips for carrying out educational activities during COVID 19 crisis**

In this moment of crisis, significant and rapid measures are required to minimize the effects of a pandemic. For the enrichment of young minds, more capacity-building, skill development, practical knowledge enhancement, motivating programmes, use of new tools and techniques, and other welfare programmes are desired. The following are some important suggested measures:

- Both Educators and students should be taught how to use technology to facilitate online teaching and learning. Governments and educational institutions should develop policies to provide free internet and digital devices to all students in order to encourage online learning, which will keep people interested and safe during a pandemic.
- Many online learning platforms provide multiple programmes on the same subject with varying levels of certificates, methodologies, and assessment criteria. As a result, the quality of programmes on various online learning platforms may vary. Because of the growing proliferation of online learning platforms, HEIs in India should develop and supply quality assurance procedures and quality benchmarks for online learning programmes.
- If the Covid-19 pandemic persists, educational institutions will need to adapt new techniques to academic assessment. Students' academic performance can be assessed in a variety of ways, including online, via quizzes, and through minor projects.
- The government should assist Higher education institutions in bolstering their resources to conduct virtual educational activities. Students also require improved access to the internet and technology, as most students cannot afford these amenities. Higher education institutions should focus more on virtual educational activities such as television, radio, and web-based education during this epidemic.
- The World Health Organization recently stated that the Covid-19 virus may never be eradicated, and that humans will have to live with it. "It's critical to state the obvious: this virus might become just another epidemic infection in our communities, and it could never go away don't believe there are any guarantees or deadlines in this. In an online briefing, WHO emergency expert Mike Ryan stated, "This sickness may settle into a

protracted problem, or it may not". In light of this statement, several countries are now considering continuing their education via distance or virtual means, and India should consider doing the same.

- Indian traditional knowledge is well renowned around the world for its scientific inventions, values, and benefits in developing sustainable technologies and treatments, and this knowledge system should be incorporated with today's mainstream higher education system in various sectors.

### **Conclusion**

The effects of virus on higher education in India have been discussed in this study. There are some educational gaps in India, and the country is currently dealing with a pandemic which provides a chance for pedagogical techniques to shift and virtual education to be used at all levels of schooling. The Ministry of Human Resources Development (MHRD) and the University Grants Commission (UGC) have made many arrangements by launching a number of virtual platforms that include online depositories, e-books, and other online teaching and learning materials. In this moment of crisis, due to the breakout of Covid-19, virtual schooling is the favoured style of education. Following Covid-19, education appears to be based on generally acknowledged online/virtual education, which may or may not represent a parallel system of education. The study also offered ways to lessen the effects of a pandemic. The country will go forward and achieve general improvement in the education sector if these suggested actions are implemented.

### **Future Direction**

This work does not include any statistical analysis of the influence of Covid-19 on higher education; however, a more in-depth investigation including statistical research might be conducted in the near future.

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**Cytoprotective Epigenetic and DNA-Damage Repair Molecular Mechanisms of Glycemic Control and  $\alpha$ -Lipoic Acid Supplementation in Type-2 Diabetic Patients**

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**Background:**

Increased generation of biomarkers of inflammation and oxidative stress and reduced antioxidant status plays an important role in the etiopathogenesis and complications of type-2 diabetes mellitus. In the present study, we evaluated the biomarkers of inflammation, oxidative stress, antioxidants status, risk factors of cardiovascular disease such as lipid profile, homocysteine, and the biomarker of oxidative DNA-damage 8-hydroxy-2-deoxy-guanosine (8-OHdG) concentration, leucocyte DNA and DNA-repair enzymes in patients with type-2 diabetes mellitus and type-2 diabetic patients with glycemic control supplemented with  $\alpha$ -lipoic acid (ALA).

**Subjects and methods:**

Convenience biological sampling from people attending a diabetes screening clinic laboratory. Participants at the rural diabetes screening clinic at Neyveli township, Tamilnadu, India had their medical history recorded as well as body mass index, fasting blood glucose, HbA1c, lipidperoxides, inflammatory cytokines, lipid profile, homocysteine, reduced glutathione, total antioxidant status, 8-OHdG, DNA-damage repair enzymes such as nitric oxide synthase, xanthine oxidase and Poly(ADP-ribose)polymerase-1(PARP-1) and leucocyte DNA were measured. Statistical analysis was performed using students t-test.

**Results:**

The biomarkers of inflammation such as IL-6, TNF- $\alpha$ ,  $\alpha$ -AFP and the biomarkers of oxidative stress such as lipidperoxides, HbA1c, total cholesterol, LDL-C, TGs, homocysteine, 8-

OHdG are significantly increased ( $p<0.01$ ) and the reduced GSH concentration, total antioxidant status and antioxidant enzymatic activities such as catalase, superoxide dismutase, glutathione peroxidase, G6PD, ATP, HDL-C levels and the concentration of leucocyte DNA are significantly decreased ( $p<0.01$ ) and the DNA-repair enzymes such as nitricoxide synthase, xanthine oxidase and PARP-1 activities are found to be significantly elevated ( $p<0.01$ ) in type-2 diabetic patients, which are significantly ameliorated and/or reversed by the supplementation of  $\alpha$ -lipoic acid and glycemic control in type-2 diabetic patients.

**Conclusions:**

Supplementation of  $\alpha$ -Lipoic acid with glycaemic control exerts antiinflammatory antioxidant and hypolipidemic effects and hence maintains genome stability by augmentation of energy status and DNA-damage repair mechanisms. This is of clinical significance as 8-OHdG is a strong indicator of oxidative stress mediated DNA damages and genome instability with in blood circulation and vessel walls and other tissues that increases the risk of cardiovascular disease (CVD) in diabetic patients.



**SPECTRAL AND THERMAL CHARACTERIZATION OF ORGANIC AND INORGANIC HYBRID Cd & Ba CRYSTALS BY SLOW EVAPORATION METHOD**

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**ABSTRACT**

Single crystal of PTMACl –BaCl<sub>2</sub>grown by slow evaporation method at room temperature using water solvent. FTIR is utilized to analysis the modes of vibration of different molecular group present in the sample. The thermal stability of the grown crystal were studied by TG/DTA. The powder x-ray diffraction reveals that the sample is crystalline with good quality.

**Key words:** Slow evaporation ;PTMACl : Crystalline; Thermals stability.

**1.INTRODUCTION**

Alkyl substituted ammonium derivatives of A<sub>2</sub>BX<sub>4</sub> type compounds have been extensively investigated in recent years <sup>[1]</sup>. Alkyl substituted ammonium derivative crystals of the type A<sub>2</sub>BX<sub>4</sub> (Where A= Univalent cation, B= Divalent transition metal cation and X=Halogen) exhibit phase transitions mainly due to the rotational and conformational motion of the alkyl groups <sup>[2],[8]</sup>. The A<sub>2</sub>BX<sub>4</sub> family of compounds manifest a wide range of physical properties, including transparent conductivity, ferromagnetism, and superconductivity <sup>[3],[5]</sup>. Hence it finds wide range of application in the industries such as fibre optic communication, electronic and photonic etc as these industries depend on crystals or materials like semiconductors, superconductors, solid state lasers, polarizers, transducers, ultrasonic amplifiers, non-linear optics, electro-optics, photosensitive, piezo-electric, crystalline films for computer and microelectronic industries <sup>[4],[9],[10]</sup>. The grown crystals of PTMACl-BaCl<sub>2</sub>thermal stability were confirmed from the decomposition pattern of TG-DTA curve. The crystal undergoes double

stage decomposition and has stability upto 915.28°C. The crystalline nature of PTMACl-BaCl<sub>2</sub> was analyzed by powder x-ray diffraction.

## 2. EXPERIMENTAL

PTMACl-BaCl<sub>2</sub> complex was prepared by mixing Phenyl trimethyl ammonium chloride and Barium chloride in 1:1 molar ratio respectively using triple distilled water. The two solutions were mixed together in a thoroughly acidic medium by using 1ml of HCl. Then the resulting solution was filtered through Whatman 42 filter paper. The solution was kept at room temperature for preparation of solids by slow evaporation. The solution prepared is shown and the solution after crystallization is also shown. A colorless transparent crystalline product of PTMAC-BaCl<sub>2</sub> complex was obtained after 10 days.

## 3. RESULT AND DISCUSSION

### FTIR STUDIES

The FTIR spectrum of [PTMACl-BaCl<sub>2</sub>] compound is shown in **Figure :1**. The N-H stretching appears at 3387.00 cm<sup>-1</sup> due to the presence of NH<sup>4+</sup> ions. The peak appears at 1635.64 cm<sup>-1</sup> is due to C-C stretching. The peak appears at 1496.76 cm<sup>-1</sup> is due to C-C stretching of aromatic group.

The peak at 1118.71 cm<sup>-1</sup> is due to C-N-C stretching vibrations. The C-H bend due to methyl and methylene group occurs at 948.98 cm<sup>-1</sup>.

The alkane symmetric C-C stretching vibration occurs at 840.96 cm<sup>-1</sup>. The C-N-C deformation vibration occurs at 748.38 cm<sup>-1</sup>.

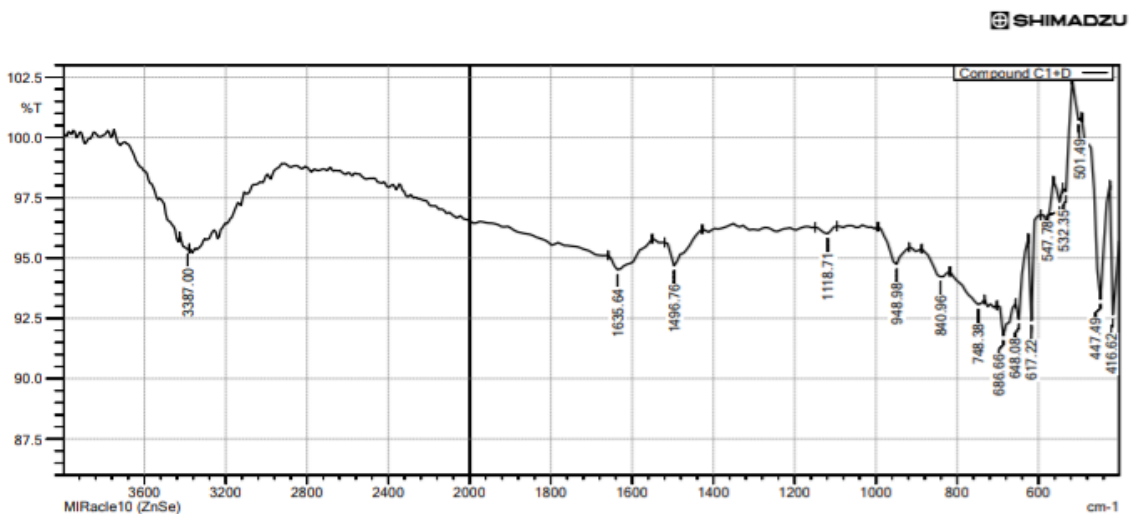


Figure:1 FT-IR spectrum of PTMACl-BaCl<sub>2</sub> compound

### UV SPECTROSCOPIC STUDIES

The UV spectrum PTMACl-BaCl<sub>2</sub> is shown **Figure 2**

The UV spectrum PTMACl-BaCl<sub>2</sub> shows that the grown crystal of the compound is highly pure in nature as no peak is obtained near the adsorption value of water. It also confirms the presence of aromatic compounds in the crystal.

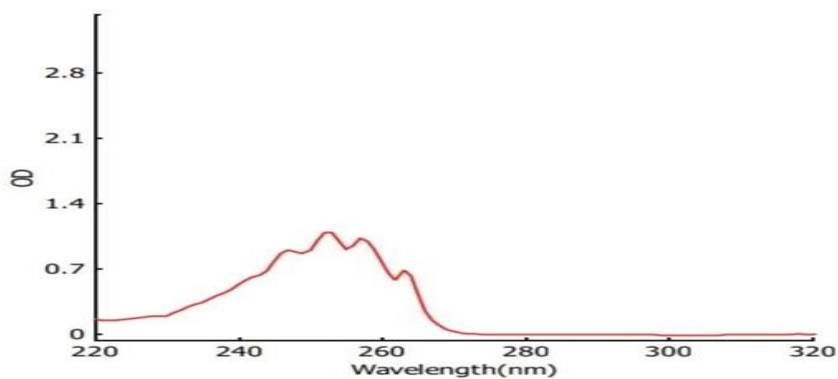
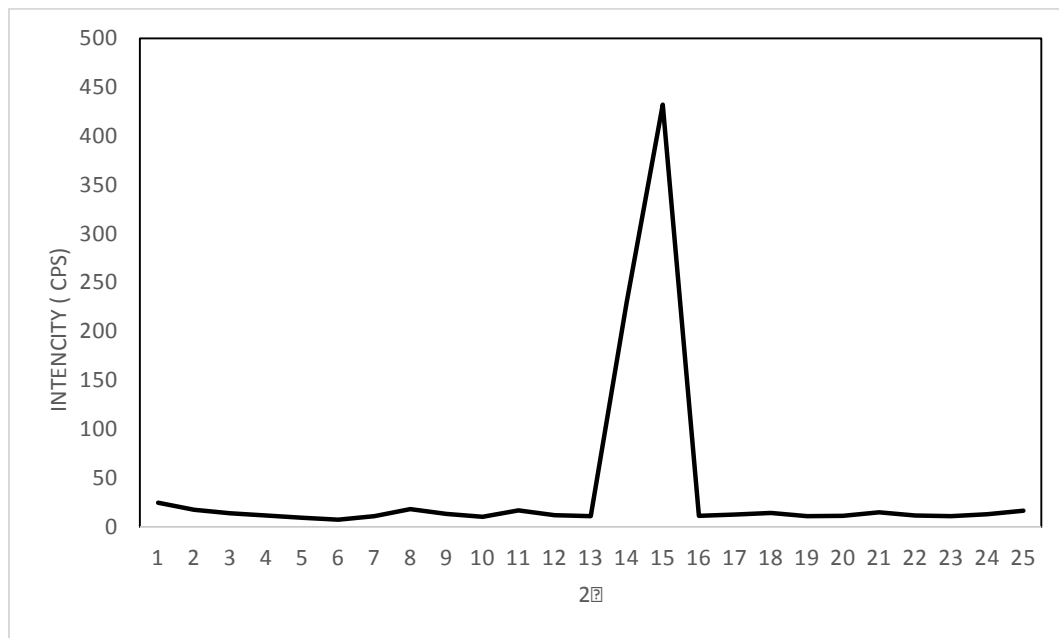


Figure 2: UV spectrum of PTMACl-BaCl<sub>2</sub> compound

### XRD ANALYSIS

X- ray powder diffraction pattern of the compound is shown in **Figure:3** Bragg's peak of high intensity is obtained at specific  $2\theta$  angles. This shows that the compound is crystalline in nature.



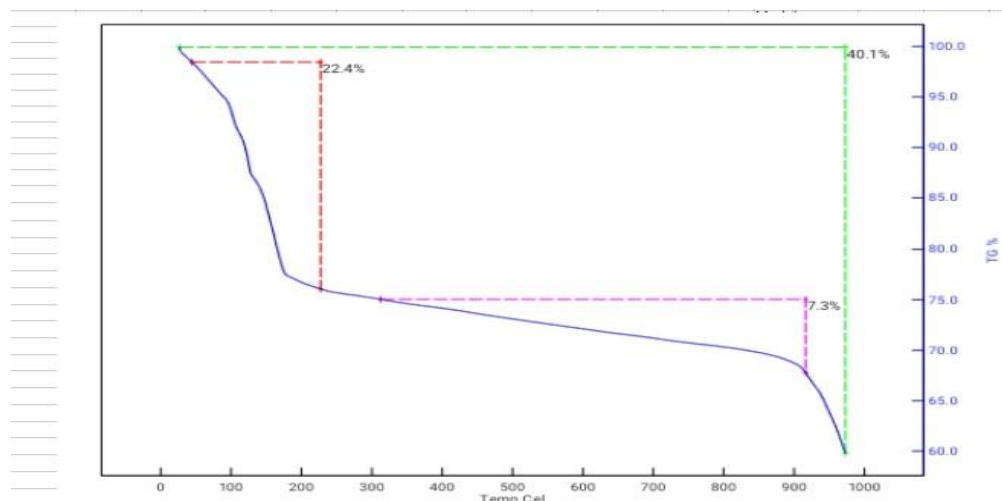
**Figure 3: XRD pattern of PTMACl-BaCl<sub>2</sub> compound**

### THERMAL ANALYSIS

The TGA curve shows the two stages weight loss when heated between the room temperature and 910.42°C. The first stage of decomposition starts at 40.82°C and end at 230.24°C the weight loss noted at this temperature is 22.4%. It is assumed that Cl will get elevated first followed by the decomposition of hydrocarbons and nitrogen gas.

When the complex undergoes decomposition as above, one mole of complex decomposed to one mole of phenyl trimethyl ammonium chloride and one mole of barium chloride. In the second stage, the decomposition of barium chloride starts at 310°C and ends at 915.28°C with the weight loss of the weight loss can be accounted for formulating the following reaction.

The decomposition takes place between 40.8°C and 915.28°C. The total weight loss during this period is calculated as 40.01%. It is clearly seen from the thermogram that the crystal is thermally stable in **Figure :4**



**Figure 4: TGA thermogram of PTMACl-BaCl<sub>2</sub> compound**

## CONCLUSION

The grown crystals were characterized using UVPTMACl-BaCl<sub>2</sub> spectroscopic studies and Powder X – ray diffraction studies and Thermogravimetric analysis

The FT- IR spectra of compound confirms the presence of methyl group and benzyl group. It also confirms C- C and C-N- C bonds. In compound C- Br bond was confirmed using FT-IR spectra. The UV spectra of PTMACl-BaCl<sub>2</sub> compound confirm the absence water and confirms the high purity of crystal. The powder XRD pattern of PTMACl-BaCl<sub>2</sub> compound show the sharp peaks Which are characteristics of the crystals. The crystalline nature of the prepared compounds is confirmed by getting well defined peaks at different  $2\theta$  values and %crystallinity. ThePTMACl-BaCl<sub>2</sub> compound show two stage decomposition in the TG thermogram. It confirms the higher stability of this compound.

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**SYNTHESIS AND CHARACTERIZATION OF ORGANIC POTASSIUM BROMIDE  
HYBRID CRYSTAL BY SLOW EVAPORATION METHOD**

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**Abstract:**

Hybrid single crystals consisting of an organic surfactant and an inorganic moiety are promising functional materials. Over the past several years, crystalline organic-inorganic hybrid materials, have been extensively explored. Both inorganic and organic complex in a single crystal have versatile structures and unique properties. The inorganic and organic hybrid crystal of potassium complex crystal has been successfully synthesized by slow evaporation growth technique at room temperature using water as a solvent. The grown crystals should be characterized using TG-DTA, UV spectroscopy, X-ray diffraction, FT-IR analysis, to identify thermal stability, purity, crystallinity and functional group of the crystal. Depending upon the assorted data, crystals were subjected to different applications.

**Keywords:** Slow Evaporation method, Inorganic – Organic hybrid crystals, single crystals.

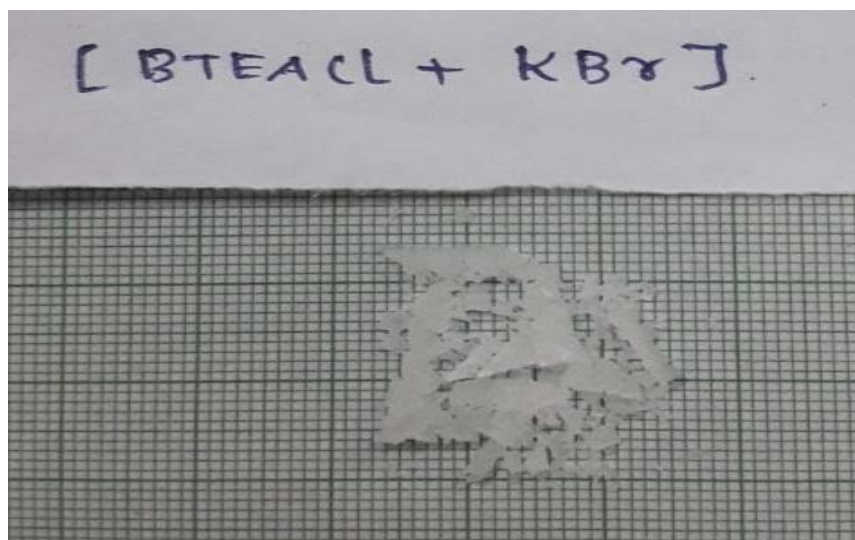
**1. INTRODUCTION:**

Crystals are solid materials which constitute molecules, atoms and ions that are arranged in some patterns and lattice. Crystal is considered as the building block of solid materials [1-3]. The essential aspects of crystal growth such as cooling, super saturation and heat of crystallization. Crystals can be formed naturally and can be prepared in laboratories. Crystal growth is the important stage of crystallization process [4]. Crystal growth has become important in today's technological system in the field of Chemistry, Physics, engineering, transportation, medical and safety technologies, computer industry, electronic industry, fibre optic communications and crystalline films for microelectronics as these depends on crystals or

materials like semiconductors, superconductors, magnetic garnets, solid state lasers, piezo-electric, non-linear optics, electro – optic, photosensitive, refractory of different grades [5-6].

## 2. EXPERIMENTAL DETAILS:

[BTEACl – KBr] complex crystal was prepared by dissolving Benzyltriethylammonium chloride and potassium bromide in 1 : 1 molar ratio respectively using triple distilled water. The two solutions were mixed together thoroughly in acidic medium by using 1 ml of bromine water as a catalyst. The solution should be stirred well. Then the resulting solution was filtered through whatman 42 filter paper. The solution was kept at room temperature for preparation of solids by slow evaporation. A colourless transparent crystalline product of [BTEACl – KBr] complex crystal was obtained after 14 days was shown in **fig.1**



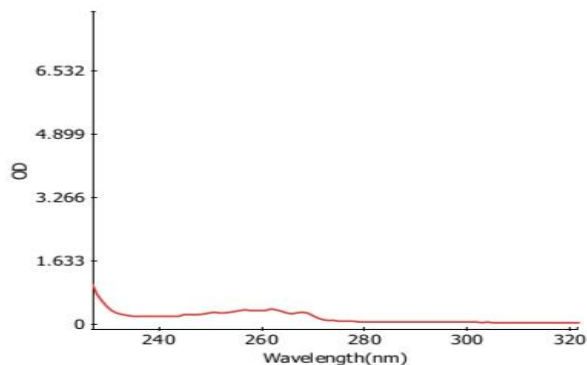
**Fig.1 [BTEACl – KBr] complex crystal**

## 3. RESULTS AND DISCUSSIONS

### 1. UV Spectroscopic studies

The UV spectrum shows that the grown crystal of [BTEACl – KBr] compound crystal is highly pure in nature as no peak is obtained near the adsorption value of water shows in the [fig.2]. It also confirms the presence of aromatic compound in the crystal.

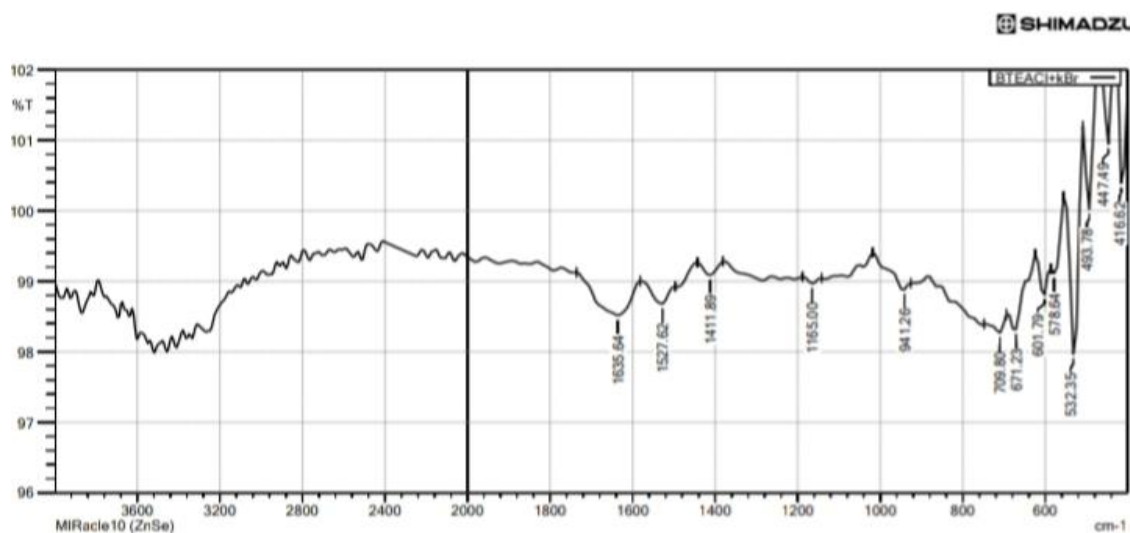




**Fig.2: UV Spectrum for [BTEACl – KBr] complex crystal**

**Spectrum for [BTEACl –**

## 2. FT – IR Studies



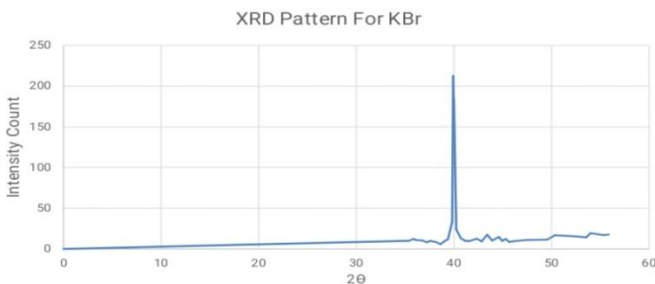
**Fig.3: FT-IR Spectrum for [BTEACl – KBr] complex crystal**

The FT – IR SPECTRUM for [BTEACl – KBr] compound crystal is shown in the [Fig.3]

The C – C stretching appears at  $1632.64\text{ cm}^{-1}$  due to methyl group. The peak at  $1527.62\text{ cm}^{-1}$  is due to C = C group. The C – C stretching aromatic or alpha - CH<sub>2</sub> bonding appears at  $1411.89\text{ cm}^{-1}$ . The peak at  $1165.00\text{ cm}^{-1}$  is due to C- N- C stretching vibrations. The peak at  $941.26\text{ cm}^{-1}$  is due to C=N stretching. The peak at  $709.80\text{ cm}^{-1}$  is due to C-Br stretching. The peak at  $671.23\text{ cm}^{-1}$  is due to the presence of alkene group.

### 3. XRD ANALYSIS

X-ray diffraction pattern of the compound is shown in the [Fig 3]. Bragg's peak of high intensity are obtained at specific angles. This shows that the compound is crystalline in nature.



**Fig.3: XRD pattern for [BTEACl – KBr] complex crystal**

% crystallinity of grown crystals of [BTEACl – KBr] complex crystal

$$\% \text{ Crystallinity} = \frac{I_c}{(I_c + I_a)} * 100$$

$$= 212.48 / 220.6 * 100$$

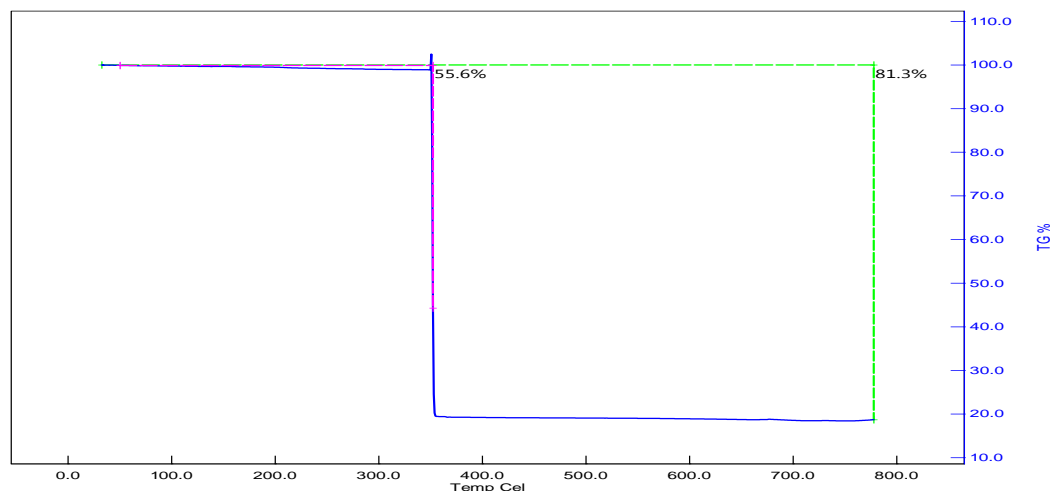
$$= 96.31\%.$$

% Crystallinity for [BTEACl – KBr] complex crystal is **96.31%**.

### 4. THERMOGRAVIMETRIC ANALYSIS

The TGA curve shows the single stage weight loss when heated between the room temperature and 790<sup>0</sup>C. The single stage decomposition starts at 20<sup>0</sup>C and ends at 370<sup>0</sup>C the weight loss noted at this temperature is 55.6%.

The decomposition takes place between 20<sup>0</sup>C to 790<sup>0</sup>C. The total weight loss during this period is calculated as 81.3%. It is clearly seems from the thermogram that the [BTEACl – KBr] complex crystal is thermally stable.



**Fig.5 TGA for [BTEACl – KBr] complex crystal**

## 5. SOLUBILITY TEST

Solubility of the newly synthesized [BTEACl – KBr] complex crystal was tested in various solvents such as DMSO, ether and water. The compound is soluble in water and insoluble in DMSO and ether.

## CONCLUSION

### [BTEACl – KBr] complex crystal

The grown crystal were characterized using UV spectroscopic studies, FTIR Spectrum, X – ray diffraction studies and Thermogravimetric analysis.

The FT-IR spectra of both compound confirms the presence of C-H, C-C and C-N bonds. It also confirms that C-Br bond. The UV spectra of [BTEACl – KBr] complex crystal confirms the absence of water and confirms the high purity of crystals. The XRD pattern of [BTEACl – KBr] complex crystal shows the sharp peaks which are characteristics of the crystals. The crystalline nature of the prepared complex crystal is confirmed by getting well defined peaks at different  $2\theta$  values and % crystallinity with 97.6%. The [BTEACl – KBr] complex crystal shows single stage decomposition and the total weight loss is 81.3%. It withstands the higher thermal stabilities of the complex crystal.

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**PROCESS DEVELOPMENT FOR TEXTILE DYE REMOVAL BY BIO-SORPTION  
USING HYBRID HYDROGEL**

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**ABSTRACT**

As the global economy grows day by day and the world urbanizes, it also has led to alarming levels of pollution for both the mankind and the environment. Water pollution is considered to be a major concern of pollution as every day about 2 million tons of industrial and agricultural waste and sewage is discharged directly into water bodies without being treated. The World Bank estimates that the textile dyeing and treatment alone contributes about 17 – 20 % of the total industrial water pollution. One of the most promising methods for water purification is adsorption due to its high adaptability and comparatively low cost. So, for purification technique hybrid hydrogel is the best adsorbent to treat textile effluents. As adsorbents, hydrogels have a strong impact on the treatment of dyes and heavy metals ion due to the presence of hydrophilic functional groups such as carboxylic acid, amine, hydroxyl and sulfonic acid groups could be used as complexing agent for the removal of metal ions from aqueous solutions. Chitosan is a linear, natural cationic polymer that was chosen to treat effluents. As it has low mechanical strength and thermal stability, polyvinyl alcohol which is a hydrophilic, biodegradable compound and a cross linking agent Glutaraldehyde was blended with chitosan as a good adsorbent for Reactive black 5 dye that we have chosen. The effecting parameters on adsorption of dyes such as concentration of dyes, temperature, pH, incubation time and solid- liquid ratio were studied and the maximum adsorption for each parameters were found to be 96.7%, 98%,

89.6%, 96.7%, 97.1% respectively at 50 ppm. The adsorption isotherms were analysed in different solid- liquid ratio using Langmuir, Freundlich and Temkin models and the best fit of adsorption data was observed in Langmuir model with  $R^2$  value of 0.9238. The Swelling capacity of hydrogel was found to be increased to 1.37 times the initial dry weight of the gel. The continuous fixed bed reactor was also designed and the adsorption analysis were performed by packing the chitosan-PVA-G hydrogel onto the column for the adsorption of Reactive black 5 dye. The response surface methodology was also constructed and the maximum adsorption of 93.8% was observed at 50 ppm of dye for 180 min.

**Keywords:** Hybrid hydrogel, Chitosan, Polyvinyl alcohol, Glutaraldehyde, Reactive Black 5 dye, Adsorption isotherms

**IMPORTANCE OF SCREENING THYROID ANTIBODIES**

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**Abstract:**

Among various Endocrinological disorders, Thyroid disorders are the most common. One of the prominent types of thyroid disorder is Autoimmune Thyroiditis. known by testing the levels of thyroid antibodies.

This study aims at testing the two main thyroid antibodies - Anti thyroglobulin (TgAb) and Anti Thyroid Peroxidase (TPO Ab) in thyroid patients and normal individuals and finds the relevance between the group.

A total of 105 samples within the age group of 20 to 50 years were collected within a duration of one month and tested for thyroid markers - Thyroid Stimulating Hormone (TSH), Total Thyroxine (T4), Total Triiodothyronine (T3) along with TgAb and TPO Ab. Among 105, 17 were known thyroid disorder patients on medications. Based on the obtained results, samples were categorised under three heads, Normal, Hypothyroid (Overt and Subclinical) and Naive. Among the 88 random samples, 2 were hypothyroid on treatment and 2 subclinical were advised medication, 61 had normal parameters and 23 had abnormal parameters. Amongst these, final two groups taken for comparison were

1. 21 hypothyroid (17 known hypothyroid, 4 from random samples (2 on medication and 2 advised to be on medication totalling to 21) and
2. 23 naive (from 88 random who had abnormal thyroid parameters or thyroid antibodies).

When their thyroid antibodies were compared (positive for either or both TPO Ab and Tg Ab) it was found that Out of 21 hypothyroid cases, 15 were positive and out of 23 naive cases 17 were positive.

All the 15 hypothyroid cases had abnormal thyroid parameters (either TSH/T3/T4) and were on medication. Among the 17 naive who tested positive, 6 had abnormal thyroid parameters, 11 were at future risk. Thus the levels of TPO Ab and TgAb can be indicators to identify the onset of Autoimmune Thyroiditis in individuals and precautionary measures can be adopted.

**Keywords:** Hypothyroidism, Thyroid parameters, Thyroid antibodies Anti-TPO positive, Anti-Tg positive, Chennai, India,



**EXPERIMENTAL AND SIMULATION STUDY ON PERFORMANCE, EMISSION CHARACTERISTICS OF ETHANOL BLENDED DIESEL FUEL IN IC ENGINE**

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**Abstract**

We constructed an engine cylinder model using the software CONVERGE and the programme CHEMKIN to further examine the effects of ethanol/diesel mixes on engine combustion and emission characteristics. The model was tested and found to be accurate. For the diesel engine, 154 reactions and 68 species were employed to determine the combustion process of diesel fuel and ethanol. Different ethanol concentrations were also tested to see what effect they had on the combustion and emission characteristics of diesel engines, such as power output, brake specific fuel consumption, brake thermal efficiency, cylinder pressure, cylinder temperature, and nitrogen oxide, carbon monoxide, and soot emissions. The higher the ethanol percentage, the higher the cylinder pressure and temperature. The cylinder pressure increased by 0.46 percent and the thermal efficiency increased by 3.63 percent when the ethanol content was 20% at 100% load. Fuel consumption increased by 4.23 percent because of the reduced calorific value of Ethanol, but power fell by 4.12 percent. Ethanol/diesel blends also lowered CO and soot emissions significantly. In comparison to diesel, the D80E20's soot and CO emissions were lowered by 63.25 percent and 17.24 percent at 100 percent load, respectively. However, NOx emissions rose by 1.39%..

**Keywords:** diesel engine; ethanol/diesel blended fuel; CONVERGE; combustion and emission characteristics

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## **Introduction**

High thermal efficiency [1, 2], good fuel efficiency [2, 3], and increased power make diesel engines popular in agriculture and industry. This has been a major scientific research topic for diesel engine experts looking for ways to save energy and reduce pollutants [4] despite the fact that the diesel engine has provided wealth to the world economy [5]. There has been a lot of interest in renewable fuels and clean fuels as a means of reducing human dependence on fossil fuels and adapting to increasingly harsh emission rules [6]. An ethanol-based biofuel has the potential to significantly reduce diesel use and exhaust gas emissions. In some cases, they can even be used to totally replace fossil fuels in diesel engines. [9] Ethanol has significant calorific value and can be utilised as a clean, oxygenated fuel [9]. Ethanol can be used as a substitute for diesel because it is inexpensive and easy to obtain [10]. There are less incomplete combustion products (CO and HC) in ethanol combustion because the flame propagation speed is quick [11], the combustion efficiency is high [12], and the combustion quality is good. Ethanol's latent heat of vaporisation is higher than diesels. For example, vaporisation can lower the cylinder's maximum combustion temperature and minimise NO<sub>x</sub> emissions [14].

Air intake and charge coefficient rise in tandem with a decrease in cylinder pressure as well as an increase in diesel power output [15]. Researchers are interested in ethanol because of its potential as a substitute to petroleum. O<sub>2</sub> fuel provides significant advantages over standard fuel when it comes to reducing emissions, according to numerous research [16–21]. Oxygenated fuels, such as ethanol, are common [22]. Cellulose and other wastes are used as raw materials for the production of ethanol, which is a renewable energy source. Environmentally-friendly biofuel ethanol reduces hazardous pollutants such as CO<sub>2</sub> and PM in motor vehicle exhaust [23, 24]. Ethanol has been extensively explored as an oxygenated renewable fuel and is appropriate for improving diesel engine emissions and substituting fossil fuels [25]. The effect of fuel stratification on the combustion parameters of diesel/ethanol dual-fuel engines was explored by Dongle et al. [26]. Ethanol was found to extend the ignition delay duration, according to their findings. Studying the effects of diesel/ethanol dual fuel on engine combustion and emissions was done by Pedrozo et al [27]. With an effective pressure range of 0.6 to 2.4 MPa, the net indicated that a dual-fuel engine's thermal efficiency was higher than the typical diesel engines.

To further improve net efficiency and reduce NO<sub>x</sub> emissions from dual-fuel engines, the Miller cycle can be used. In the end, combining ethanol and diesel can greatly improve the engine's combustion and emission properties. Numerical engine simulation has also grown in importance with the advancement of computers [28,29] as a tool for engine development. ANSYS Fluent, CONVERGE, AVL-Fire, and AVL-BOOST are just a few of the simulation tools now in use. It was found that using the FLUENT computer simulation programme, researchers could study the mixing and combustion of direct hydrogen injection and natural gas-rotary injection engines [30]. Hydrogen stratification was found to be more pronounced as injection duration was lengthened, according to the researchers' findings. The effects of varying fuel mixing ratios on diesel engine spray, combustion, and emission characteristics were studied by Zhang et al. [31] using the software CONVERGE. Cold start engine combustion, in-cylinder formaldehyde, and unburned methanol emissions were simulated by Gong et al. [32] using the AVLFire simulation tool.

Diesel injection strategy for NG/diesel RCCI combustion and emission characteristics were researched by Poorghasemi et al. [33] with CONVERGE. Changing the injection approach was found to lower NO<sub>x</sub> emissions, according to their findings. But there are just a few investigations on the impact of low ethanol concentrations and comprehensive chemical kinetic mechanisms on fuel concentrations in medium-speed diesel engines. CFD software CONVERGE was used in conjunction with the CHEMKIN application to numerically simulate the combustion process of a diesel engine. Using a medium-speed diesel engine, we were able to test the validity of our simulation model under a variety of operating situations. A final investigation was conducted to determine the effect of diesel/ethanol blended fuel on engine combustion and emission characteristics at various loads (25, 50 or 100%) and blending ratios (D100, D95E5, ..., D90E10) on diesel/ethanol mixed fuels with high ethanol blending ratio.

## **Materials and Methods**

### **2.1. Mathematical Model**

The numerical simulation of a diesel engine is carried out using the commercial CFD software CONVERGE. The use of CONVERGE, which automatically builds high grids, saves both time and money. A wide range of geometric, hydrodynamic, and chemical solvers are available in CONVERGE, together with many different options for spray, combustion, turbulence, and emissions submodels.. The combustion and emission performance of an engine may be properly calculated and numerically simulated using CONVERGE.

### 2.1.1. Turbulence Model

An internal combustion engine's cylinder contains a very turbulent atmosphere. Turbulence enhances the thickness of the flame and the rate at which it burns and releases heat. Thermal transfer over the boundary was numerically predicted using the RNG (Re-normalization group) k-# model and the turbulent flow wall function model [37]. The following is how it's said [38]:

$$\frac{\partial(\rho k_t)}{\partial t} + \text{div}(\rho k U) = \text{div}[\alpha_k \mu_{eff} \text{grad } k_t] + \tau_{ij} \cdot S_{ij} - \rho \varepsilon$$

$$\frac{\partial(\rho \varepsilon)}{\partial t} + \text{div}(\rho \varepsilon U) = \text{div}[a_\varepsilon \mu_{eff} \text{grad } \varepsilon] + C_{1\varepsilon}^* \frac{\varepsilon}{k_t} - \tau_{ij} \cdot S_{ij} - C_{2\varepsilon} \rho \frac{\varepsilon^2}{k_t}$$

with

$$\tau_{ij} = -\overline{\rho u'_i u'_j} = 2\mu_t S_{ij} - \frac{2}{3}\rho k_t \delta_{ij}$$

and

$$\mu_{eff} = \mu + \mu_t \quad \mu_t = \rho C_\mu \frac{k_t^2}{\varepsilon}$$

$$C_{1\varepsilon}^* = C_{1\varepsilon} - \frac{\eta(1 - \frac{\eta}{\eta_0})}{1 + \beta\eta^3} \quad \eta = \frac{k_t}{\varepsilon} \sqrt{2S_{ij} \cdot S_{ij}}$$

where  $\rho$  is the density, g/cm<sup>3</sup>;  $k_t$  is the turbulent kinetic energy, m<sup>2</sup>/s<sup>2</sup>;  $U$  is the fluid velocity, m/s;  $S_{ij}$  is the turbulent source term;  $\#$  is the turbulent dissipation rate; and  $\mu$  is the molecular viscosity, Pas. The Kronecker delta  $\delta_{ij}$  is provided by  $\delta_{ij} = 1$  if  $i = j$  and  $\delta_{ij} = 0$  if  $i \neq j$ .  $C_{1\#} = 1.42$ ,  $C_{2\#} = 1.68$ ,  $\alpha_k = \alpha_\# = 1.39$ ,  $C_\mu = 0.0845$ ,  $\eta_0 = 4.377$ ,  $\beta = 0.012$ .

### 2.1.2. Spray Breakup Model

We chose the KH-RT diesel spray variant, which is extensively utilised. There are two distinct parts to the spray: a liquid core and a gas–liquid mixing zone. The liquid core breaking event is described by the KH model, and the gas–liquid mixing area breaking phenomenon is described by the KH and RT models [39]. [40] is the length of the core or the breakdown.

$$L_b = C_{bl} \sqrt{\frac{\rho_l}{\rho_g}} d_0$$

In the broken length  $L_b$  range, the KH crushing model is in charge of the crushing operation. The KH and RT models are used to characterise it outside the range of  $L_b$ . The RT model is employed first to manage droplet breakage by CONVERGE; if this is not successful, the KH model is used [39].

$$\tau_{KH} = \frac{B_1}{U} \sqrt{\frac{\rho_l}{\rho_g}} r_0$$

### 2.1.3. Combustion Model

Classic combustion models can be found in CONVERGE. The SAGE combustion model [41] was used to model chemical kinetics in this article. It takes a collection of input files in the CHEMKIN format. The SAGE combustion mode makes use of a 68-species and 154-reaction chemical reaction mechanism. In addition to the ethanol-related species found in these 68 taxa, the 154 reaction taxa also contain the oxidation process that occurs during the synthesis of ethanol. The burning of different fuels can be described by a variety of chemical mechanisms. To paraphrase Turns [42], the following is an example of an elementary multi-step reaction mechanism:

$$\sum_{m=1}^M v'_{m,i} x_m = \sum_{m=1}^M v''_{m,i} x_m \text{ for } i = 1, 2, \dots, I$$

Stochastic coefficients for the reactants and products are given by (i.e.  $v_{m,i}$ ) and (i.e.  $v_{m,i}$ ) accordingly;  $I$  is the total number of reactions. The chemical symbol ( $x_m$ ) indicates that this species has been involved in this particular reaction. The  $w_{m,i}$ 's net production rate is reported by

$$\dot{\omega}_m = \sum_{i=1}^I v_{m,i} q_i \text{ for } m = 1, 2, \dots, M$$

where  $M$  is the total number of species and

$$v_{m,i} = v_{m,i}'' - v_{m,i}'$$

The reaction rate parameter  $q_i$  of the  $i$ th reaction is

$$q_i = k_{i,f} \prod_{m=1}^M [X_m]^{v_{m,i}'} - k_{i,r} \prod_{m=1}^M [X_m]^{v_{m,i}''}$$

$k_{i,f}$  and  $k_{i,r}$  are the forward and reverse rate coefficients for the reaction  $I$  respectively. Forward rate coefficient in SAGE is expressed as follows:

$$k_{i,f} = A_i T^{b_i} \exp\left(\frac{-E_i}{RT}\right)$$

Activation energy ( $E_i$ ) = cal/mol, preexponential factor ( $A_i$ ), temperature exponent ( $b_i$ ), ideal gas constant ( $R$ ), and temperature ( $T$ , K). Equation (12) specifies the reverse rate coefficient, although it can also be computed using the equilibrium rate coefficient  $K_{i,c}$  as follows:

$$K_{i,c} = \frac{k_{i,f}}{k_{i,r}}$$

The equilibrium coefficient  $K_{i,c}$  is determined by thermodynamic properties

$$K_{i,c} = K_{i,p} \left( \frac{P_{atm}}{RT} \right)^{\sum_{m=1}^M u_{m,i}}$$

where  $P_{atm}$  is the atmospheric pressure, Pa. The equilibrium constant  $K_{i,p}$  is obtained via

$$K_{i,p} = \exp \left( \frac{\Delta S_i^1}{R} - \frac{\Delta H_i^1}{RT} \right)$$

The  $\Delta$  refers to the change that occurs in passing completely from reactants to products in the  $i$ th reaction, specifically

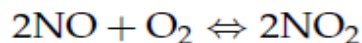
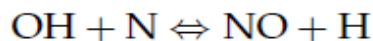
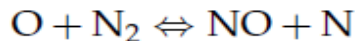
$$\frac{\Delta S_i^1}{R} = \sum_{m=1}^M u_{m,i} \frac{S_m^1}{R}$$

$$\frac{\Delta H_i^1}{RT} = \sum_{m=1}^M u_{m,i} \frac{H_m^1}{RT}$$

where  $S_{de}$  denotes entropy, J/(mol\_K); and  $H_{de}$  denotes enthalpy, kJ/mol.

#### 2.1.4. NO<sub>x</sub> Model

Thermal NO is thought to be the principal source of NO<sub>x</sub>, based on the operating process features of the internal combustion engine cylinder. The Zeldovich process [43] is a classic thermodynamic NO generating mechanism. Then, to build an extended Zeldovich mechanism, a reaction route comprising a hydroxyl group interacting with a nitrogen atom to generate NO is added. The three reactions that make up this mechanism are as follows:



### 2.1.5. Soot Model

Under high temperature and oxygen deficiency circumstances, hydrocarbon fuel undergoes a sequence of physical and chemical processes that result in soot particles; however, most of the soot will be oxidised before the exhaust valve opens. A basic empirical model has been effectively employed in estimating soot emission from internal combustion engines. It was developed based on the cylinder's soot formation and oxidation properties. This soot model was utilised as a semiempirical two-step model in CONVERGE. [44] describes the net creation rate of soot:

$$\frac{dM_{soot}}{dt} = \frac{dM_{ae}}{dt} - \frac{dM_{so}}{dt}$$

where  $M_{soot}$  is the total quantity of soot in kilogrammes,  $M_{ae}$  is the amount of soot produced in kilogrammes, and  $M_{so}$  is the amount of soot oxidation in kilogrammes. The following is a diagram of the soot formation rate model [44]:

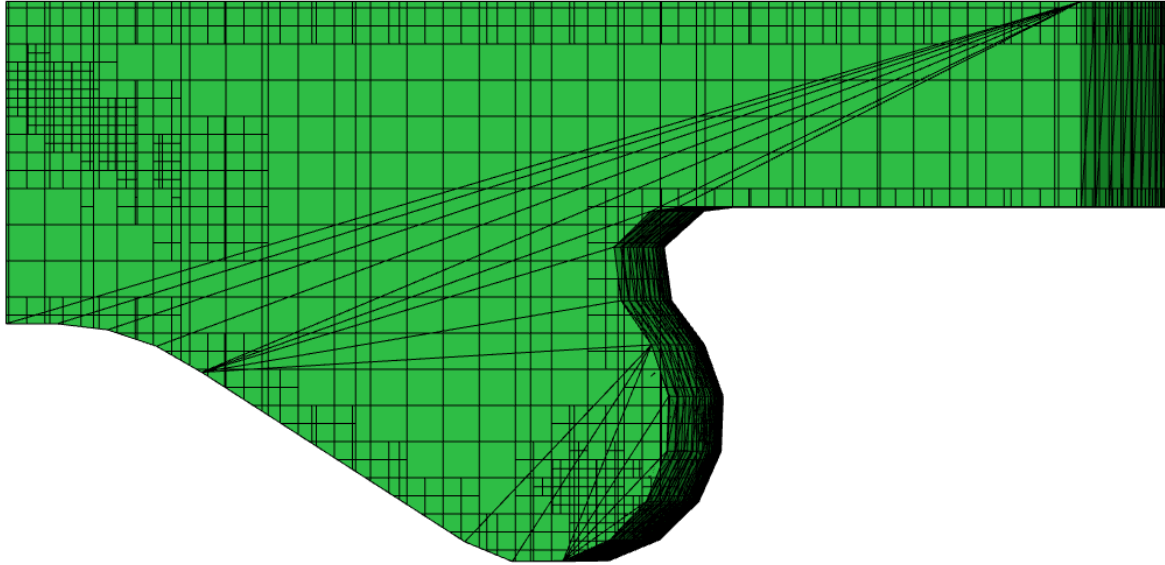
$$\frac{dM_{sf}}{dt} = A_f p_p^{0.5} \exp\left(-\frac{E_{ae}}{RT}\right) \cdot M_{fv}$$

where  $A_f$  stands for the first factor,  $p_p$  for pressure,  $E_{ae}$  for activation energy, and  $M_{fv}$  for fuel vapour quality. When the chemical reaction mechanism models the ignition and combustion process, acetylene ( $C_2H_2$ ), the precursor of soot, is commonly utilised instead of fuel vapour [44].

## 2.2. Establishment of Simulation Model

The one-dimensional simulation verification of the engine was carried out in this work utilising AVL-BOOST to identify the engine's beginning conditions. In CONVERGE, a three-dimensional CFD model of a diesel engine was developed based on the engine's actual shape. Figure 1 depicts a 3-D CFD simulation model of a cylinder.





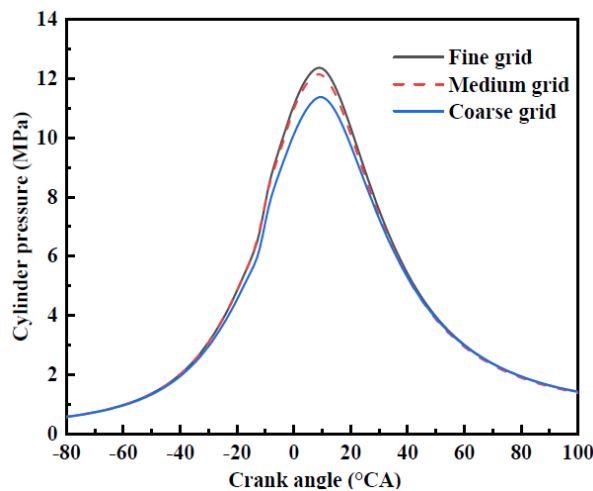
**Figure 1.** The geometric model of the combustion chamber in CONVERGE environment

### ***2.3. Computational Mesh***

The symmetrical distribution of eight nozzle holes creates a dynamic mesh according to the geometry of the four-cylinder four-stroke Marine diesel engine block. The model's fine mesh partitioning guarantees that droplet breakup and evaporation are precisely predicted. When pure diesel is fully loaded, Figure 2 displays the cylinder pressure created by three grid configurations. In-cylinder pressure does not differ significantly between the thin and medium grilles. The best intermediate grid was chosen because it ensures calculation accuracy while

Diesel/ethanol blended fuels improve the brake thermal efficiency of the engine. Since ethanol is an oxygenated fuel, the oxygen content of the blended fuel increases, and the brake thermal efficiency of the engine improves. For example, when the ethanol content in the blended fuel increases to 20%, the cylinder pressure increases by 0.46%. In addition, compared with D100, the engine power of D80E20 reduces by about 4.12%; this is because ethanol has a high oxygen content and low calorific value; Diesel/ethanol blended fuel increases BSFC and reduces power. The blended fuels of D95E5, D90E10, D85E15, and D80E20 decrease by 0.96%, 1.97%, 2.99%, and 4.12%, respectively; this is mainly due to the low calorific value of ethanol. Ho

wever,theBTEoftheengineimprovesduetotheincreaseinoxygencontent; Diesel/ethanol blended fuel will lead to increase of the soot, the carbon monoxide, and the NOx emissions. Compared with D100, the CO and soot emissions of D80E20 increase by 63.25% and 17.24%, respectively. As the oxygen content of the blended fuel increases, the combustion is more sufficient, and the soot emission reduces. In conclusion, adding ethanol to diesel engines can improve combustion and emission characteristics. This trend is worth studying. Further research is needed to obtain more accurate results.reducing calculation time. For this investigation, the intermediate grid was deemed the best option.



**Figure 2.** Comparison between in-cylinder pressure curves of different basic grids.

### 3. Experimental Cases and Engine Setup

#### 3.1. Fuel Properties

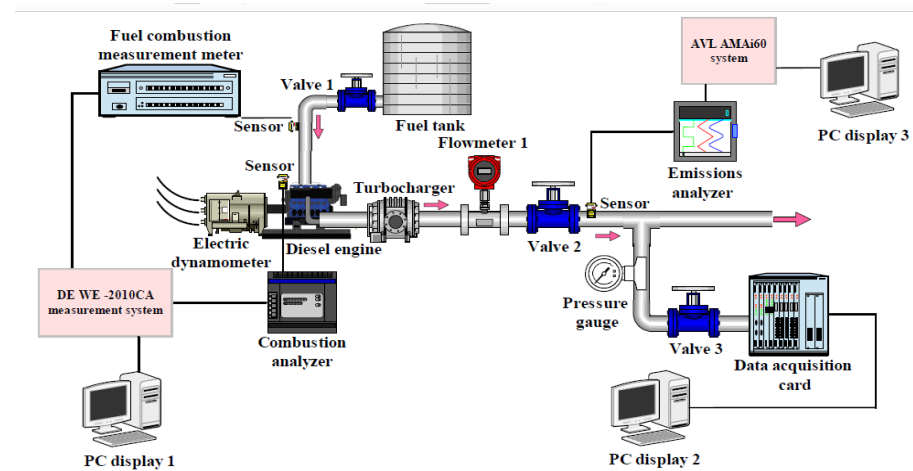
In this experiment, diesel and ethanol were used. The combustion and emission characteristics of diesel/ethanol mixed fuels were studied after varying concentrations of ethanol were blended into diesel fuel. Table 1 lists the qualities of the fuel. D100 denotes pure diesel, D95E5 denotes 95 percent diesel with 5 percent ethanol, D90E10 denotes 90 percent diesel with 10 percent ethanol, D85E15 denotes 85 percent diesel with 15 percent ethanol, and D80E20 denotes 80 percent diesel with 20 percent ethanol.

**Table 1.** The properties of diesel/ethanol blended fuel

Fuel	Diesel	Ethanol
Chemical formula	-	C <sub>2</sub> H <sub>5</sub> OH
Boiling temperature (°C)	190–280	64.7
Oxygen volume fraction (%)	0.0	34.7
Density (g/m <sup>3</sup> , at 20 °C)	0.82–0.86	0.79
Viscosity (MPa·s, at 20 °C)	3.0–8.0	1.2
Flash point (°C)	65–88	13–14
Cetane number (CN)	45–65	8
Low calorific value (MJ·kg <sup>-1</sup> )	42.5–42.8	26.8

### 3.2. Engine Specifications

A marine medium-speed diesel engine was used in the test. Table 2 shows the basic parameters of the diesel engine. Figure 3 depicts a schematic design of the experimental system.



**Figure 3.** Schematic diagram of engine test.

**Table 2.** Engine specifications and boundary conditions

Type	Value	Type	Value
Bore × stroke (mm)	190 × 210	Compression ratio	14
Number of cylinders	4	Head temperature (K)	553
Engine speed (rpm)	2000	Piston temperature (K)	423
Effective power (kW)	220	Wall temperature (K)	433
Nozzle radius (mm)	0.26	Temperature at IVC (K)	341
Fuel injection holes	8	Pressure at IVC (bar)	1.97
Cylinder diameter (MPa)	2.05	Turbulent kinetic energy (m <sup>2</sup> /s <sup>2</sup> )	62.0271
Connecting rod (mm)	410	Turbulent dissipation (m <sup>2</sup> /s <sup>3</sup> )	17,183.4

Total uncertainty of experiment = Square root of [(uncertainty of pressure sensor)<sup>2</sup> + (uncertainty of BSFC)<sup>2</sup> + (uncertainty of BTE)<sup>2</sup> + (uncertainty of Brake power)<sup>2</sup> + (uncertainty of NOx emission)<sup>2</sup> + (uncertainty of CO emission)<sup>2</sup> + (uncertainty of Soot emission)<sup>2</sup>] = Square root of [(1.5%)<sup>2</sup> + (1.7%)<sup>2</sup> + (0.53%)<sup>2</sup> + (0.3%)<sup>2</sup> + (0.53%)<sup>2</sup> + (0.32%)<sup>2</sup> + (2.8%)<sup>2</sup>] = 3.706%

### 3.3. Uncertainty Analysis

Experimental measurement data, in general, contain some mistakes and uncertainties [45]. The selection, observation, and calibration of sensors all contribute to the uncertainty of experimental outcomes. The required experimental results are calculated using the measurement results. Equation can be used to calculate the uncertainty % of metrics like BSFC, BTE, and NOx (24). Equation (25) shows that R is a function of the independent variables I1, I2, ..., In. Un denotes uncertainty in the independent variable in Equation (24), while UR reflects uncertainty in the result.

$$U_R = \left\{ [(\partial R / \partial I_1) u_1]^2 + [(\partial R / \partial I_2) u_2]^2 + \dots + [(\partial R / \partial I_n) u_n]^2 \right\}^{1/2}$$

$$R = \{I_1, I_2, I_3, \dots, I_n\}$$

Table 3 shows the measuring range and accuracy of the measuring equipment we utilised in this article. The overall experimental uncertainty was calculated using the equation below.

**Table 3.** Uncertainty of measured parameters

Measurements.	Measuring Range	Accuracy	Uncertainty (%)
Engine speed	1–2000 rpm	±0.2%	±0.24
Pressure sensor	0–25 MPa	±10 kPa	±0.5
Exhaust gas temperature	0–1000 °C	±1 °C	±0.25
NO <sub>x</sub> emission	0–5000 ppm	±10 ppm	±0.53
CO emission	0–10% vol	±0.03%	±0.32
Soot emission	0–9 FSN	±0.1 FSN	±2.8
BSFC	-	±5 g/kW·h	±1.5
BTE	-	±0.5%	±1.7
Brake power	-	±0.03 kW	±0.3
Air flow rate	0–33.3 kg/min	±1%	±0.5
Fuel flow rate	0.5–100 L/h	±0.04 L/h	±0.5

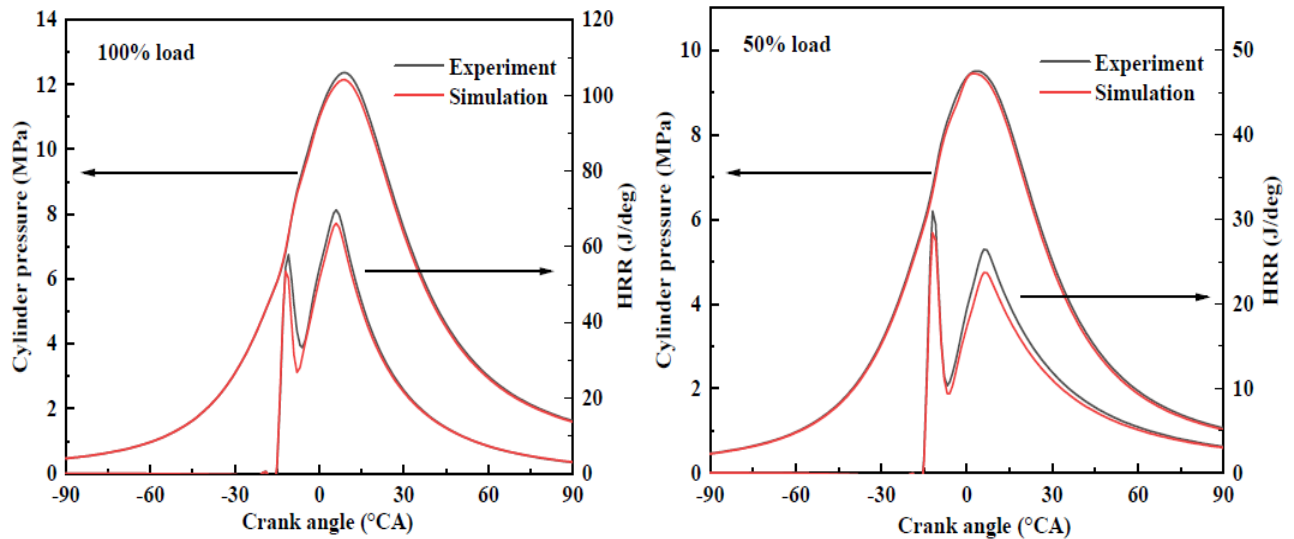
### 3.4. Model Validation

The simulation results were compared to the experimental data to ensure that the model was accurate. During the experiment, a Horiba MEXA-1600 exhaust gas analyzer was utilised to measure the created nitrogen oxide with a 1 percent inaccuracy. The brake specific fuel consumption was measured using a fuel consumption meter (FCMM-2). The combustion of the diesel engine was monitored using a combustion analyzer (DEWE-2010CA). The smoke created was measured using an Opacimeter (AVL Dismoke-4000). The fuel injection rate was measured using the EFS-IFR600, which had a measurement error of 0.5 percent. The load on the diesel engine was measured using a hydraulic dynamometer. The electronically controlled diesel engine was controlled by an electronic control unit (ECU) system. Temperature, flow, and pressure were also measured using appropriate sensors. Table 4 contains detailed specifications for the key measuring instruments.

**Table 4.** Specifications of main measuring instruments

Item	Content	Accuracy	Uncertainty (%)
Electric dynamometer	NIDY S22-2/0525-1BV-1	Torque: $\pm 0.5\%$ F.S; Speed: $\pm 1$ r/min	$\pm 0.2$
Dynamometer control system	PUMA OPEN1.4.1	$\pm 0.5\%$ F.S	$\pm 0.2$
Air flowmeter	TOCEIL 20N125	$\pm 1\%$	$\pm 0.15$
Diesel flowmeter	TOCEIL CMFG010	0.11%	$\pm 0.15$
Temperature sensor	Thermojunction type	$\pm 0.5$ °C	$\pm 0.15$
Pressure sensor	Piezoresistance type	$\pm 0.5\%$ F.S	$\pm 0.5$
Emissions analyzer	AVL AMAi60	$\pm 1.0\%$ F.S	$\pm 0.25$
Combustion analyzer	DEWE-2010CA	/	$\pm 0.25$
Injection measuring instrument	EFS-IFR600	$\pm 0.5\%$	$\pm 0.5$

A four-cylinder four-stroke diesel engine was used in the experiment. The tests were carried out at 200 rpm with 50% and 100% loads, respectively. D90E10 mixed fuel was used in the diesel engine. Figure 4 depicts both the experimental and modelling results. As can be observed in Figure 4, the difference between the experimental and simulation results is just about 5%. As a result, the model can properly forecast diesel engine combustion and emission characteristics.



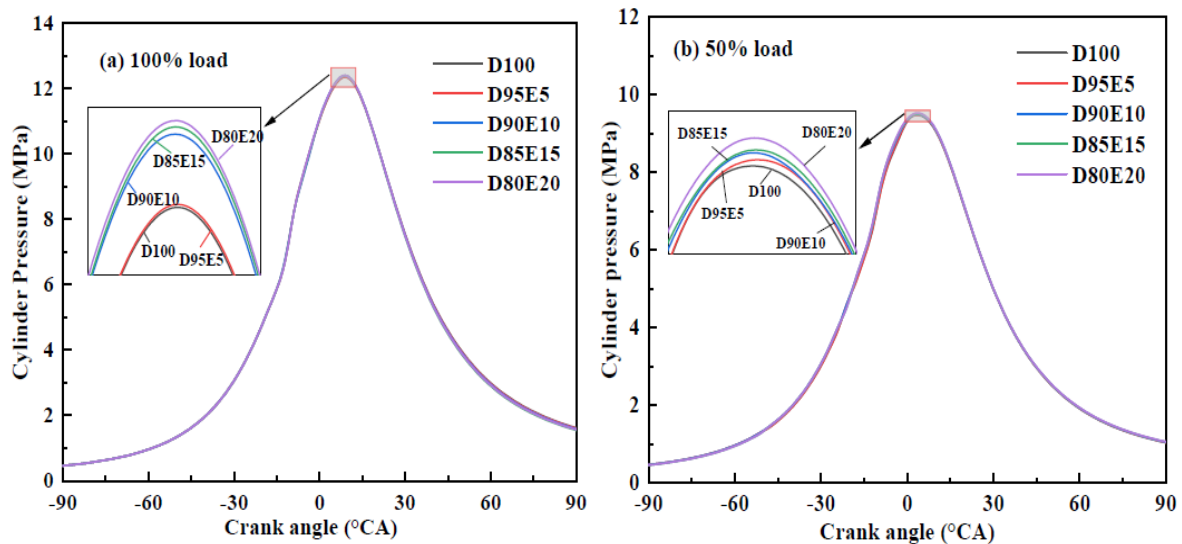
**Figure 4.** Comparison between experimental and simulation results of engine cylinder pressure and heat release rate.

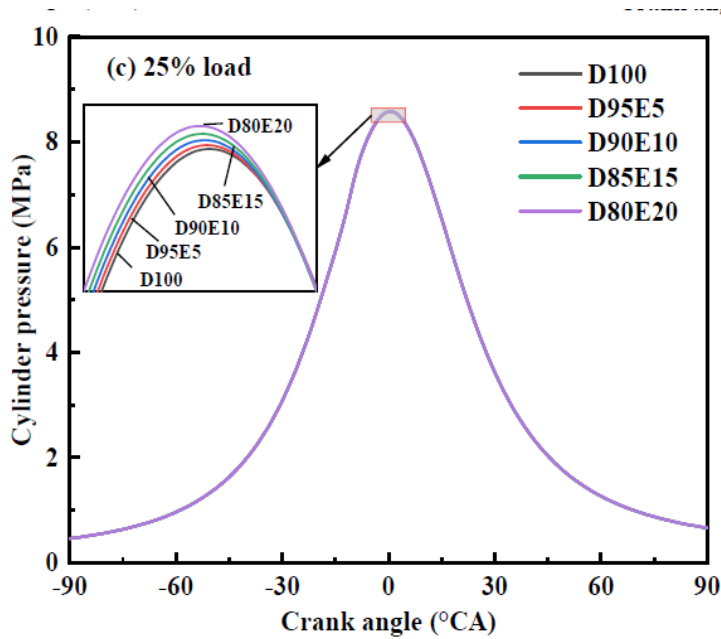
## 4. Results & Discussion

### 4.1. Engine Combustion Performance

#### 4.1.1. Cylinder Pressure

Figure 5 shows the effects of diesel/ethanol blended fuel with different blending ratios on the engine's cylinder pressure at different loads (including 100% load (see Figure 5a), 50% load (see Figure 5b), 25% load (see Figure 5c)). The cylinder pressure of D80E20 is the highest, followed by D85E15, D90E10, D95E5, and D100. As the ethanol ratio increases in the blended fuel, the cylinder's maximum combustion pressure increases gradually. For example, when the ethanol ratio in the blended fuel increases to 20%, the cylinder pressure increases by 0.46% because the cetane number of ethanol is low, leading to the extension of the mixture amount formed during the ignition delay period. In addition, ethanol is an oxygenated fuel that provides more oxygen while participating in the in-cylinder combustion reaction and effectively promotes combustion. Therefore, the pressure in the cylinder increases. Similar conclusions were drawn by Liang et al. [15] and Chen et al. [16]



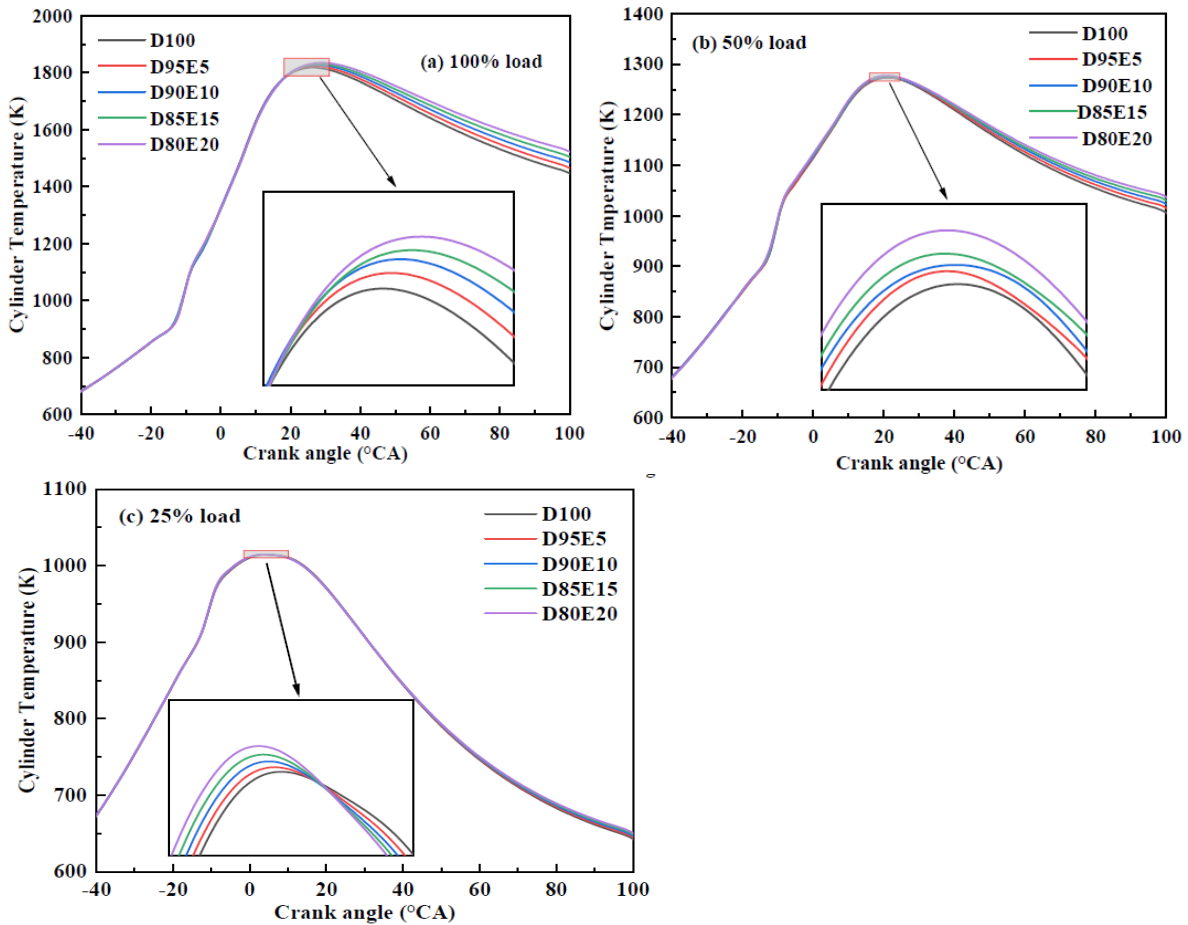


**Figure 5.** Effects of diesel/ethanol blended fuels with different blending ratios on cylinder pressure under different loading conditions

#### 4.1.2. Cylinder Temperature

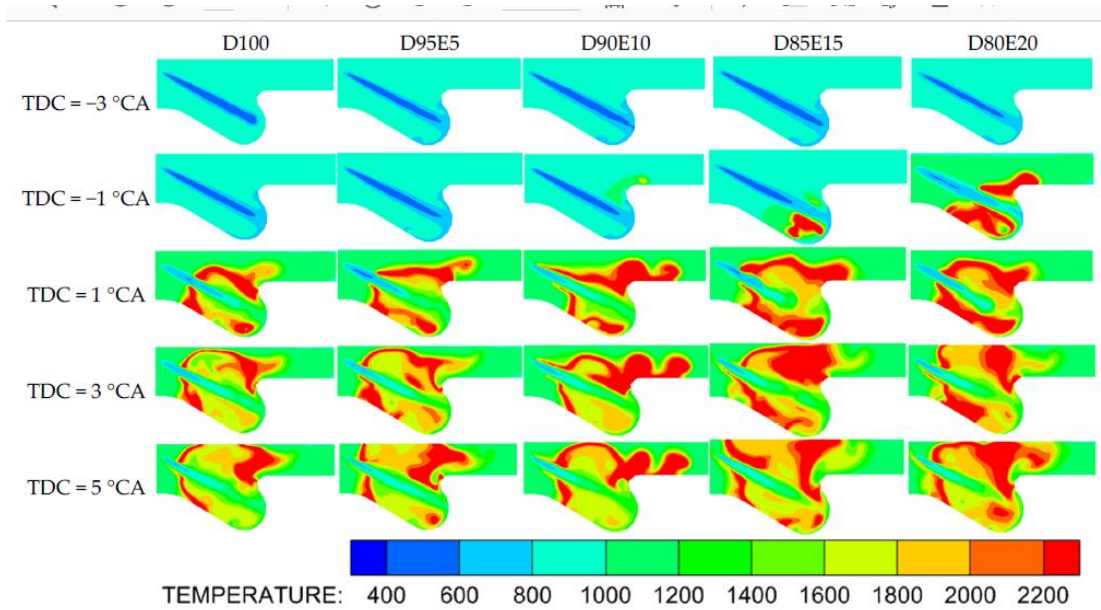
Figure 6 shows the effects of diesel/ethanol blended fuel with different blending ratios on the engine's cylinder temperature at different loads (including 100% load (see Figure 6a), 50% load (see Figure 6b), 25% load (see Figure 6c)). As the ratio of ethanol in the blended fuel increases, the maximum cylinder temperature also increases. When the ethanol ratio in the blended fuel increases to 5%, 10%, 15%, and 20%, the peak temperature of the cylinder becomes 0.28%, 0.52%, 0.65%, and 0.94% higher than diesel, respectively; the main reason for this is that ethanol is an oxygenated fuel. As the ethanol ratio increases, the oxygen content of blended fuel also increases, and the decrease in viscosity can better facilitate the atomization of fuel into the combustion chamber. Simultaneously, the higher oxygen content increases the combustion rate of blended fuel, improving the intensity of premixed combustion, and sufficient combustion. Therefore, the cylinder temperature increases. Zhang et al. [35] drew similar conclusions.





**Figure 6.** Effects of diesel/ethanol blended fuels with different blending ratios on temperature under different loading conditions.

Figure 7 shows the distribution field of the temperature in-cylinder at 100% load. Compared with D100, diesel/ethanol blended fuel produces more high-temperature areas because ethanol's lower density and surface tension promote fuel atomization and sufficient combustion.



**Figure 7.** The distribution field of the temperature in-cylinder at 100% load. [K]

#### 4.1.3. Heat Release Rate

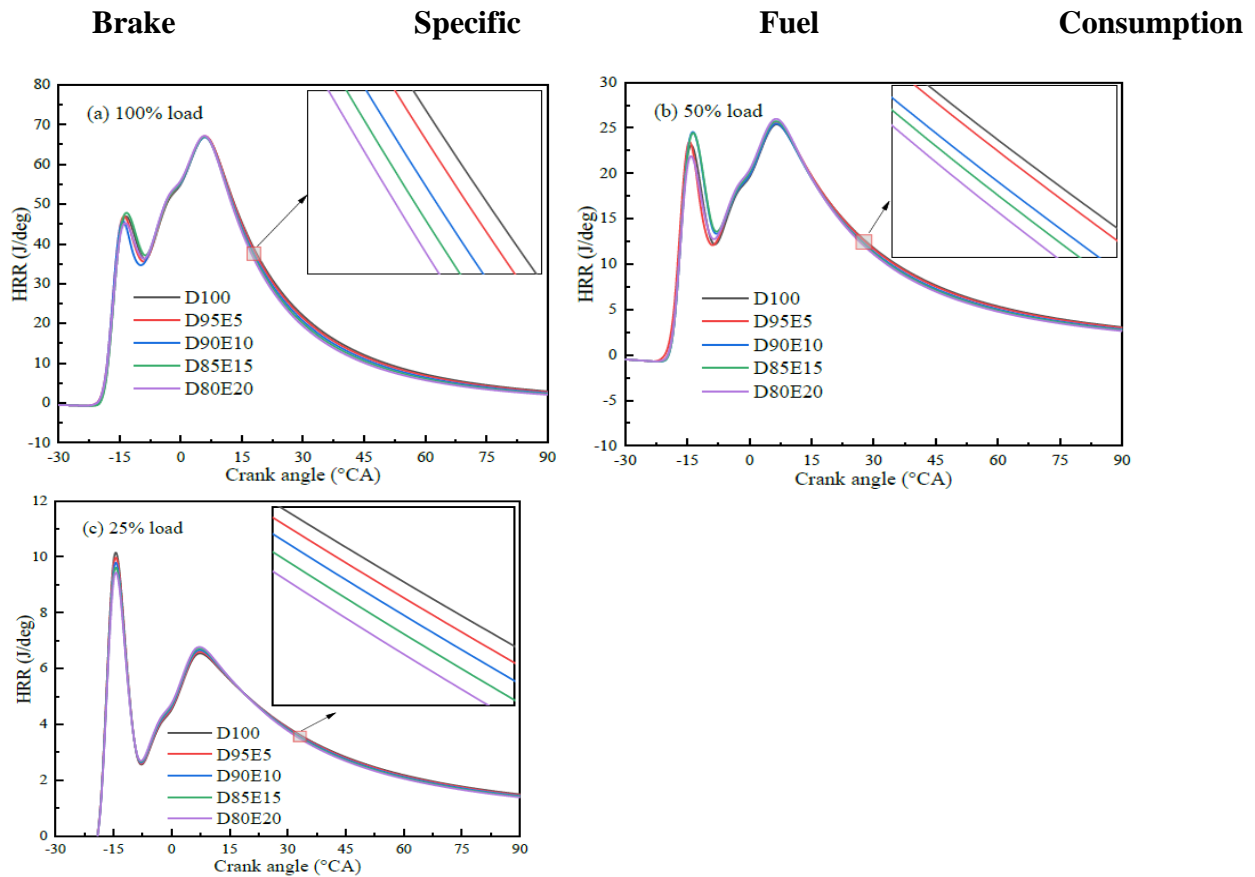
Figure 8 shows the effects of diesel/ethanol blended fuel with different blending ratios on the engine's heat release rate (HRR) at different loads (including 100% load (see Figure 8a), 50% load (see Figure 8b), 25% load (see Figure 8c)). The overall HRR of diesel/ethanol blended fuel increases as the ethanol blending ratio increases because of the low cetane number and high latent heat of vaporization in ethanol, which leads to a longer ignition delay period of the blended fuel, increases the amount of combustible mixture formed in the premixing stage, improves the engine combustion conditions, and allows the blended fuel to burn fully. Liu et al. [46] evaluated the effects of E0, E10, and E20 on the engine. Their conclusion also confirmed that HRR increases with the increase in ethanol ratio.

### 4.2. Economic Performance

#### 4.2.1. Brake Specific Fuel Consumption

Brake specific fuel consumption (BSFC) is an important index for measuring the economic performance of an engine [47]. Figure 9a shows the effects of diesel/ethanol blended fuel with different blending ratios on the engine's BSFC at different loads. The

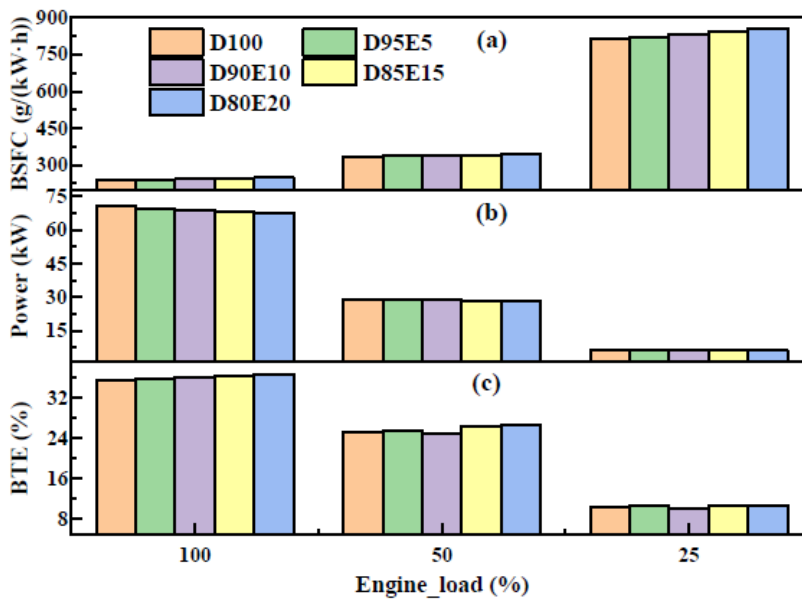
dieselengine’s fuel consumption gradually as the ethanol ratio increases in blended fuel. Forexample, when pure diesel is used at 25% load, the fuel consumption of the engine is810.79 g/(kW\_h). As the ethanol content in the blended fuel increases to 5%, 10%, 15%, and20%, the fuel consumption increases to 820.22/(kW\_h), 831.88/(kW\_h), 842.76/(kW\_h), and853.91/(kW\_h), respectively; this is because the calorific value of diesel fuel (42.5 MJ/kg) ishigher than the calorific value of ethanol (26.8 MJ/kg), as shown in Table 1. An increase inthe ratio of ethanol in blended fuel reduces the total calorific value of blended fuel, leadingto an increase in BSFC.



**Figure 8.** Effects of diesel/ethanol blended fuels with different blending ratios on HRR under different loading conditions

#### 4.2.2. Brake Power

Figure 9b shows the effects of diesel/ethanol blended fuel with different blending ratios on the engine's brake power at different loads. The engine's power decreases gradually as the ethanol ratio increases in the blended fuel. Moreover, the higher the ethanol ratio is in the blended fuel, the more apparent the reduction in engine power. Compared with D100, the power of D95E5, D90E10, D85E15, and D80E20 blended fuel reduces by 0.96%, 1.97%, 2.99%, and 4.12%, respectively; this is because the calorific value of ethanol/diesel blended fuel is lower than D100, resulting in lower combustion power than diesel.



**Figure 9.** Effects of diesel/ethanol blended fuels with different blending ratios on (a) BSFC, (b) power, and (c) BTE under different loading conditions

#### 4.2.3. Brake Thermal Efficiency

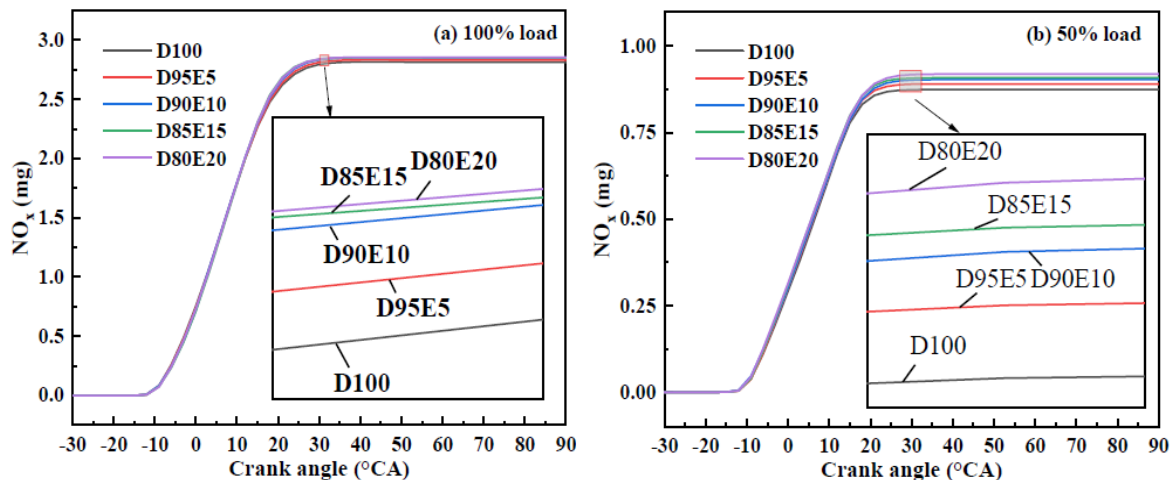
Figure 9c shows the effects of diesel/ethanol blended fuel with different blending ratios on the engine's brake thermal efficiency (BTE) at different loads. BTE decreases with increased ethanol content at low loads and increases as the ethanol ratio increases at high loads because the increase in ethanol ratio in diesel/ethanol blended fuel improves the spray characteristics of the blended fuel. Since ethanol is an oxygenated fuel, it increases the oxygen content of the blended fuel, improving the combustion characteristics of the fuel, and further improving the BTE of the engine. Han et al. [48] investigated the dynamic characteristics of diesel/ethanol dual fuel engines

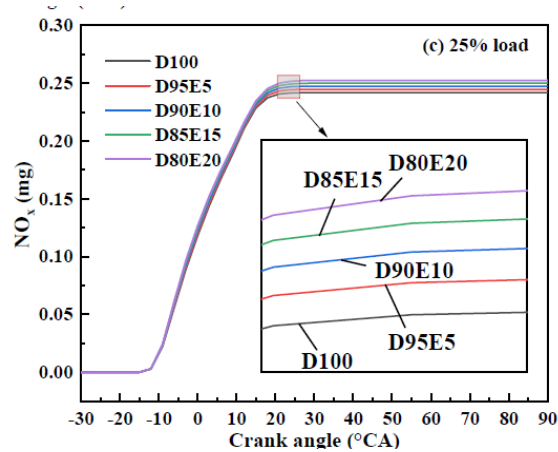
and reached similar conclusions. They confirmed that the combustion efficiency and BTE of ethanol decreased under low load conditions in the dual fuel mode and increased under medium and high load conditions

### 4.3. Emission Performance

#### 4.3.1. NOx Emission

Figure 9 shows the effects of diesel/ethanol blended fuel with different blending ratios on NOx emission at different loads (including 100% load (see Figure 9a), 50% load (see Figure 9b), 25% load (see Figure 9c)). NOx emission increases with increased engine load; because the increase in engine load leads to increased peak temperature, which improves the emission level of NOx. In addition, the engine's NOx emission increases as the ethanol ratio increases in the blended fuel; this is because ethanol has low density, low viscosity, and high oxygen content characteristics, which improve combustion in the engine cylinder and produce more NOx in the local high-temperature area. Compared with the cylinder temperature cloud diagram in Figure 10, NOx generation is mainly affected by the temperature in the cylinder. The higher the temperature is, the more NOx emissions are, particularly in the concentrated temperature area. In addition, the cetane number of diesel/ethanol blended fuel is lower than D100, which leads to the extension of the ignition delay period, the increase of in-cylinder fuel injection, and premixed combustion, thereby increasing NOx emission. Similar conclusions were drawn by Sayin et al. [49] and Alptekin et al., [50].

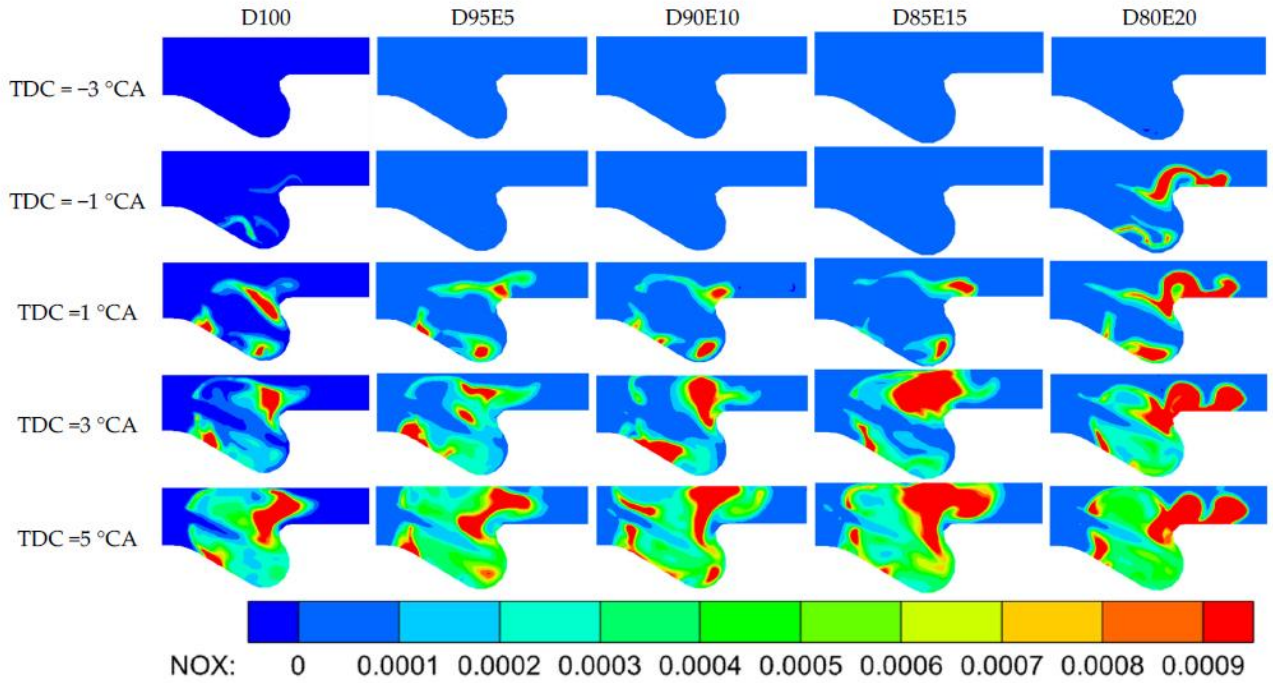




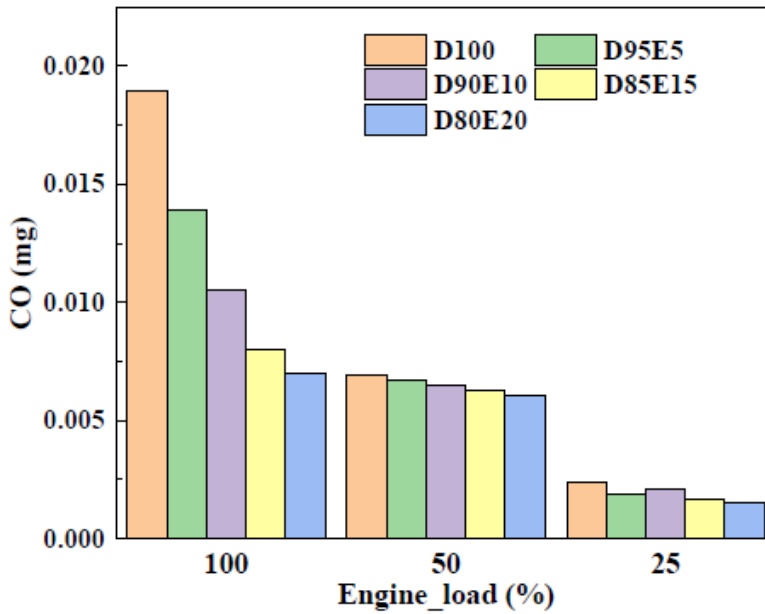
**Figure 10.** Effects of diesel/ethanol blended fuels with different blending ratios on NOx emission under different loading conditions.

#### 4.3.2. CO Emission

Figure 11 shows the effects of diesel/ethanol blended fuel with different blending ratios on the engine's CO emission at different loads. Compared with pure diesel, CO emission increases with increased ethanol content at a low load. At high loads, CO emission decreases with increased ethanol content; this is because at low load, the inlet temperature is low, and the latent vaporization heat of ethanol is higher than diesel, resulting in more heat absorption in the combustion process of blended fuel, difficult complete combustion, and increased CO emission (see Figure 12). There are large amounts of fuel injection per cycle at high loads and higher temperatures in the cylinder. As an oxygenated fuel, ethanol can provide additional oxygen during combustion, effectively improving the problem of insufficient oxygen in the cylinder, creating sufficient combustion, and inhibiting the generation of CO. This observation is consistent with the conclusion of Le et al. [14].



**Figure 11.** The NOx distribution field in the cylinder at 50% load [g]

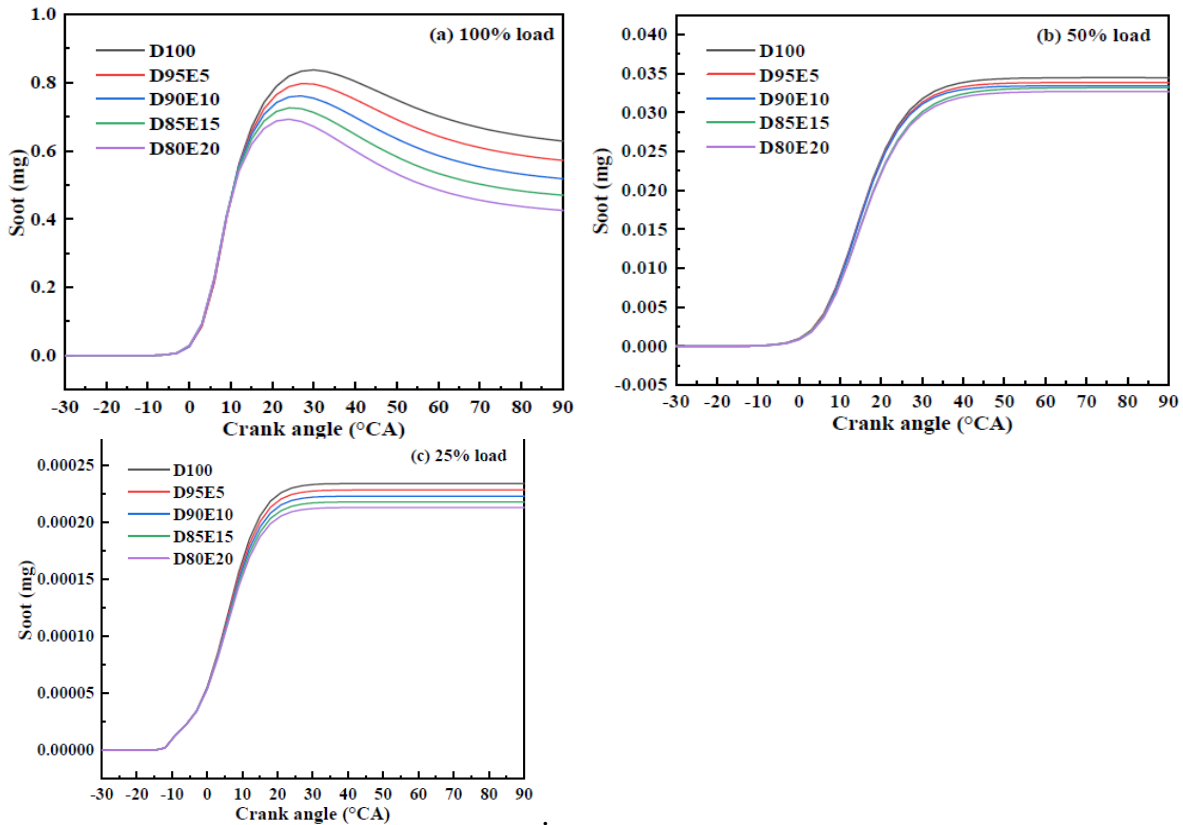


**Figure 12.** Effects of diesel/ethanol blended fuels with different blending ratios on CO emission under different loading conditions

#### 4.3.3. Soot Emission

Figure 13 shows the effects of diesel/ethanol blended fuel with different blending ratios on engine soot emissions at different loads (including 100% load (see Figure 13a), 50% load (see Figure 13b), 25% load (Figure 13c)). Soot emission increases as the engine load increases because the oxygen in the cylinder is insufficient at higher loads and large amounts of soot form in the high-temperature anoxic area. In addition, soot emission decreases as the ethanol ratio increases in blended fuel. For example, under 100% load conditions, soot emission increases by 4.77%, 9.08%, 13.51%, and 17.24% when the ethanol content in blended fuels increases to 5%, 10%, 15%, and 20%, respectively. This increase is mainly because the combustion temperature in the cylinder is higher at high loads, and the oil supply per cycle increases, enabling the formation of an over-concentrated mixture. At this time, the mitigation effects of ethanol on the local over-concentrated area in the cylinder and the combustion promotion effects of additional oxygen are more apparent and effectively reduce the soot emission under high load conditions.





**Figure 13.** Effects of diesel/ethanol blended fuels with different blending ratios on soot emission under different loading conditions.

### 1. Conclusions

Due to the global energy crisis [51–56] and environmental problems [57–61], the development of diesel engines is also facing great challenges. In this paper, our main conclusions are as follows:

Diesel/ethanol blended fuels improve the brake thermal efficiency of the engine. Since ethanol is an oxygenated fuel, the oxygen content of the blended fuel increases, and the brake thermal efficiency of the engine improves. For example, when the ethanol content in the blended fuel increases to 20%, the cylinder pressure increases by 0.46%. In addition, compared with D100, the engine power of D80E20 reduces by about 4.12%; this is because ethanol has a high oxygen content and low calorific value;

Diesel/ethanol blended fuel increases BSFC and reduces power. The blended fuels of D95E5, D90E10, D85E15, and D80E20 decrease by 0.96%, 1.97%, 2.99%, and 4.12%, respectively; this is mainly due to

low calorific value of ethanol. However, the BTE of the engine improves due to the increase in oxygen content; Diesel/ethanol blended fuel will lead to increase of the soot, the carbon monoxide, and the NO<sub>x</sub> emissions. Compared with D100, the CO and soot emissions of D80E20 increase by 63.25% and 17.24%, respectively. As the oxygen content of the blended fuel increases, the combustion is more sufficient, and the soot emission reduces. In conclusion, adding ethanol to diesel engines can improve combustion and emission characteristics. This trend is worth studying. Further research is needed to obtain more accurate results.

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**PRODUCTION, OPTIMIZATION AND PARTIAL PURIFICATION OF  
INDUSTRIALLY IMPORTANT PROTEASE ENZYME FROM MANGROVE SOIL BY  
BACILLUS SP.**

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**ABSTRACT**

Proteases have characteristics of biotechnological interest and have thus become important industrial enzymes. Microbial enzymes are widely used in industrial processes. protease are one of the most important enzymes in present-day biotechnology. Protease production was investigated using *Bacillus* sps isolated from Manakudi mangrove sediments, Kanyakumari District, Tamil Nadu. Bacterial diversity from mangroves ecosystems has been studied for their unique biochemical processes and their use in various applications. The various temperature and pH tested for optimum growth and enzyme production, maximum enzyme production was observed at 30 to 40°C and pH 8.0. The production of the enzyme, its thermostable nature and compatibility with most commercial pharmaceutical, food and detergent features which suggest its application in the detergent industry.

**Keywords:** Protease, Mangrove ecosystem, Mangrove sediments, *Bacillus* sps

**Introduction**

Mangroves are highly productive marine ecosystem where bacteria busily take part in bio-mineralization and biotransformation of minerals (Gonzalez-Acosta, 2006). The distribution of microbial activities in estuarine systems is complex and variable. Leaves and woods provided by mangrove plants to the soil are degraded by large variety of microbes which actively participate in heterotrophic food chain (Alongi, 1994). *Bacillus* produces a wide variety of extra-cellular enzymes, including proteases. Several *Bacillus* species involved in protease production are e.g. *B. sterothermophilus*, *B. subtilis*, *B. mojavensis*, *B. cereus* and *B. megaterium* (Ammaret *al.*, 1991; Sookkheoet *al.*, 2000; Beg and Gupta, 2003; Banik and Prakash, 2004; Grezeet *al.*, 2005 and Soareset *al.*, 2005).

Proteases are widespread in nature, microbes serve as a preferred source of these enzymes because of their rapid growth, the limited space required for their cultivation and the ease with which they can be genetically manipulated to generate new enzymes with altered properties that are desirable for their various applications (Anwar and Saleemuddin, 1998; Beg and Gupta, 2003). Probably the largest application of proteases is in laundry detergents, where they help removing protein based stains from clothing (Banerjee *et al.*, 1999; Banik and Prakash, 2004). Among these, *Bacillus sps* is the most important group of bacteria that are involved in the enzyme industry and this bacterium is also known to produce proteolytic enzymes quite effectively.

Despite this, only a few studies have been done on proteolytic enzymes from *Bacillus* spp. Furthermore studies have showed that nutritional factors including sources of carbon and nitrogen can influence protease enzyme production. Besides this nutritional factor, physical factors such as inoculum concentration (Tobeet *al.*, 2005), temperature, pH (Yossanet *al.*, 2006) and incubation time (Lowry, 1998) can also significantly affect protease production.

The present investigation was aimed to optimize the growth parameters of *Bacillus sps* isolated from different sources in-order to enhance the protease enzyme production.

## **Materials and Methods**

### **Sample collection**

The sediment samples were collected from four different sites at Manakudi Mangroves, Kanyakumari District, Tamil Nadu. Sediment was collected from 4cm deep by using sterile spatula, stored in a sterile polythene bags and refrigerated at 4° C till further processing.

### **Enumeration of bacteria**

The sediment samples were dried and serially diluted from  $10^{-1}$  to  $10^{-9}$ . 0.1ml from each dilution was plated on nutrient agar medium containing 2% starch and incubated overnight at 30°C temperature. After incubation, the colonies were counted. The counts were expressed in colony forming units (cfu) per grams of the sample.

### **Identification of microbes**

Spread plate technique on Nutrient agar plates were used for isolation of microorganism. A total of fifteen isolates were grown on minimal agar plates. The predominated microorganism was identified by inoculating them in suitable medium for colony morphological identification. Microscopical, macroscopical and biochemical characterization were performed.

### **Protease production**

The inoculum was prepared by adding a loop full of pure culture into 25 ml of sterile CMB medium and incubated at 37 °C on a rotary shaker for 24 h. A 10% inoculum from the culture was added to gelatin broth (GB) containing gelatin, 10 g/l; casein enzymatic hydrolysate, 10 g/l; NaCl (w/v), 100 g/l and pH 9. After incubation of 66048 h at 37 °C under shaking condition (100 rpm), the culture was harvested and growth was measured at  $A_{660}$ . The cultures were centrifuged at 10,000 rpm for 10 min at 4 °C. The cell free extract was used as crude preparation to measure protease activity.

### **Purification of Enzyme**

The supernatant was fractionated by precipitation with ammonium sulfate between 50% and 70% of saturation. All subsequent steps were carried out at 4 °C. The protein was resuspended in 0.1M Phosphate buffer, pH 7.0, and dialyzed against the same buffer

### **Assay for Protease**

The enzyme was assayed in the reaction mixture containing 2.0 ml of 0.5 per cent casein solution in 0.1 M CO<sub>2</sub>-HCO<sub>3</sub> buffer (pH 9.5) and 1 ml enzyme solution in a total volume of 3.0 ml. After inoculation at 30°C for five minutes, the reaction was stopped by addition of 3.0 ml of 10 percent ice cold TCA and centrifuged at 10000 rpm for five minutes. Protein in the supernatant was estimated by the method (Lowry, 1988). To fifty ml quantities of standard growth broth containing 1 percent casein, various carbon sources *viz.*, starch, glucose, fructose, maltose, sucrose and cellulobiose at 0.5 per cent levels were added in separate 100 ml Erlenmeyer flasks without adding carbon source. They were sterilized, inoculated and incubated at 30°C for 3 days and at the end of incubation, the cell free filtrate served as the enzyme source.

### **Effect of pH**

Erlenmeyer flasks containing 50 ml quantities of modified standard growth broth containing the optimum casein concentration and carbon sources were taken and the pH of the broth was adjusted to 4, 5, 6, 7, 8,9, 10 and 11 in different flask using pH meter with 1 N HCl or 1 N KOH and sterilized. The bacterial cultures were inoculated and incubated at 30°C for 3 days. At the end of incubation period the cell free culture filtrate was obtained and used as enzyme source.

### **Effect of Temperature**

Fifty ml quantities of modified standard growth broth were dispensed in 100 ml Erlenmeyer flasks. The pH adjusted to 10 by adding 0.1 N NaOH. The flasks were sterilized, inoculated and incubated at different temperatures *viz.*, 20, 30, 40, 50, 60, 70°C for 3 days. At the end of inoculation period, the cell free culture filtrate was obtained and used for the enzyme assay.

### **Results and Discussion**

In the present investigation, the bacterial isolates of 4 sites were enumerated (Table 1) and fifteen different morphological features of isolates were determined (Table 2). The most

predominant bacteria were selected. Based on morphology and biochemical studies, the isolate was identified as *Bacillus* sps (Table 3). The isolated source of *Bacillus* sps maximum enzyme production was observed at 24 hours. It exhibited their maximum ability to biosynthesize proteases within 24 h incubation period. The protease enzyme from *Bacillus* SNR01 was partially purified by ammonium sulphate fractionation.

**Table 1: Enumeration of different isolates in sites 1, 2, 3 and 4**

Isolates	Site 1	Site 2	Site 3	Site 4
	Colony forming units (cfu / gm)	Colony forming units (cfu / gm)	Colony forming units (cfu / gm)	Colony forming units (cfu / gm)
1	$180 \times 10^3$	-	$155 \times 10^3$	$49 \times 10^3$
2	$41 \times 10^3$	$80 \times 10^3$	$103 \times 10^3$	$88 \times 10^3$
3	$130 \times 10^3$	$107 \times 10^3$	$96 \times 10^3$	$95 \times 10^3$
4	-	$112 \times 10^3$	$122 \times 10^3$	-
5	$117 \times 10^3$	-	$109 \times 10^3$	-
6	-	$103 \times 10^3$	$95 \times 10^3$	$124 \times 10^3$
7	$121 \times 10^3$	$90 \times 10^3$	$99 \times 10^3$	$66 \times 10^3$
8	-	$123 \times 10^3$	$132 \times 10^3$	$88 \times 10^3$
9	$124 \times 10^3$	-	-	$133 \times 10^3$
10	$90 \times 10^3$	$86 \times 10^3$	-	$77 \times 10^3$
11	$108 \times 10^3$	-	-	-
12	$88 \times 10^3$	$124 \times 10^3$	$103 \times 10^3$	$113 \times 10^3$
13	$139 \times 10^3$	$77 \times 10^3$	-	$57 \times 10^3$
14	-	-	$79 \times 10^3$	$88 \times 10^3$
15	$24 \times 10^3$	$99 \times 10^3$	-	-

**Table 2: List of microorganism in different sites**

Isolates      Microorganisms

1	<i>Bacillus sps</i>
2	<i>E. coli</i>
3	<i>Aeromonassps</i>
4	<i>Vibrio sps</i>
5	<i>Klebsiellasps</i>
6	<i>Pseudomonas sps</i>
7	<i>Aerococcussps</i>
8	<i>Shigellasps</i>
9	<i>Acetobactersps</i>
10	<i>Streptococcus sps</i>
11	<i>Staphylococcus sps</i>
12	<i>Micrococcus sps</i>
13	<i>Enterobactersps</i>
14	<i>Enterococci sps</i>
15	<i>Azotobactersps</i>

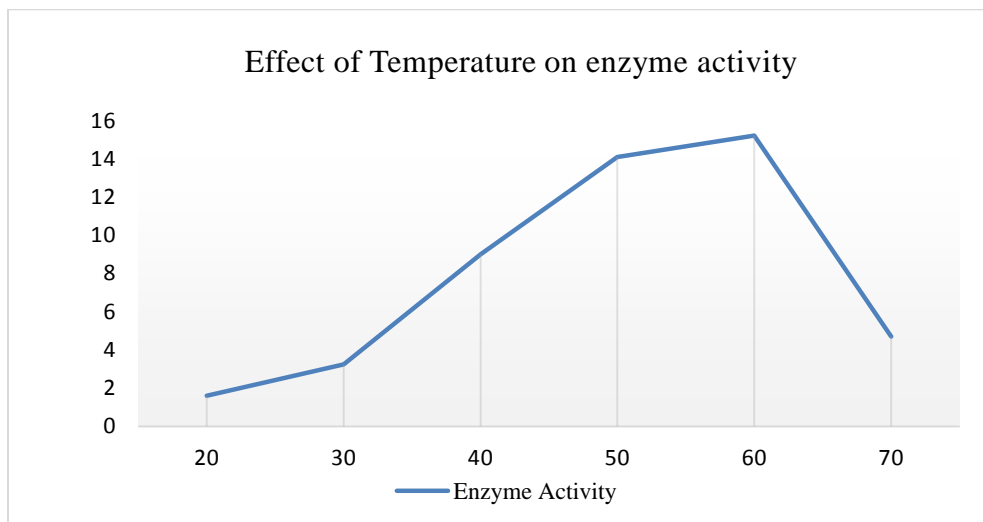
**Table 3: Morphological and Biochemical Observations**

<b>Tests</b>	<b>Results</b>
Gram's Staining	G+ rod
Motility	+
Spore staining	+
Indole Production test	-
Methyl red	+
Test	
VogesProskauer	+
Test	
Citrate utilization test	+

Catalase test		+
Oxidase		+
Urease		-
Nitrate Reduction		-
TSI		AK, G
Alkaline (AK)		
Acid(A)		
Gas (G)		
Carbohydrate fermentation	Glucose	+
	Lactose	+
	Sucrose	+

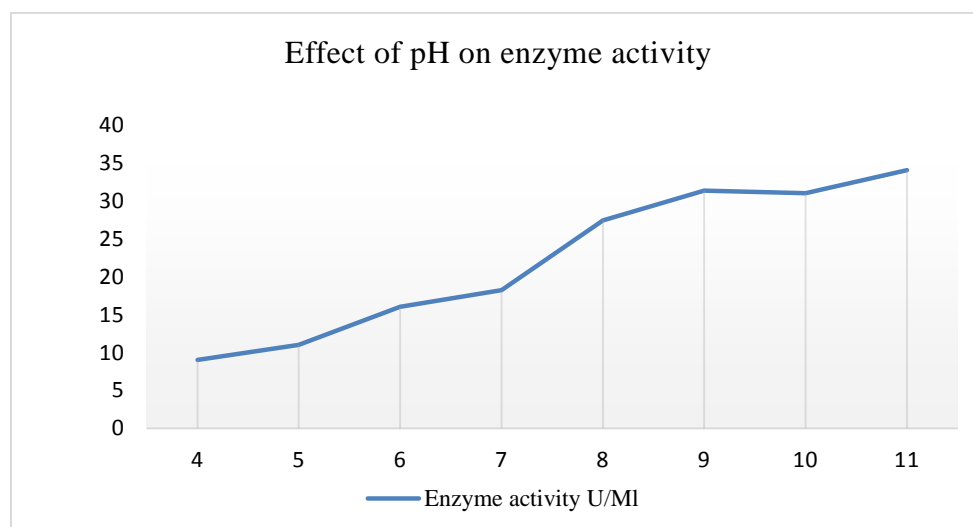
The various temperature and pH tested for optimum growth and enzyme production. Maximum enzyme production was observed at 30 to 40°C (Graph 1) and pH 8.0 (Graph 2).

**Graph 1: Effect of temperature on enzyme activity**



The influence of incubation temperature on protease production by bacteria was studied by several workers (Schwimmer, 1981; Vortulaet *al.*, 1991; Tsakalidouet *al.*, 1999). The different incubation temperatures tested for protease production 60°C was found to be optimum for selected isolate. The optimum temperature for protease production for *B. licheniformis* was 45°C and for *B. subtilis* 50°C. But inactive at 55-90°C (Schwimmer, 1981).

**Graph 2: Effect of pH on enzyme activity**



The different pH levels tested, pH 11 was found optimum for selected isolate. Even though pH initially decreased, it reached alkalinity when secondary metabolites were released



and become constant (Kaur *et al.*, 1998) Further studies by *B. licheniformis* S-40 was able to grow in a pH range of 7-12 with better protease production in alkaline range(Schwimmer, 1981).

### Conclusion

Protease is the single class of enzymes which occupy a pivotal position with respect to their application in both physiological and commercial fields.It represent about 60% of total enzymes market sales.At present, the largest part of the hydrolytic enzyme market is occupied by the alkali proteases.The present investigation clearly showed that the mangroves sediment was a good asset for isolating microorganisms with the ability of producing protease enzyme. The thermostable protease producing strain can be mass produced and can be used commercially for industrial purposes.

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**PRELIMINARY PHYTOCHEMICAL SCREENING AND ANTIMICROBIAL STUDIES  
OF *CISSUS QUADRANGULARIS* IN KOVALAM VILLAGE, KANYAKUMARI  
DISTRICT, SOUTH INDIA**

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**ABSTRACT:**

Every culture throughout the world has been using herbal and natural products of folk medicine from centuries. Various plant parts such as leaves, bark, fruits, roots and seeds are used in treatment of various diseases. It had been reported that the plants used in allopathic medicines were potential sources of antiviral, antitumour and antimicrobial agents. Herbal drugs have become increasingly popular and their use is widespread. Clear cut proof of their efficacy in microorganisms including pathogenesis is yet to be explored. So, there is a need to develop alternative drugs for the treatment of infectious diseases from medicinal plants. The side effects of drugs available today compel the discovery of new pharmaco-therapeutic agents from medicinal plants. Based on above apprehensions, the present work was undertaken for phytochemical screening of five different plants and evaluation of their antibacterial potency. The plant used in the present study was collected from Kovalam village of Kanyakumari District, South India. The plant materials were washed thoroughly, dried in shade, grounded to fine powder and stored before analysis. Various phytochemical analysis was performed in water extract, ethanol extract and chloroform extract. The results revealed the presence of various active phytochemicals in the extracts and the best being ethanolic extract. Further, the ethanolic plant extract was subjected to antibiotic sensitivity test against five different human pathogens like *Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeroginosa*, *Bacillus subtilis*. The

plant have potential effects towards the Gram negative microorganisms. Considering the easy availability of these medicinal plants, there still exists a scope for scientific studies to explore its availability in medicinal field. Further studies are needed to isolate bioactive principles from the aqueous extracts.

**Keywords:** Phytochemical screening, *Cissus quadrangularis*, Antibiotic sensitivity test.

## INTRODUCTION:

Nature becomes a great source of medicinal treatment for millions of years. Much of the world's biological diversity remains unexplored as a source of novel biological compounds and the search for new bioactive agents from natural sources, including extreme environmental niches is expanding (Cragg and Newman, 2001).

Medicinal plants are the richest bio-resource of drugs of traditional systems of medicine, modern medicines, nutraceuticals, food supplements, folk medicines, pharmaceutical intermediates and chemical entities for synthetic drugs. Currently, WHO has urged its member countries to provide financial support for traditional practitioners to develop the traditional medical systems. It is imminent to utilize both the traditional and modern medical systems to fulfill the primary healthcare of the world (Hasim *et al.*, 2010).

The demand for more and more drugs from plant sources is continuously increasing. It is therefore essential for systematic evaluation of plants used in traditional medicine for various ailments. The increased interest in plant derived drugs is mainly because of the wide spread belief that 'herbal medicine' is safer than costly synthetic drugs which possesses side effects. Hence, there is need to screen medicinal plants for promising biological activity. Further, there is a continuous development of resistant strains, which pose the need for search and development of new drug to cure diseases (Silver, 1993).

### *Cissus quadrangularis*

#### Classification

Class :Dicotyledons

Sub Class :Gamopetalae

Order : Vitales  
Family : Vitaceae  
Genus : *Cissus*  
Species : *C. quadrangularis*

### Description

Rambling, succulent, glabrous, deciduous shrubs; stem 4-angular, winged or ridged at angles, constricted at nodes; tendrils simple. Leaves simple, entire or 3-lobed, 2-5 x 2-5 cm, ovate-suborbicular or subreniform, base truncate, margin distantly spinulose-crenate, apex obtuse, thick-coriaceous; petiole to 1 cm long. Flowers in leaf-opposed, peduncled, umbellate cymes. Calyx-tube obscurely 4-lobed, c. 2 mm long, reddish. Petals c. 2.5 mm long, ovate, acute, greenish-yellow, recurved. Stamens 4; filaments to 2 cm long; anthers yellow. Disk 4-lobed, yellow. Ovary c. 1mm long, 2-celled; ovules 2 per cell. Berry 7 mm across, subglobose. Seeds black, smooth. A climber with stout stem, fleshy, quadrangular and contracted at the node. Branching is dichotomous. Flowers are in cymose inflorescence, whitish. Fruit globose, red when ripe. The climber is armed with long tendrils.

### Uses

*Cissus quadrangularis* extract, alone or with other ingredients, reduces weight by a small amount in people who are overweight or obese. Consuming the dried herb preparations or extracts can decrease pain and swelling and improve the rate of healing in people with various types of bone fractures. *Cissus quadrangularis* product for 8 weeks decreases pain and stiffness in men with joint pain caused by exercise. It helps to increase bone mass in people with low bone mass. This has severe effect towards allergies, asthma, body building, cancer, diabetes, gout, heart disease risk factors, that occur together (metabolic syndrome), High cholesterol, Loss of appetite (anorexia), Malaria, osteoporosis, pain, painful menstrual periods, peptic ulcer disease (PUD), rheumatoid arthritis, scurvy, seizures, upset stomach, wound healing etc.

### METHODOLOGY:

#### Collection of Plant Materials:

The plants used in the present study were collected from Kovallam village of Kanyakumari District, South India. The collected plants were recognized and validated in the Department of Botany, Holy Cross College (Autonomous), Nagercoil-4. The plant materials were washed thoroughly with water to remove the soil and dust particles. Further, they were dried in shade, grounded to fine powder form and stored in air tight container at room temperature before analysis.

**Phytochemical Analysis:**

**Tests for Carbohydrates:**

a) Benedict's Test:

Equal volume of Benedict's reagent and test solution in test tube were mixed. Heated in boiling water bath for 5 min. Solution may be appeared green, yellow or red, depending on the amount of reducing sugar present in test solution.

**Tests for Amino acid:**

a) Ninhydrin test:

3 ml of test sample and 3 drop of 5 % Ninhydrin solution were heated in water bath for 10 min and observed for purple or bluish colour.

**Tests for Protein:**

a) Biuret Test:

To 3 ml sample, 4 %NaOH and few drops of 1 % CuSO<sub>4</sub> solution was added and observed for violet or pink color.

**Test for Vitamins:**

Test for B<sub>2</sub> (Riboflavin):

Dissolve 1 mg in 100 ml of water. The solution has a pale greenish yellow colour by transmitted light and an intense yellowish green fluorescence by reflected light, which disappears on addition of mineral acids or alkalies.

**Test for Nicotinic Acid:**

a) Heat a small quantity with twice its weight of soda lime, pyridine is evolved.

- b) Dissolve 50 mg in 20 ml water, neutralize with 0.1 m NaOH, added 3 ml of copper sulphate ( $\text{CuSO}_4$ ) solution, a blue precipitate is formed.

**Tests for Vitamin C:**

- a) To 2 ml of a 2% w/v solution, add 2 ml of water, 0.1 gm of sodium bicarbonate and about 20 mg of ferrous sulphate, shake and allow standing, deep violet color is produced. Add 5 ml of 1 ml sulphuric acid, the colour disappears.

**Tests for Inorganic elements:**

- a) Test for Iron:

To 5ml test solution add few drops 2% potassium ferro cyanide. Dark blue coloration is observed.

**Tests for Tannins:**

With 2-6 ml test solution, following colour reactions were observed:

- a) 5%  $\text{FeCl}_3$  solution – Deep blue – black coloured.
- b) Acetic acid solution – Red colour solution.
- c) Dilute  $\text{HNO}_3$  –Reddish to yellow colour.

**Test for Phenolic Compounds:**

Ferric Chloride Test :

The extract was diluted to 5 ml with distilled water. To this, few drops of neutral 5% ferric chloride solution was added. A dark green colour indicates the presence of phenolic compounds

**Detection of Flavonoids:**

Lead Acetate Test :

The libermann – Buchard's test extracts were treated with few drops of 10 % lead acetate solution. The formation of yellow precipitate confirmed the presence of flavonoids.

**Test for Alkaloids:**

Wagner 's Test:

2- 3 ml filtrate with few drops of Wagner's reagent was added and observed for reddish brown precipitate.

**Test for Phlobatannins:**

Formation of red precipitate when aqueous extract of plant sample was boiled with 1% aqueous hydrochloride acid indicates the presence of phlobatannins.

**Test for Steroids:**

a) Salkowski Reaction:

To 2 ml of extract, 2 ml chloroform and 2 ml concentrated H<sub>2</sub>SO<sub>4</sub> was added. The chloroform layer turns red colour and acid layer showed fluorescence.

**Tests for Saponin Glycosides:**

a) Foam Test:

The drug extract or dry power was shaken vigorously with water. Persistent foam was observed.

**Determination of Antibacterial Activity:**

**Disc diffusion method:**

Preliminary screening of the extracts was carried out by disc diffusion method (Bauer *et al.*, 1966). Briefly, freshly grown liquid culture of the test pathogens (*Escherichia coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Bacillus subtilis*) were seeded over the nutrient agar plates with a sterile swab. Sterile filter paper discs of eight mm diameter were soaked with 40 µl of 50 mg/ml the extracts and air dried to evaporate the solvent and the discs were applied over the seeded MHA plates at equidistance. Control was also maintained.

The plates were incubated at 37°C for 18 – 24 h. After the incubation period, the plates were observed for a clearance zone around the discs which indicates a positive antibacterial activity of the respective extracts. The clearance zones formed around each disc were measured. Each experiment was carried out in triplicates.

**Phytochemical analysis of *Cissus quadrangularis***



Phytochemical analysis of *Cissus quadrangularis* was carried out by the following solvents: water, ethanol and chloroform. The water extract of *Cissus quadrangularis* possess different active components like carbohydrates, amino acid, protein, vitamin, nicotinic acid, vitamin C and saponin glycosides. The ethanol extract of *Cissus quadrangularis* possess different active components like carbohydrates, vitamin, nicotinic acid, inorganic elements, tannin, flavanoids and saponin glycosides. The chloroform extract of *Cissus quadrangularis* possess different active components like carbohydrates, protein, vitamin, nicotinic acid, vitamin C, phenolic compound and saponin glycosides. The phytochemical results of *Cissus quadrangularis* is depicted in the Table.

**Results for phytochemical analysis of *Cissus quadrangularis***

Sl. No	Name of the Plant	Extract	Carbohydrates	Amino acid	Protein	Vitamin	Nicotinic acid	Vitamin C	Inorganic elements	Tannin	Phenolic compound
1	<i>Cissus quadrangularis</i>	water	+	+	+	+	+	+	-	-	-
2		Ethanol	+	-	-	+	+	-	+	+	-
3		Chloroform	+	-	+	+	+	+	-	-	+

The similar results were seen in the research work of Jainu and Devi in (2004). Phytochemical studies of *Cissus quadrangularis* have shown the presence of various versatile constituents such as flavanoids, triterpenoids, vitamin C, stilbene derivatives and many others like resveratrol, piceatannol, pallidolperthenocissin and phytosterols. Out of which ascorbic acid, triterpene,  $\beta$ -sitosterol, ketosteroid, two asymmetrical tetracyclic triterpenoids and calcium were identified as major constituents of this plant. of Jainu and Devi

The investigation of Morimitsu *et al.* (2000), revealed that the phytochemical present in the different samples have many medicinal properties and it can able to cure many ailments.

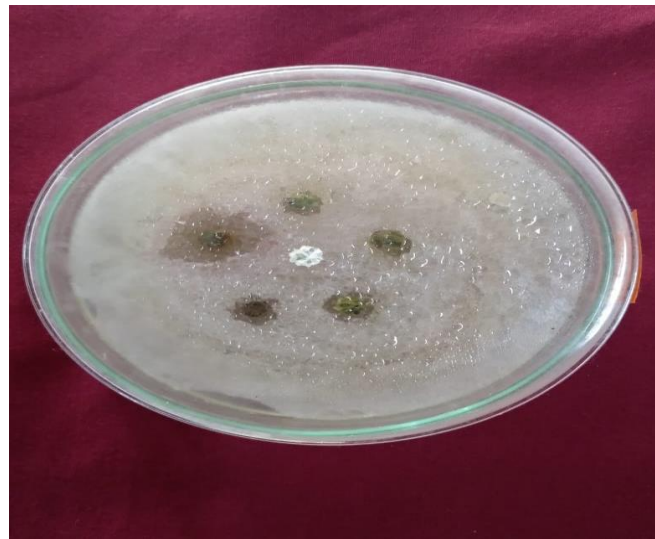
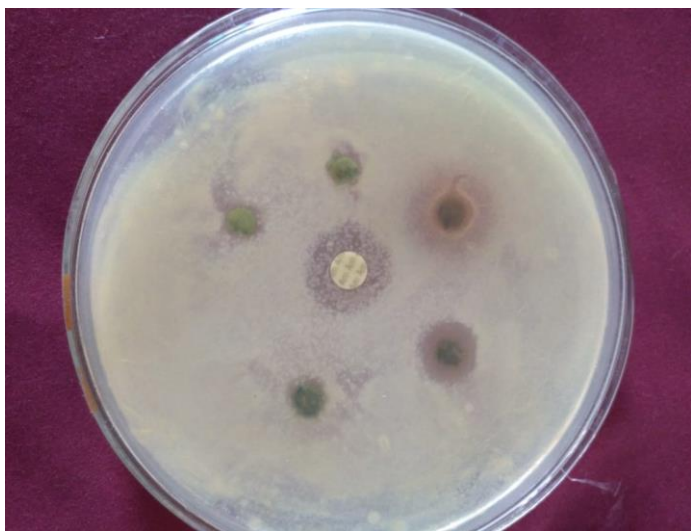
Alkaloid in *Cissus quadrangularis* stem is one of the largest phytochemical groups of compounds which have variety of medicinal properties such as it was used as a pain killer for much kind of diseases (Kam and Liew, 2002). The stem of *Cissus quadrangularis* was rich in flavonoids and it also has the antidiabetic activity. This type of flavones has the ability to inhibit the enzyme which regulates the glucose level in the blood (Farooq *et al.*, 2007).

The results of Priyanka Yadav in (2016), revealed similar indices that preliminary qualitative chemical tests of extract show positive results for alkaloid, flavonoids, triterpenoids, carbohydrates, tannins, protein, flavonoids and glycoside are the active constituents in stem and they are better extracted out by ethanol extract, having a high % yield of *Cissus quadrangularis* and may be responsible for its pharmacological activities. The results of screening test revealed the presence of medically active compounds. It could be seen that phenol, alkaloids, tannins and flavonoids were present in the ethanolic extract of *C. quadrangularis*, while saponin and carbohydrates were absent (Shabiet *al.*, 2014).

#### **ANTIBIOTIC SENSITIVITY TEST:**

Preliminary screening of antimicrobial activity was evaluated by using disc diffusion method against four human pathogenic bacteria. The antibiotic Ampicillin was used as standard. In *Cissus quadrangularis*, maximum zone of inhibition (6mm) was recorded against *Pseudomonas aeruginosa* and the minimal zone of inhibition (4.4mm) was recorded against *Staphylococcus aureus*. Abu Shanabet *al.*, (2004), explained that the infections caused by Gram negative bacteria were found to be multi-drug resistant, difficult to treat with conventional antibiotics. However, Gram negative bacteria have showed resistance effect in all cases (extract as well as ceftriaxone). The extract have remarked antibacterial activity against *Enterococcus faecalis* possessing maximum zone of inhibition. The variation of the susceptibility of microorganisms towards the *A. vasica* leaves extract attributed to the presence of several bio-active phytochemicals and their intrinsic properties that are related to the permeability to the cell surface of micro-organisms.

#### **Plate 8: Results For Antibiotic Sensitivity Test:**



## CONCLUSION

The present study clearly emphasized the presence of chemical constituents in all the selected medicinal plants. It was also concluded that antimicrobial activities of these plants against the pathogenic organisms, indicates the medicinal effect and supports the claim of traditional healers, that it has been used to relieve common symptoms and diseases. Considering the easy availability of these medicinal plants, there still exists a scope for scientific studies to explore its availability in medicinal field. Further studies are needed to isolate bioactive principles from the aqueous extracts. However, more clinical and pathological studies should be conducted to investigate the active potentials of bioactive compounds present in the plants.

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12.

**Bhagavad Gita – A lodestar of Leadership in Modern Era**

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**Abstract**

The Bhagavad Gita is one of the most precious religious scriptures. It holds the answers to all the problems of human life in this competitive world, be their personal or professional endeavours. In this paper, six major teachings of the Bhagavad Gita are analysed, which aids, to a large extent, in building the capacity of senior managers. The approach used in this qualitative research study is hermeneutics. Hermeneutics is a field that analyses the originality of writings using a technique of interpretation and understanding. Following discussion and analysis, findings were provided that will be very useful to managers in effectively managing subordinates toward goals and success.

**Key words:** Bhagavad Gita's philosophies, modern management, mentoring, strategic planning, principles of management.

**Introduction**

The Bhagavad Gita is one of the most holy religious scriptures in the world. It holds the answers to all of humanity's problems, whether personal or professional, in this competitive atmosphere. This study looks at six major Bhagavad Gita lessons that can assist senior managers significantly increase their capabilities. In this qualitative research endeavour, hermeneutics was used. Hermeneutics is a discipline of study that uses interpretation and understanding tools to analyse the originality of works. Following the conversation and analysis, managers were given recommendations that would help them manage their subordinates more effectively toward their goals and achievements.

### **The Bhagavad Gita's philosophies and modern leadership philosophies**

Most western management ideas are included in the Bhagavad Gita, such as achieving objectives, guiding one's work, and increasing performance, as well as defined goals, tactical planning, and strategy building. Management concepts based on the Bhagavad Gita and western management philosophies differ significantly. The Bhagavad Gita tackles concerns at the most fundamental level of human knowledge and life, whereas current management theories tend to focus on problems at the material, external, and peripheral levels. When a person has a good attitude, their activities will improve for the betterment of himself and society.

Regardless of the nature of the strategies used to achieve this, the attraction of materialism and an unquenchable quest for profit characterise contemporary management philosophy. Because of the West's enormous riches, "management by results" has piqued the curiosity of governments all over the world, including India. Western management ideas have also gained a lot of traction in our country's business and administrative divisions. The main reason for this tendency is because our people were unable to recognise and comprehend the lessons of our sacred writings, and many of them were lost during colonial administration.

### **Review of Literature:**

Singhal and Chatterjee have developed three definitional themes to better understand and study "spirituality at work," and have linked the employment relationship—loyalty—with

several other factors, including sociocultural, organizational, and individual, to present a framework in which the emergence of an issue from the private individual domain to the organisational domain is seen as having the potential to address concerns about eliciting commitment from employees in a tense work environment.

A study plan on the topic of spirituality in management was proposed by Pandey and Gupta, drawing on modern humanistic psychology and traditional Indian wisdom. According to Mukherjee, "spirit" refers to the life-breath that animates both people and organisations. He emphasises the significance of researching non-traditional means of learning beyond cognition that may increase leadership clarity in decision-making and relationship management, as well as pursue both personal fulfilment and organisational enrichment using knowledge from classical Indian wisdom.

Young investigates the notion of entrepreneurial learning and connects it to Deepak Chopra's seven spiritual principles of success, proposing triple-loop learning as the ultimate degree of entrepreneurial learning. Entrepreneurs who learn in three loops are more likely to follow the seven spiritual rules of success. Smith discusses the current positivistic and materialist business ethics paradigms' failure to adequately address the magnitude of the current business ethics crisis.

According to Narayanswamy, those who make a compelling case for spirituality in management education will earn better results. Sivakumar and Rao outline the steps to establishing an ethical organisational culture based on Indian ethos, which include explicitly articulating the organization's basic principles, choosing appropriate individuals, rewarding ethical behaviour, and monitoring unethical behaviour.

### **Research methodology and scope**

This is a descriptive research study. Hermeneutics approach is used in this qualitative research study. Hermeneutics is a field that employs a technique of interpretation, the study of textual originality with the assistance of other interpretations. It is a method of justification. This



approach is often used in the interpretation of sacred scriptures in the Jewish and Biblical exegetical traditions.

The focus of study is confined to the six Spiritual management beliefs offered by Bhagavad Gita and does not cover all of the ideologies presented by Bhagavad Gita.

## **Spiritual leadership Ideologies (SLI) in the Bhagavad Gita**

### **1. Meaningful work:**

The Bhagawad Gita states that one should continue to do good works without expecting anything in return, i.e., live a selfless life. In the words of Lord Krishna, "don't be infatuated with results; instead, focus your actions and energy on your profession." This provides the message to current managers that working efficiently and successfully may bring them success rather than running away from physical and monetary pleasures.

### **Guiding:**

A leader's greatest strength is that he or she should embrace rather than avoid issues. Leaders must be persistent in their efforts, unwavering in their determination, and unflappable in the face of adversity. A good leader does not lead out of fear or rage, but rather out of patience. Managers should focus their efforts on mentoring their employees rather than trying to dominate them.

### **Self-control**

Lord Krishna highlights three factors required for effective leadership: learning discipline, effective communication, and equanimity discipline. A competent leader must be able to learn in order to effectively educate his followers. To be an effective leader, he must be a good communicator as well as a good listener. He must also be truthful and show respect for the people. The manager should serve as a role model for his or her subordinates and be the first to protect them in times of crisis.

### **Self-Reliance**

Great leaders must be strong and willing, and they must not be scared of the repercussions of their decisions: Once a decision has been taken, the manager must implement it with excitement and confidence, and he must not retreat to his old position as a good leader; otherwise, he will lose his identity as a good manager. He should make the best of whatever has happened to him and learn from his mistakes and failings. Change is the one constant; there should always be changes, and a great leader must be willing to adapt to changing situations.

### **Emotional control**

They must be able to handle and manage pressure. The essential test of a manager is his ability to stay calm and collected under pressure. Krishna, for example, had a main purpose of assisting the Pandavas in defeating the Kauravas, yet he never lost patience and instead assisted the Pandavas.

### **Tactic**

Managers should design solid strategies: In the Mahabharata, Krishna recognises that the Kauravas would go to any length to win, so he carefully plans his strategy. He was paying close attention to their tactics. A successful leader must be a skilled thinker; only then will he be able to win and lead this fierce competition, and his organisation will thrive. These beliefs are extremely accurate and applicable in today's environment; one should always be on the watch for greed and malevolent purpose, and be prepared to face the consequences.

### **Discussions and findings**

The Gita urges us not to compromise our existing obligations for an unknown future. Working just for the anticipated benefits suggests that the quality of current job or duty performance suffers as a result of mental stress produced by worry about the future. Because there is uncertainty in every situation, the forecasts and goals made may not always be accurate. Managers' actions in such situations may not provide the desired effects. The Bhagavad Gita gives correct advice through the Nish Kama karma principle, which says that work should be done with no expectations of results.

Once the director's lower-order expectations are addressed, it should be rather straightforward to maximise his contribution to the firm and society. This, however, is not always the case. A low-paid nurse or self-employed carpenter, on the other hand, may exhibit higher levels of self-actualization despite lower work satisfaction. A sound mental health is a state of mind that can maintain or restore a tranquil, pleasant equilibrium. Internal consistency and calmness are necessary for a stress-free, healthy mind. The Bhagavad Gita's lessons assist managers in becoming more strong, disciplined, and strategic, as well as strengthening their abilities to coach and lead their employees to victory in any challenging scenario.

### **Conclusion**

Many organisations and institutions now offer Bhagavad Gita-based training to their top executives in order to improve personal and professional lives, as well as increase productivity and the development of confidence, courage, enthusiasm, bravery, and intelligence, all of which are required to become a successful leader, manager, or entrepreneur, etc. Many leaders in the national liberation struggle were influenced by the Bhagavad Gita. It helps managers maintain inner calm and strength in order for them to think, act, and resolve towards the ultimate aim of becoming a brilliant leader and effective manager.

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13.

**PREPARATION OF SILICA GEL FROM RICE HUSK ASH**

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**ABSTRACT**

Rice husk (RH) is a by-product of rice dehulling and rice husk ash (RHA) is generated by combustion in a separate boiler. Both RH and RHA are abundantly accessible in rice growing countries such as China, India, Brazil, the USA, and Southeast Asia. RH has therefore been recycled by burning it for energy production. This generates RHA, which contains a huge quantity (85–95%) of amorphous silica. Rice husk derived silica gel can be explored for one of the above application to replace high cost alkoxide (Eg. TEOS) derived silica products. During the past few years, numerous aerogel products have penetrated the commercial market. The starting material used plays an important role in deciding the final properties and total production cost. Sodium silicate-based aerogels have found wide applications owing to their cheap raw material cost. The ambient concentration for offering silica gel with size equivalent to that of commercial silica gel used in column chromatography has been verified in the present work

**INTRODUCTION**

Rice husk (RH) is the hard protecting natural covering present over the rice grains. Globally, the annual rice production is about 571 million tons which could consequently results approximately about 140 million tons of husk as waste after de hulling process in rice mills. Rice husk is an unutilized product agricultural waste which is abundantly available and causing environmental issues in countries like India, Taiwan, China, Indonesia, Philippines, etc.,

During milling of paddy 80% of weight is received as rice, broken rice and bran. The remaining 20% of weight corresponding to the paddy has been removed as RH. These RH

contains 70-90% organic matter like cellulose (50%), lignin(25%-30%) etc., and remaining constitute mineral components like silica (15-20%) and other minerals like Ti, Mg, Ca, in form of oxides (10-15%). At present, rice husk creates a disposal problem due to lack of commercial scope. In order to dispose the RH, it has been burnt in the field, which causes tedious environmental issues. Upon burning, RH yields ash content corresponding to the 60 to 80 % siliceous content and 20% to 40 % other minerals.

Under controlled condition the burning yields better quality of Rice Husk Ash (RHA), which can be evaluated by some analytical and chemical analysis. Completely burnt RHA yields, white colored mass – corresponding to pure silica (Figure 1), whereas partially burnt RHA appears to be blackish (Figure 1), due to presence of partially burnt char of organic constituents. The average composition of well burnt RHA is 90% amorphous silica, 5% carbon and 2%  $K_2O$ . The Bulk Density of rice husk is low and lies in the range of 90-130kg/m<sup>3</sup>.

Rice Husk is an excellent source of high grade amorphous silica. This silica has been a good material for the synthesis of very pure silicon, silicon nitride, silicon carbide and magnesium silicide. RHA that has amorphous silica content and large surface area can be produced by combustion of rice husk at controlled temperature, suitable incinerator as well as grinding method is required for burning and grinding rice husk in order to obtain good quality ash.

Rice Husk Ash as a pozzolanoic reactive material can be used to improve surface area of transition zone between the microscopic structure of cement paste and aggregate in the high performance concrete. Rice husk ash provides good compressive strength to the concrete. It is a by product hence it helps in cutting down the environmental pollution. The high silica content material makes it as a good supplementary cementitious material or pozzolanic admixture.

Rice Husk Ash is a green supplementary material that has application in small to large scale. It can be used for waterproofing. It is also used as the admixture to make the concrete resistant against chemical penetration. The main application of rice husk ash in the construction of High Performance Concrete. Since, the silica has different industrial applications in versatile forms, the possibility of using RH derived silica need to be explored more.

Column Chromatography is described as the useful technique in which the substances to be isolated are presented onto the highest point of a column loaded with an adsorbent, go through the column at various rates that rely upon the affinity of every substance for the adsorbent and the solvent mixture and are typically gathered in solution as they pass from the column at various time. The most common examples of stationary phases for column chromatography are silica gel while organic solvents are regarded as the most common mobile phase.

## **METHODS AND MATERIALS**

### **Materials**

RHA was collected from paddy field which is a residue from pyrolysis of rice husk. This pollution-carrying residue (RHA) was utilized as material in our work. All the chemicals are analytical grade and used without further purification. The HCl and NaOH solution of different concentrations were used.

### **Method**

#### **Acid Leaching Method:**

The aim of acid pre-treatment is to improve the purity of silica product. It proves to be an effective way in substantially removing most of the metallic impurities and production ash silica completely white in colour. It was conducted in a following manner. 10 grams of RHA samples were added to the 100 ml of 2M HCl. The solution was stirred and refluxed for about 1 h to remove the metal ion present in it. The solution is filtered through Whatmann No.41 ash less filter paper and then the filtrate is washed with water. The filtrate is dried in hot air oven for 20 minutes. The residues were used for silica extraction.

#### **Sodium Silicate Extract:**

The residue is added to 1M of NaOH which is dissolved in 100 ml of water. The solution is stirred and refluxed for about 2h . The solution is cooled and filtered. This step is to dissolve the silica and produce a sodium silicate solution. The solutions were filtered through Whatmann

No.41 ash less filter paper, and the carbon residues were washed and dried. The resulting sodium silicate extract is used for making silica aerogels.

### Synthesis of Silica Aerogel

The sodium silicate extract is taken in different proportion and made upto 100 ml and it is titrated against standard 1 M HCl with constant stirring to pH value 8. The solution is left over for the reaction

**Table :1.** Summary of Sample preparation.

<b>Samples</b>	<b>Volume of Sodium Silicate extract (ml)</b>	<b>Volume of water (ml)</b>	<b>Volume of HCl (ml)</b>	<b>Aging Time (hours)</b>
Sample 1	10	90	4	24 hours
Sample 2	20	80	9	
Sample 3	30	70	15	
Sample	40	60	22	

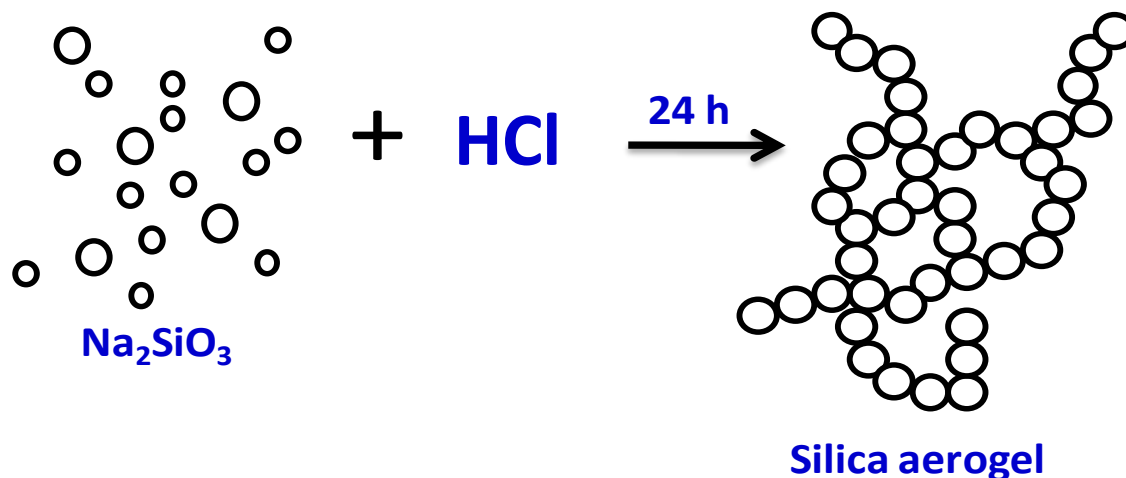




**Figure 1. Photograph of silica gel prepared using different concentration of sodium silicate**

## **RESULT AND DISCUSSION**

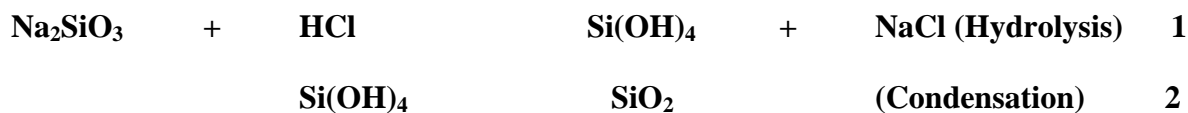
### **Formation of Silica:**



**Figure 2. Schematic representation of formation of silica aerogel**

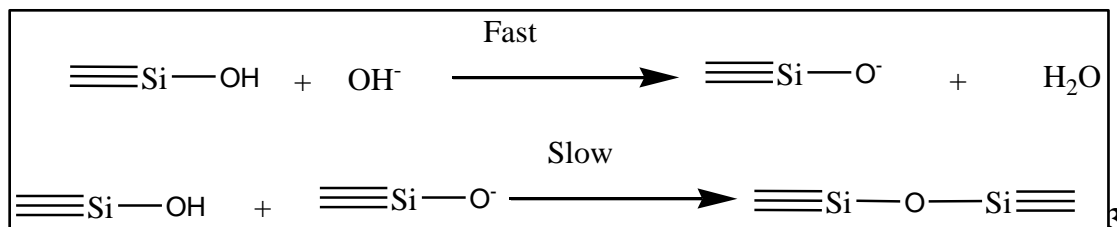
**Mechanism of formation :**

The sol–gel process is a two-step reaction, i.e., hydrolysis followed by condensation as stated in equations 1 and 2. In the first step, sodium silicate reacts with water in the presence of an acid to form silicic acid and a sodium salt, followed by poly condensation, delivering a silica gel as the final product (figure 2). The poly condensation reaction can be assessed by Si Nuclear Magnetic Resonance Spectroscopy up to the sol–gel transition point, where the lines increase rapidly in width and become practically unobservable due to the low concentration of Si in the hydrogels. The gelation time is inversely proportional to the rate of gel formation. The mechanism was presented in detail in the study by M-Jose et al. in 1997.



It is important to state that the process of hydrolysis is rapid, while the condensation process is very slow. Because, the hydrolysis process depends on the role of acid concentration as well as base concentration i.e., sodium silicate. However, in the case of condensation, the

silanol groups combine together with each other in order to form silicate network as represented in the equation 3.



### Optimization through concentration of Na<sub>2</sub>SiO<sub>3</sub>

Difference concentration of Na<sub>2</sub>SiO<sub>3</sub> during the titration against the HCl of known concentration could able to form neutralized product silicate, which can be of different size. This could be due the presence of variable concentration of silicate precursor. However, each and every concentration of sodium silicate upon hydrolysis with HCl could able to results in silica gel as shown in Figure 2. In order to validate the formation and particle size of silica formed, different analytical techniques were used.

### Particle size analysis:

Based on the concentration of silicate precursor, it was noticed that there is big difference in the particle resulted after drying. polymers, Silanol groups are easily react with each other forming silica particles bridged with silicate network. The silica surfaces has hydrogen bonding as well as electrostatic forces of attraction, which could able to form big clusters of gel particles. As evidenced from the corresponding particle size distribution curves presented in Figure 1, it came to know that sample prepared with higher concentration of silicate seems to have comparatively higher value.

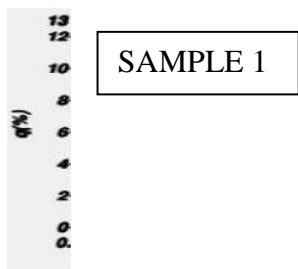


Figure 3 Particle size distribution curve of silica aerogel sample 1



Figure 4 Particle size distribution curve of silica aerogel sample 2



Figure 5 Particle size distribution curve of silica aerogel sample 3

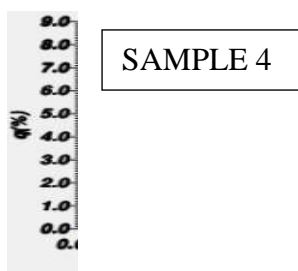


Figure 6 Particle size distribution curve of silica aerogel sample 4

Table -2 Particle size distribution and means size

Sample No	Volume of Sodium Silicate	Partacle Size( $\mu\text{m}$ )	Median
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	Solution (mL)		Particle Size
Sample 1 (Direct)	10	2 $\mu$ m-110 $\mu$ m	8 $\mu$ m
Sample 2	20	4 $\mu$ m-150 $\mu$ m	40 $\mu$ m
Sample 3	30	20 $\mu$ m-200 $\mu$ m	55 $\mu$ m
Sample 4	40	4 $\mu$ m-150 $\mu$ m	50 $\mu$ m

From the table, it can be seen that SAMPLE 1 with lower volume i.e., 10 ml of sodium silicate is titrated against 4 ml of HCl give the lower particle size ranges 2  $\mu$ m-110  $\mu$ m. SAMPLE 2 with volume of 20 ml of sodium silicate is titrated against 9 ml of HCl gives the medium particle which ranges 4  $\mu$ m-150  $\mu$ m. SAMPLE 3 with volume of 30 ml sodium silicate is titrated against 15 ml of HCl give the higher particle size ranges from 20 $\mu$ m-200  $\mu$ m. SAMPLE 4 with volume of 40 ml sodium silicate is titrated against 22 ml of HCl give the particle size ranges from 4  $\mu$ m-150 $\mu$ m. By comparing the samples we can see the particle size of each samples increases at the higher concentration and the size of the particle is lowered at certain concentration. This could be strongly evidenced from the particle size of sample 3, which has been prepared using 30 ml of sodium silicate shows particle size close to 20 to 200 micrometer. It means at the optimum concentration of sodium silicate is 30 ml from the stock solution.

#### CONCLUSION:

During the past few years, numerous aerogel products have penetrated the commercial market. The starting material used plays an important role in deciding the final properties and total production cost. Sodium silicate-based aerogels have found wide applications owing to their cheap raw material cost. The ambient concentration for offering silica gel with size equivalent to that of commercial silica gel used in column chromatography has been verified in the present work. It came to know that 30 ml of the stock solution is used to prepare the silica gel with particle size ranging from 20 to 200 micrometer. The important parameters such as molar ratio, sol pH, gelation time, aging, washing, solvent exchange, and

silylating agents used can alter the physio-chemical characteristics of aerogels, offering distinct properties depending upon the specific applications, which will be explored in future.

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14.

**INSILICO MOLECULAR DOCKING AND ADMET TOXICITY STUDIES OF  
CINNAMALDEHYDE POLYESTER (CPE)**

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**ABSTRACT**

Heterocyclic compounds are widely used in life sciences and technology. They find their application in the drug industry also. Oxadiazole is a heterocyclic compound belonging to the class of diazoles which exhibit a wide variety of pharmacological activities like anti-bacterial, anti-fungal, anti-oxidant, anti-inflammatory, anti-cancer, anti-tumour, analgesic, due of the ability of the oxadiazole. Hence, we focused our attention on the study of biomedical application of aromatic polyesters containing substituted oxadiazole ring in their back bone.

**Keywords: Oxadiazole, Polyesters, Anti-cancer, toxicity, Molecular docking**

**INTRODUCTION**

Polymer is a class of materials which all of us use in our day-to-day life. They are the main constituents in our food, clothes, human bodies etc. Hence it is important for every chemist to understand its importance, properties and applications<sup>[1]</sup>. Application of polyesters is that they can be used in industries because of excellent properties like high tensile strength, abrasion, resistance, and resilience and also used in making films for they are of good balance between mechanical strength and barrier properties against oxygen, smells and oils<sup>[2]</sup>. Computational studies are the crucial steps in the drug designing. There are numerous areas of computational studies and one of them is identification of relationships between chemical structures and properties and recognized as QSAR. Quantitative structural activity relationship practices



molecular parameters to enumerate a pharmacological or chemical property for a set of molecules<sup>[3]</sup>. Docking study is the computational routine to determine probable binding manners of a ligand to the dynamic site of a receptor. It makes an image of the dynamic site with interaction points known as grid. Then it fits the ligand in the binding site either by grid search or energy search<sup>[4]</sup>.

## **MATERIALS AND METHODS**

In this study, in silico molecular docking and ADMET toxicity studies were carried out using BIOVIA Discovery Studio (DS) 2017 software.

Polymeric Compound used:

The above polymer was synthesized and characterized by Subha et al[34]. As an application part in the present investigation, the polymer was subjected to molecular docking and ADMET toxicity studies.

### **Preparation of protein for anti-bacterial and anti-cancerous analysis**

The X-ray diffraction-based Crystal Structure of human HDAC8 complexed with SAHA (PDB ID: 1T69) with a resolution 2.91 Å for Anti-cancer and Structural insight into the quinolone-DNA cleavage complex of type IIA topoisomerases (PDB ID: 3FOF) for anti-bacterial analysis were selected. Hydrogen were added to the protein 1T69 and 3FOF applied by the Forcefield algorithm, subsequently the energy of protein was minimized using CHARM forcefield in DS.

### **Ligand preparation**

The polymer and standard drug Pazopanib, Moxifloxacin were drawn in chemdraw software, subsequently, energy minimized and saved in SDF file format for docking studies.

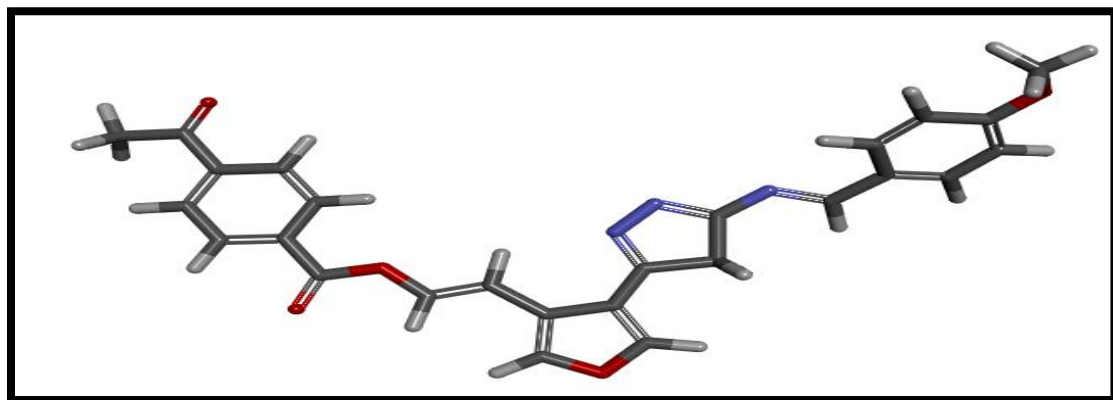
### **Docking study**

A molecular docking study was executed, to evaluate the most preferred geometry of the protein-ligand complex. A computational docking study was used to inspect structural complexes of the 1T69 and 3FOF with polymer in order to understand the structural basis of these target proteins. Possible binding modes between the ligands and these target proteins were analysed by CDOCKER (CHARMm-based DOCKER) protocol incorporated within DS. The algorithm offers full ligand flexibility and employs CHARMm force fields. Ligand binding affinity was calculated using CDOCKER energy, CDOCKER Interaction energy, Hydrogen bonds, binding energies, protein energy and ligand-protein complex energy. The CDOCKER energy is mentioned in negative values. More negative value energy is indicated as a higher binding affinity of the ligands with the target protein.

#### **ADMET Toxicity Analysis for Cinnamaldehyde polyester (CPE)**

Absorption, distribution, metabolism, elimination, and toxicity (ADMET) properties were predicted using ADMET descriptors in Discovery Studio (Accelrys, San Diego, CA, USA). The module uses six mathematical models, to quantitatively predict properties by a set of rules/keys that specify threshold ADMET characteristics for the chemical structure of the molecules based on the available drug information: ADMET absorption predicts human intestinal absorption (HIA) after oral administration. The model was developed using 199 compounds in the training set based on the calculations AlogP (ADMET AlogP98) and 2D polar surface area (PSA 2D). The absorption levels of HIA model are defined by 95% and 99% confidence ellipses in the ADMET PSA 2D, ADMET AlogP98 plane. The model is based on a genetic partial least squares method on a training set of 784 compounds with experimentally measured solubilities.

#### **RESULT AND DISCUSSION**

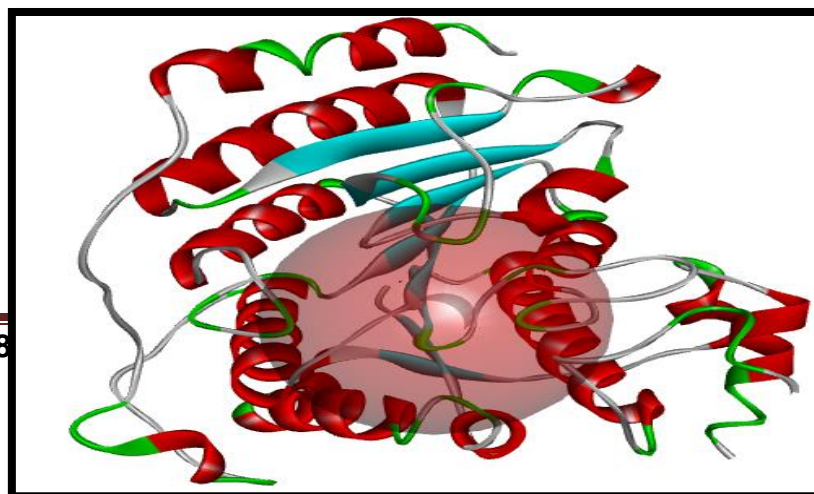


**Fig 1 3D structure of the Cinnamaldehyde polyester (CPE)**

### Anti-cancer activity

In silico anti-cancer activity of the Cinnamaldehyde polyester (CPE) was analysed in molecular docking studies. In this docking analysis Pazopanib used as a standard drug for compare the binding activity of the Cinnamaldehyde polyester (CPE) and Crystal Structure of human HDAC8 complexed with SAHA (PDB ID: 1T69) was used for target protein (Fig2). The CDocker binding energy of the Cinnamaldehyde polyester (CPE) and the standard drug were listed in Table 1. From the docking result the Cinnamaldehyde polyester (CPE) has higher binding affinity compared to the standard drug. Fig 3 and Fig 4 shows the 3D and 2D binding interactions of the Cinnamaldehyde polyester (CPE). In this molecular docking analysis,

The Cinnamaldehyde polyester (CPE) formed one strong hydrogen bond interaction with Arg 37 amino acid of the human HDAC8 receptor. The hydrogen bond length is 2.1Å. The His 180 amino acid formed Pi-Sigma interaction with the Hydrogen atom of the Cinnamaldehyde polyester (CPE) (Fig 4.4). Additionally, the aromatic benzene group of the Cinnamaldehyde



polyester (CPE) formed two Pi-Pi stacked interaction with Phe 208 and Phe 152 amino acids respectively. Similarly, Sis 153 shows Pi-Alkyl interaction with benzene group of the Cinnamaldehyde polyester (CPE). The other active site amino acids of the human HDAC8 receptor shows non bonded Vander Waals interaction with Cinnamaldehyde polyester (

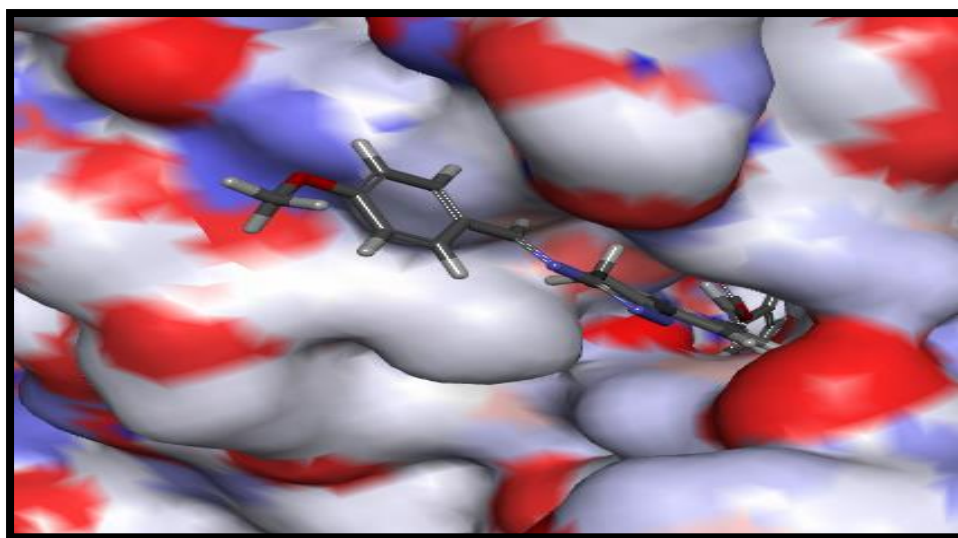
**Fig 2 Secondary structure of the human HDAC8 receptor with active site sphere**

CPE) and shows higher binding energy of this polyester. The above overall interactions increases the CDOCKER energy value to 26.3461 Kcal/mol of Cinnamaldehyde polyester (CPE).

Molecules	CDOCKER energy (Kcal/mol)
Cinnamaldehyde polyester(CPE)	26.3451
Pazopanib	22.3864

**Table 1 CDOCKER energy of the polymer in human HDAC8 receptor**

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**Cinnamaldehyde polyester (CPE) with the human HDAC8 receptor.**

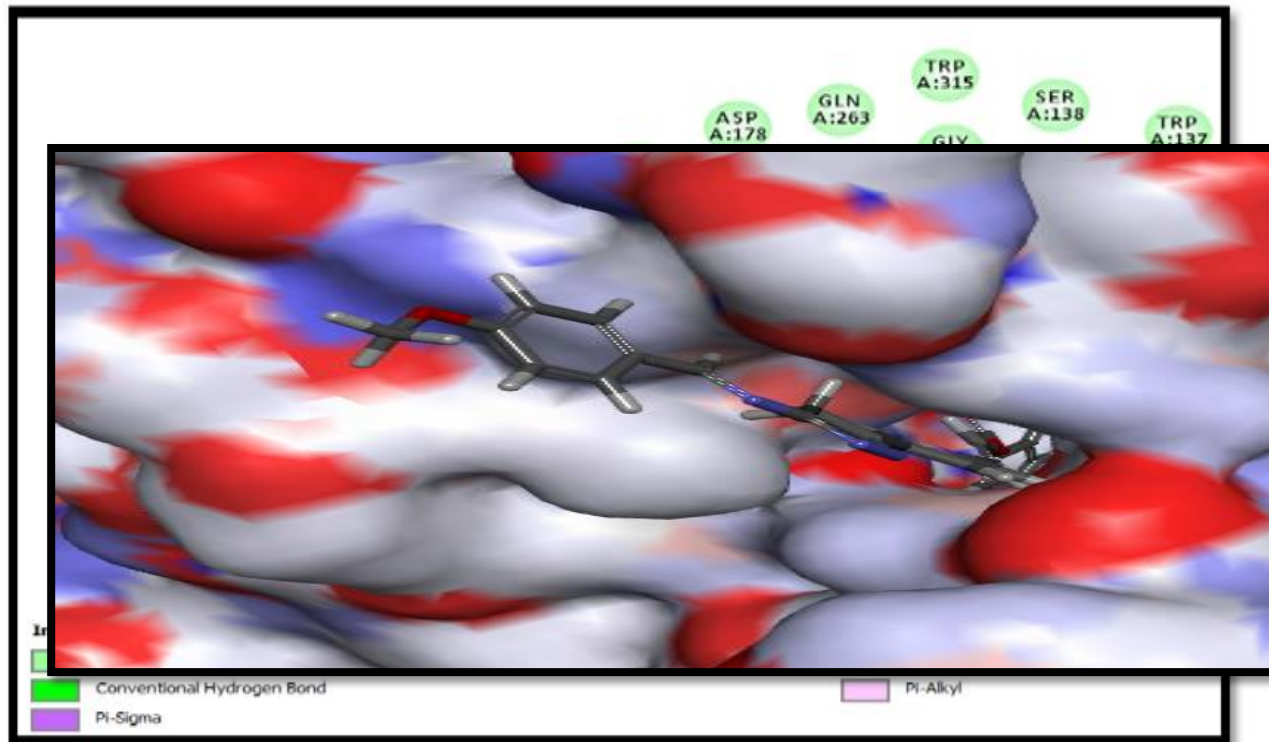
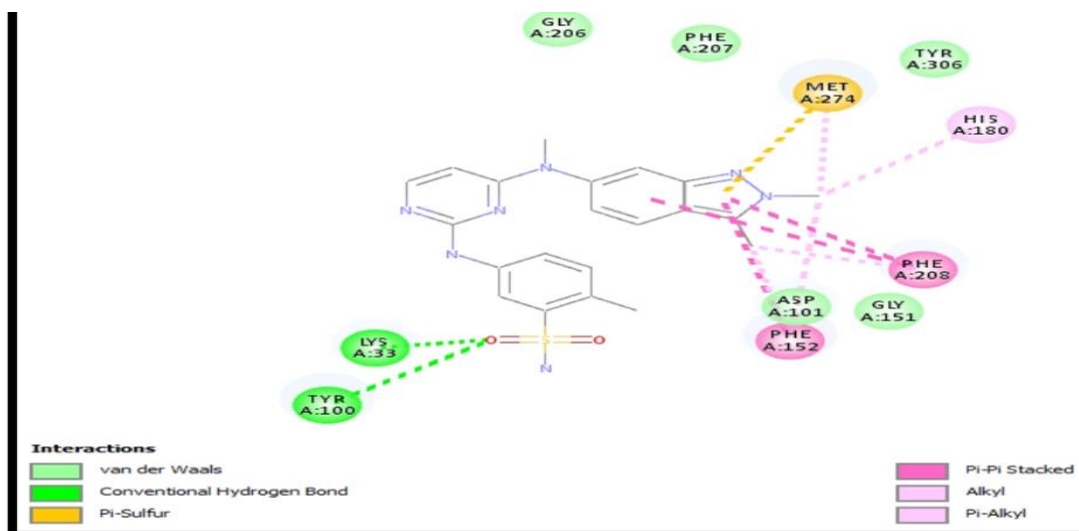


Fig 4 2D binding interaction of the Cinnamaldehyde polyester (CPE) with the human HDAC8 receptor

Fig 5 3D interaction of the pazopanib drug in human HDAC8 receptor



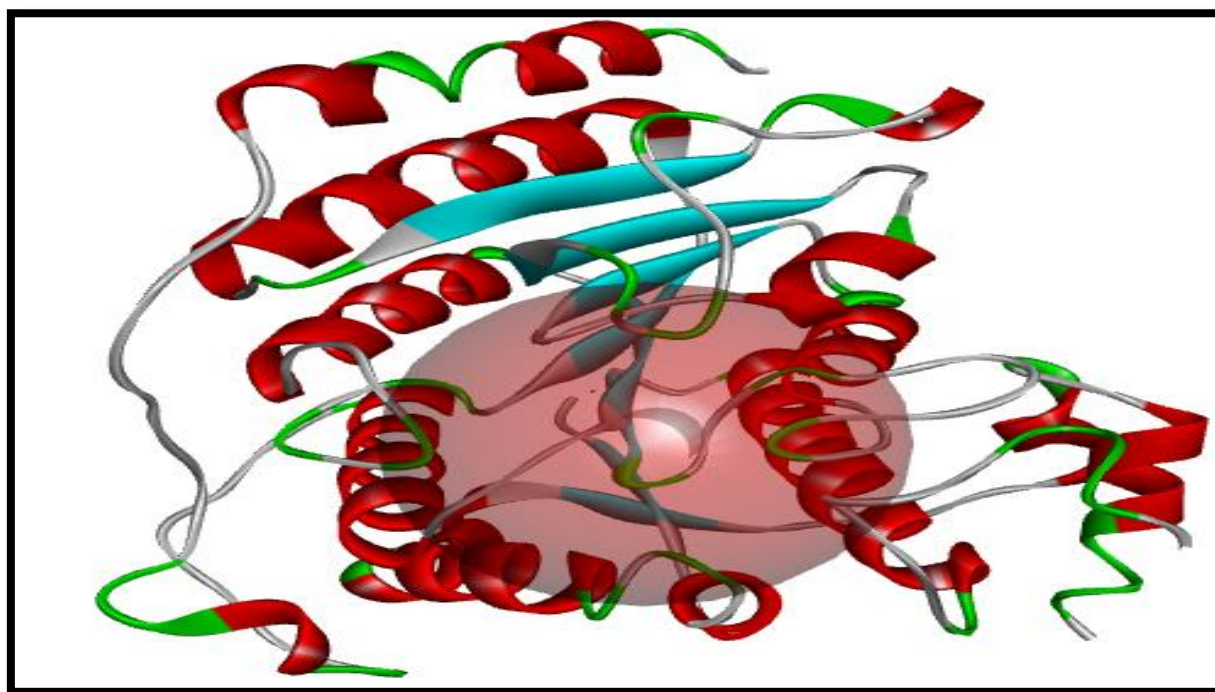


**Fig 6 2D interaction of the pazopanib drug in human HDAC8 receptor**

In this anti-cancer molecular docking studies, Pazopanib drug used as standard for compared activity of the Cinnamaldehyde polyester (CPE). The DOCKER energy of the Pazopanib is 22.3864 Kcal/mol. Its shows low binding energy compared to the polymer. 3D and 2D interactions of the pazopanib shows in Fig 5 and Fig 6. The ketone group of the Pazopanib forms two strong hydrogen bond interaction with Lys 33 and Tyr 100 residues. The Phe 152 and Phe 208 forms Pi-Pi stacked interactions with Pazopanib drug.

**Antibacterial activity**

The secondary structure of the quinolone-DNA cleavage complex of type IIA topoisomerases receptor is shown in Fig 7. In this in silico molecular docking studies of antibacterial activity, moxifloxacin used as a standard drug. From the result, the Cinnamaldehyde polyester (CPE) shows good binding affinity compared to the moxifloxacin drug.



**Fig 7 Quinolone-DNA cleavage complex of type IIA topoisomerases**

Molecules	CDOCKER energy (Kcal/mol)
Cinnamaldehyde polyester(CPE)	27.2594
Moxifloxacin	20.3572

Table 2 CDOCKER energy of the Cinnamaldehyde polyester in type IIA topoisomerases receptor

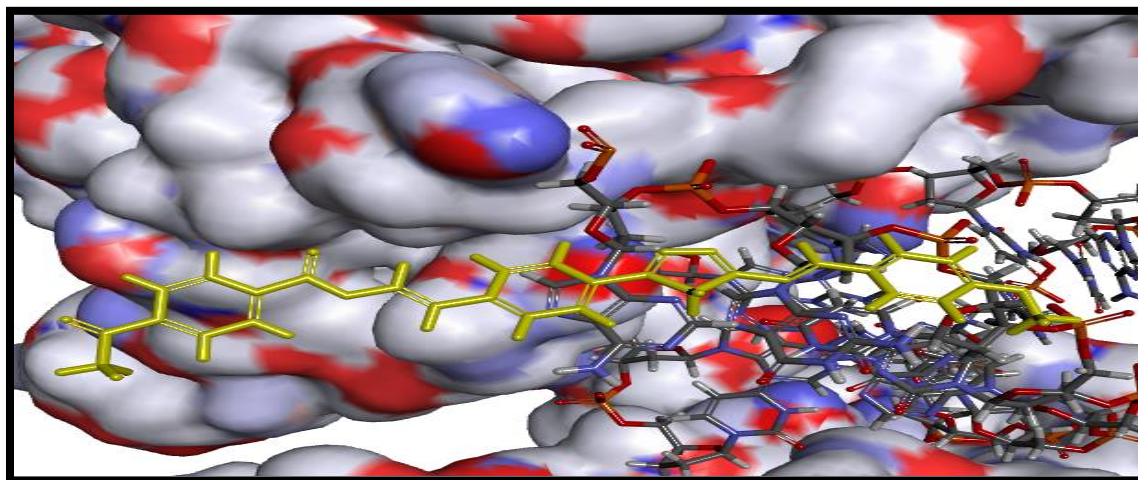
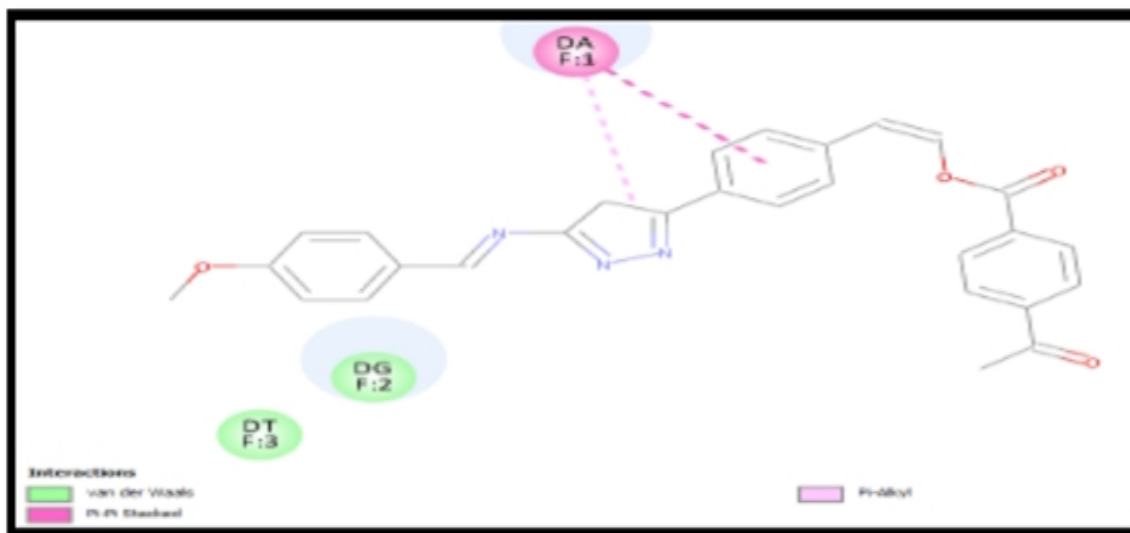
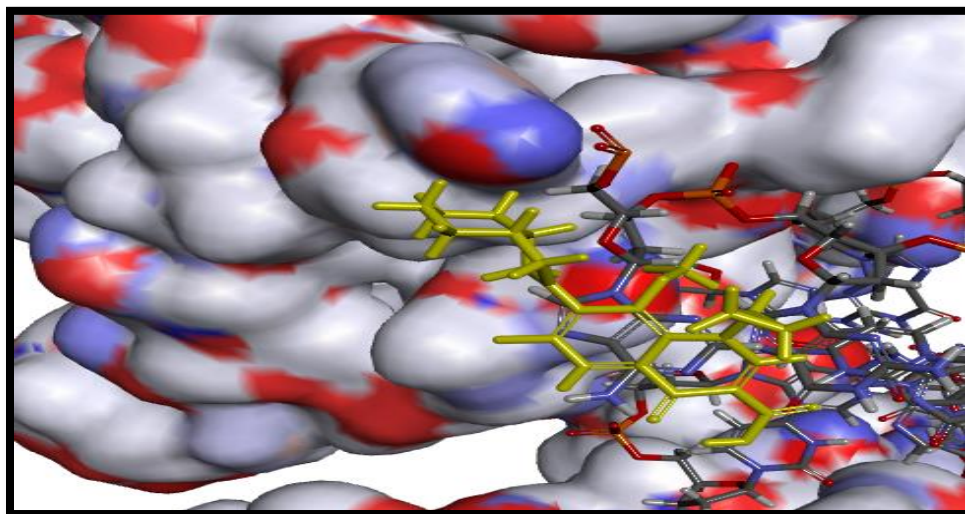


Fig 8 3D binding interaction of Cinnamaldehyde polyester (CPE) with the type IIA topoisomerase receptor



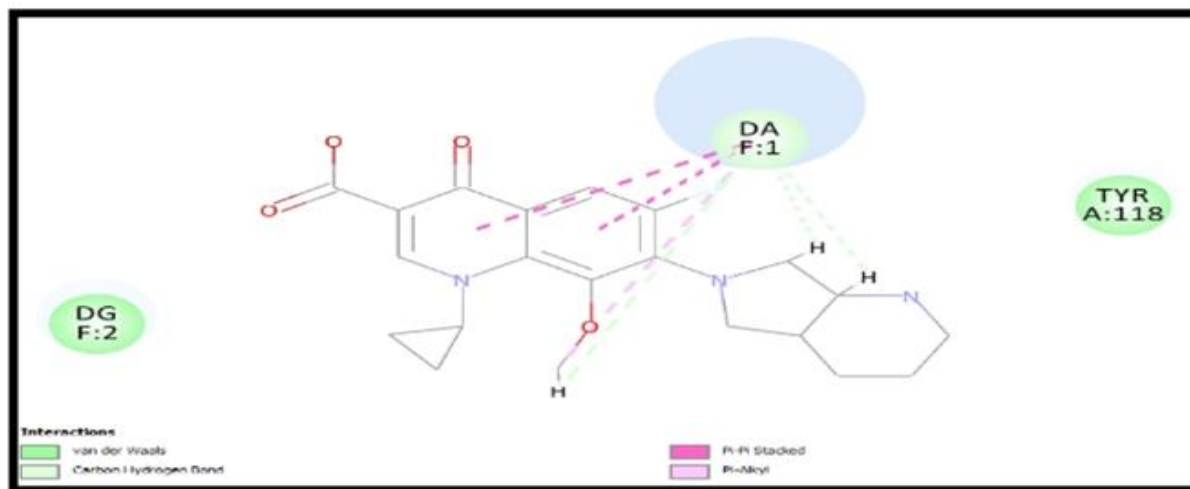
**Fig 9 2D binding interaction of Cinnamaldehyde polyester (CPE) with the type IIA topoisomerases receptor**

In this anti-bacterial docking studies, the Cinnamaldehyde polyester (CPE) was integration with the DNA which bind with the type IIA topoisomerases receptor. This polymer forms Van der Waals interaction with guanine and thymine nucleotides. Further the benzene group form Pi-Pi stacked interaction with adenine nucleotide. The CDOCKER energy of the polymer is 27.2594 Kcal/mol. The moxifloxacin drug shows low binding energy (20.3572 Kcal/mol-1) compared to the Cinnamaldehyde polyester (CPE). It forms carbon hydrogen bond with adenine of the DNA.



**Fig 10 3D binding interaction of moxifloxacin with the type IIA topoisomerase receptor**





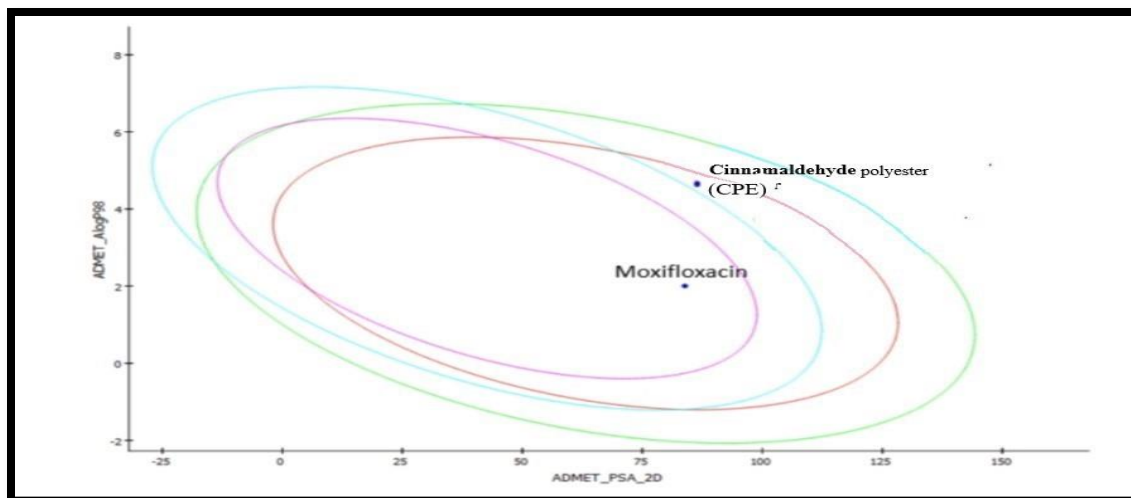
**Fig 11 2D binding interaction of moxifloxacin with the type IIA topoisomerase receptor**

### ADMET analysis

Chemical absorption, distribution, metabolism, excretion, and toxicity (ADMET) play key roles in drug discovery and development. A high-quality drug candidate should not only have sufficient efficacy against the therapeutic target, but also show appropriate ADMET properties at a therapeutic dose. A lot of in silico models are hence developed for prediction of chemical ADMET properties. However, it is still not easy to evaluate the drug-likeness of compounds in terms of so many ADMET properties.

The ADMET result of the Cinnamaldehyde Polyester (CPE) is declared in Table 4.3 and the plot of polar surface area (2D PSA) and AlogP for this compound is represented in Fig 4.12. The intestinal absorption and blood brain barrier penetration were predicted by 2D PSA and AlogP that include 95% and 99% confidence ellipses in ADMET study. The region of ellipses defines, where the compound is expected as well absorbed. The absorption level (human intestinal absorption-HIA) of the molecule shows good absorption (value 0 as good absorption). The absorption levels of HIA model are defined by 95% and 99% confidence ellipses in the ADMET. Similarly, aqueous solubility of the compound has good solubility and absorption nature in aqueous media. Further, all compounds are satisfactory with respect to CYP2D6 liver, suggesting that PA are non-inhibitors of CYP2D6. The model orders either as “toxic” or “nontoxic” and gives a certainty level pointer of the probability of the model’s prescient

exactness. Our results indicate that the compound is nontoxic to liver and thus they experience significant first-pass effect. According to the model for the compound to have an optimum cell permeability should follow the criteria ( $PSA < 140 \text{ \AA}^2$  and  $AlogP98 < 5$ ). Further, the hepatotoxicity level of the molecule was calculated, the molecules with liver toxic nature were filtered out. Similarly, the molecule was found to be satisfactory with respect to CYP 450 2D6 liver enzyme, suggesting that the derivative molecules were non inhibitors of the metabolic enzyme. Finally, the PPB prediction denotes that all the molecules have binding  $\leq 90\%$  clearly revealing that the molecule have good bioavailability and are not likely to be highly bound to carrier proteins in the blood. The compound showed polar surface area as  $(PSA) < 140 \text{ \AA}^2$ . Since the AlogP98 criteria, the compound had AlogP98 value  $< 5$ . From the result of ADMET, it is founded that the molecule have drug likeness properties and also it will be useful as a potent new drug in anti-cancer and anti-bacterial activity.



**Fig 12 ADMET prediction analysis of Cinnamaldehyde polyester (CPE) and moxifloxacin drug.**

**Table 3 ADMET properties of Cinnamaldehyde polyester (CPE)**

Mol. Name	Absorption level	Solubility level	BBB level	PPB level	Hepatotoxic level	CYP 2D6	PSA 2D	AlogP98
Cinnamaldehyde Polyester(CPE)	Good	Good	Low	<90%	No	No	45.24	3.48
Moxifloxacin	Good	Good	Low	<90%	No	No	82.34	4.19

## CONCLUSION

In this study we have used human HDAC8 receptor and quinolone- DNA cleavage complex of type IIA topoisomerases identified as best anticancer and antibacterial target.

Molecular docking results displayed Cinnamaldehyde polyester (CPE) showed the better docked score with good binding affinity comparable to the standard drug.

Also, these polymer show good drug likeness properties. From these in silico results, in future we can use this polymer as suitable drug molecules in anti-cancer and anti-bacterial activity.

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**PROCESS DEVELOPMENT FOR TEXTILE DYE REMOVAL BY BIO-SORPTION  
USING HYBRID HYDROGEL**

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**ABSTRACT**

As the global economy grows day by day and the world urbanizes, it also has led to alarming levels of pollution for both the mankind and the environment. Water pollution is considered to be a major concern of pollution as every day about 2 million tons of industrial and agricultural waste and sewage is discharged directly into water bodies without being treated. The World Bank estimates that the textile dyeing and treatment alone contributes about 17 – 20 % of the total industrial water pollution. One of the most promising methods for water purification is adsorption due to its high adaptability and comparatively low cost. So, for purification technique hybrid hydrogel is the best adsorbent to treat textile effluents. As adsorbents, hydrogels have a strong impact on the treatment of dyes and heavy metals ion due to the presence of hydrophilic functional groups such as carboxylic acid, amine, hydroxyl and sulfonic acid groups could be used as complexing agent for the removal of metal ions from aqueous solutions. Chitosan is a linear, natural cationic polymer that was chosen to treat effluents. As it has low mechanical strength and thermal stability, polyvinyl alcohol which is a hydrophilic, biodegradable compound and a cross linking agent Glutaraldehyde was blended with chitosan as a good adsorbent for Reactive black 5 dye that we have chosen. The effecting parameters on adsorption of dyes such as concentration of dyes, temperature, pH, incubation time and solid- liquid ratio were studied and the maximum adsorption for each parameters were found to be 96.7%, 98%, 89.6%, 96.7%, 97.1% respectively at 50 ppm. The adsorption isotherms were analysed in different solid- liquid ratio using Langmuir, Freundlich and Temkin models and the best fit of adsorption data was observed in Langmuir model with  $R^2$  value of 0.9238. The Swelling capacity of hydrogel was found to be increased to 1.37 times the initial dry weight of the gel. The

continuous fixed bed reactor was also designed and the adsorption analysis were performed by packing the chitosan-PVA-G hydrogel onto the column for the adsorption of Reactive black 5 dye. The response surface methodology was also constructed and the maximum adsorption of 93.8% was observed at 50 ppm of dye for 180 min.

**Keywords:** Hybrid hydrogel, Chitosan, Polyvinyl alcohol, Glutaraldehyde, Reactive Black 5 dye, Adsorption isotherms

16

**Conversion of Lord Shiva and Anju in Amish's *Shiva Trilogy* and Divakaruni's *Sister of My Heart and Vine of Desire***

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**DivyadharshiniR, Research Scholar**

**Dr. D. Divya, Head of the Department**

**Dr. Thamayanthi, Assistant Professor**

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**Dr. SNS Rajalakshmi Arts and Science College**

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**Abstract**

Every human being had its own identity and land. Human beings don't choose the land of their own, it has been decided by the almighty. People often change their places for money, pleasure, and happiness. They create their own identity in foreign land either by succeeding or by failure. Foreign land never becomes our heritage and freedom. In the series, *Shiva Trilogy*, Lord Shiva comes from a foreign land to India as a refugee and became Lord Neelkanth. As such, *Sister of my Heart and Vine of Desire* depicts the role of Anju, who identified herself in the foreign land. Relating Lord Shiva's character to Anju *Sister of My Heart and Vine of Desire*. Transforming their life in a foreign land and finding their identity on the right path.

Amish's plot in *Shiva Trilogy* leads to the main characterization of Lord Shiva, who came from Tibet to India as a refugee. Before coming to India, the writer had beautifully portrayed Lord Shiva,

Shiva! The Mahadev. The God of Gods. Destroyer of Evil. Passionate lover. Fierce warrior. Consummate dancer. Charismatic leader. All-powerful, yet incorruptible. Quick wit, accompanied by an equally quick and fearsome temper. (The Immortals of Meluha)

Lord Shiva is considered to be a supreme god in India. Devotees of Lord Shiva follow his principles and always have the fear of him. People always have faith in Lord Shiva in

everything. Amish made an explicit attempt to recreate Lord Shiva into a normal human and turn him into God again.

Tripathi had initially decided to write a book on the philosophy of evil but was dissuaded by his family members, so he decided to write a book on Shiva, one of the Hindu Gods. He decided to base his story on the fundamental concept that all Gods were once human beings; it was their deeds in human life that made them famous as God.

Sister of My Heart is the story of Anju and Sudha, two young women from Calcutta, the city of their childhood, who after a year of living separate lives are rekindling their friendship in America. Together they experience the joys, pains, mystical tales, and tiresome tasks that accompany growing up in a traditional Indian house in Calcutta. Their exceptional bond remains the core of the novel as their affection for each other increasingly shapes the course of their lives.

The deep-seated love they feel for each other provides the support they need. It gives Anju the strength to pick up the pieces after a personal tragedy, and Sudha the confidence to make a life for herself and her baby daughter, Daywithout her husband. The unlikely relationships they form with men and women in the world outside the immigrant Indian Community as well as their families in India profoundly transform them. The story ends with Anju's metaphorical declaration, "I've learned to fly" (SMH 318).

Divakaruni deals with a new facet of the immigrant experience in the sense that the movement is not necessarily a physical one or from east to west. Sudha decides that she is not interested in America anymore and likes to go back to her home in Bengal. Thus, the author wants to tread new ground. Readers like the novel's simplicity as it does not try to do too many things at once.

The plot focuses on the relationship between the two young girls, from the shared experiences of their youth to the varied experiences of their married lives. The scenes of forbidden love, demanding parental expectations, and difficult in-laws are, predictable. Her poetic language, elaborate descriptions, and symbolism are really at a higher level.

Divakaruni does a good job of creating suspense and can draw the reader through the novel simply by its suspense. We find at the end of the novel, from his letter, that he is the father of Sudha and he is not the murderer of Anju's father and what Pishi says is not true. Some critics

are also disappointed that Divakaruni stretches things a bit when she created the basis of the story, concerning the death of Anju and Sudha's fathers.

In the second half of the novel titled *The Queen of Swords* Sudha quickly learns the ways of her demanding and controlling mother-in-law. Meanwhile Anju's life in the United States has not entirely turned out as she expected. Anju and Sudha exchange letters and short phone calls, but their old intimacy is missing. The friends discover they are pregnant at the same time and both seem finally happy. Sudha's mother-in-law insists to abort her baby because she comes to know that it is a girl baby. She believes that the first child must be a son.

Sudha is not able to turn, leaving her husband must be grounds to talk to each other again as true sisters. Refusing to tie her life to another man and realizing Anju needs her, Sudha and her daughter decide to go to the United States.

After many years, the sisters are reunited, but future obstacles still loom. Whether set in America, or India, the plot features Indian-born women torn between old and new values. They provide the readers a many-layered looks at the characters and their respective worlds. The characters in the novel are filled with dreams, desires, and pain, and struggle to lead with hope and discovery. Whether in California or Calcutta, women learn to adapt to their new and changing culture and as a result, discover their own sense of self amidst joy and heartbreak.

Ironically, in her attempts to make the novel unique Divakaruni seems to have made it melodramatic and hence, stereotypic of South Asian movies. She simply develops the story between the two sisters without trying to create grandeur where it was not needed. Regardless, this is a highly emotional and beautiful written novel. Through the eyes of people caught in the clash of cultures, and by constantly juxtaposing Calcutta with a California city,

Divakaruni reveals the rewards and the perils of breaking free from the past and the complicated, often contradictory emotions that shape the passage to independence. Divakaruni's journey from a young graduate student in Calcutta to a mature writer of repute in the United States seems to have come a full circle. Whatever may be the reason for migration diaspora community faces the problems of dislocation, rootlessness, discrimination in the foreign

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**AN ACCOUNT OF MEDICINAL HERBS USED BY KOCH RAJBANSHI  
COMMUNITY IN NORTH BENGAL**

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**ABSTRACT**

India, world's second largest population containing country, blessed with multiethnic and multicultural tribal, scheduled caste communities, has a rich traditional culture. They belong to Coochbehar, Jalpaiguri, North and South Dinajpur and Maldah districts of North Bengal in India. This community also brought the ethno medicinal knowledge of plants with them and the ancient uses of those plants are very relevant with today when Covid Pandemic came with certain symptoms and many medicinal plants are used till today to fight back. Here 30 plants are documented which are used by Koch Rajbanshi community in Dooars and Terai region of North Bengal. The common name as well as the botanical name and their uses gave us the detailed knowledge about the plants. Considering the importance of the uses of these local medicinal herbs, this review is prepared which can provide valuable information and would be beneficial in wider scale.

**INTRODUCTION:**

Koch Rajbonshi is an ancient tribe, belong to the kshatriya tribe, reside in parts of Lower Assam, Northern West Bengal, Terai region of Nepal, Bhutan and Bangladesh also. Now, They belong to Coochbehar, Jalpaiguri, North and South Dinajpur and Maldah districts of North Bengal in India. In the book of LINGUISTIC SURVEY OF INDIA, written by John Abraham Greyarson mentioned that, "when we cross the river (Bramhaputra) coming from Dacca. We meet a well manked form of speech in Rangpur and District to the north and East. It is called Rajbongshi."

This community also brought the ethno medicinal knowledge of plants with them and the ancient uses of those plants are very relevant with today.

The ethnomedicine has higher potential to cure any diseases. But, as the tribal and rural people of India inclined towards the modernization, they tend to move towards allopathy medicine. By the time they lost the knowledge about the ethnomedicine and very few people know the uses and the potential about the medicinal herbs. During Covid lockdown we majorly rely on homemade remedy that can be very handy. So my study emphasise on the knowledge of the medicinal herbs used by the native people of North Bengal with special reference to Koch Rajbongshi community.

### **AIMS AND OBJECTIVES OF THE STUDY**

The main purpose of my study are as follows :

- Study some potential medicinal plants with its uses found in Dooars region with special reference to Koch Rajbanshi Community.
- Restoration of the knowledge of some ethno medicinal plants before the last generation who recognize the wild medicinal plants demolish.
- To recognize the medicinal plants parts and uses of it.

### **AREA UNDER STUDY**

The selected study area occupied in the Dooars area of West Bengal which falls under the eastern Himalaya lies within 25°58' to 27° 45' N and 89° 08' to 89° 59' E.

The altitudinal range of the Dooars region is 61 Meters.

The Koch Rajbanshi community belongs to the Coochbehar, Jalpaiguri, Alipurduar, North and South Dinajpur and Maldah districts of North Bengal in India.

### **CULTURAL TRADITION INCLUDES IN THEIR LIFESTYLE**

On the day of Bishuwa festival of the community, they prepared a special dish named 'Satsaki' which includes the Neem leaves, Dried Pat(jute) Leaves, Nyctanthes leaves, Bitter gourd leaves, Chakti leaves, Durba grass, Centella leaves, Nafashak, Dhekishak. This gives them immunity against the summer oriented skin allergies.

During summer, they specially made Moringa leaf soup named pelka and they can intake with rice, which keeps under control their blood pressure.

If in winter, they struggle with cough and cold, they are advised to take the Vitex leaves chheka with rice to cure it.

### MATERIAL AND METHOD

Primary data has been collected from the native people of the community about the plants and their parts used.

The plants are identified by the book of Dr. A.P. Das and Bengal Plants by D. Prain.

Serial no.	Name of the plant	Local name(Bengali)	Parts of Use	Uses
1	<i>Citrus maxima</i>	Jambura ,Batabilebu	Fruit juice	The fruit juice is used to cure Jaundice
2	<i>Centella asiatica</i>	Thankuni	Leaves and Young Stem	Leaves decoction are beneficial to treat Diarrhoea
3	<i>Santalum album</i>	Shwetchandan	Wood	The thick paste of the wood cures skin allergies. If one suffers with red eye problem, the paste relief the eye problem

4	<i>Hemidesmus indicus</i>	Anantmool, Anant Bel	Root decoction	Root decoction with one cup of milk, cures the kidney stone problem. Root juice mixed with water increases the milk production in lactating mother
5	<i>Terminalia chebula</i>	Haritaki	Fruits specially seeds	Seeds deep in half glass of water for overnight. Next morning, strain the water and mixed with jaggery cures Jaundice
6	<i>Cynodondactylon</i>	Durba, Durboghass	Leaves and Stem	Leaves juice treated in any cut stops bleeding Leaves and young stem decoction mixed with turmeric powder relieves piles

7	<i>Ocimum sanctum</i>	Tulsi	leaves, stem, root, flower	Leaves juice mixed with honey cures common fever. Tulsi leaf and zinger crushed treats cough,cold
8	<i>Allium sativum</i>	Peyaj	Bulb	Onion paste with water relief in burping. One spoon of onion juice and water stops nasal bleeding.
9	<i>Azadirachta indica</i>	Gura neem, Neem, Margosa	Leaves, Stem, Bark, Flower	Neem leaves paste with turmeric paste can help to dry the small pox pimples. Boiled neem leaves water with turmeric reduce the skin allergies and Dermatitis. Boiled neem leaves water with camphor oil

				cures syphilis
10	<i>Curcuma longa</i>	Holud	Rhizome	2spoon of raw turmeric juice can reduce intestinal worms. Turmeric is very much useful in skin problems and ophthalmia
11	<i>Vitex negundo</i>	Nishinda	Leaves, Floral inflorescence	Vitex leaf paste coating on joints can relief the rheumatism and arthritis and reduce the swelling , crushed Vitex leaves fragrance cures black fever. Young leaf with clarified butter covers on sores burst it out and relief pain. It helps to cure high blood pressure.



12	<i>Nyctanthes arbor-tristis</i>	Sheuli, Shefali	young leaves	Leaf juice cures yellow fever. leaf crushed helps to relief arthritis
13	<i>Dillenia indica</i>	Chalta, Panchkhol	Young Leaves, Small fruits	young leaves decoction with one cup of cold water cures blood diarrhea. ripe fruit of Elephant apple juice with one spoon of sugar reduces colic diseases. young small fruits cut and boiled in water in a day once reduce the excess bile production.
14	<i>Corchorus olitorius</i>	Pat Pata, Sukati	Young Leaves	dried young leaves named Sukati soaked in water for whole night is taken in

					empty stomach at the next day morning reduces common fever
15	<i>Bryophyllum pinnata</i>	Pathorkuchi	Leaf		Fresh juice of Bryophyllum leaves mixed with half cup of boiled water and sugar reduces flatulence. Heat the leaves of Bryophyllum keeps on the sore of any cut of skin cures by some day. Crushed leaves on urine bladder reliefs in urine problem.
16	<i>Catharanthus roseus</i>	SadaNayantara	leaf, Stem	Root,	Leaves of Nayantara chewed raw cures polyuria. Root juice treats high blood pressure.

				Relief in toxic sore on skin.
17	<i>Justicia adhatoda</i>	Vasaka	Leaf	8-10 leaves of Vasak boiled with mishri and black pepper cures cough and cold. Leaf juice with honey for few days cures blood bile. If blood level reduces causes hand and foot swells,vasak leaf juice can cures the symptoms
18	<i>Senna sophera</i>	Kalakasunda	Leaf	Regular intake of the leaf juice cures constipation. leaf juice with honey cures bile problem leaf juice in empty stomach

19	<i>Calotropis gigantea</i>	Akanda	leaf, flower	everyday clears blood White akanda leaves crushed cure rheumatism. Red akanda leaves cure piles.
20	<i>Zingiber officinale</i>	Ada	Rhizome	Crushed zinger cures toothache. Zinger juice with honey or michhri is very much beneficial
21	<i>Solanum tuberosum</i>	Alu	Tuber	Crushed potato reliefs on burn and sore. Small potato is nutritious. Cures polyuria
22	<i>Moringa oleifera</i>	Sajne, Sajina	Fruit, Young Leaves	By taking the fruits and flowers of Moringa reduces the chances of pox and fever as well as viral infection. Regularly intake

				of Moringa fruits used as vegetable controls blood sugar. Moringa is majorly beneficial to for anemia.
23	<i>Swertia chirayita</i>	Chirata	Stem	Stems of Chirata soaked for overnight, at next morning, one cup of decoction controls blood sugar level. Chirata soaked water reduces common fever. Chirata soaked water in empty stomach cures the intestinal worms
24	<i>Bambusa vulgaris</i>	Bansh	young leaves	Burnt bamboo leaves mixed with water and sugar cures intestinal worms.

25	<i>Ananas comosus</i>	Anarash	Young Leaves, Fruits	white part of the base of the stem of Ananas leaves decoction reduces the intestinal worms
26	<i>Andrographis paniculata</i>	Kalamegh, green chiratta	Leaves	8-10 leaves of Andrographis juice with honey clears intestine. leaf juice cures liver illness
27	<i>Oxalis corniculata</i>	Amrul	Leaves	Oxalis leaves juice coats on sore cures pain. Oxalis leaf boiled with Cow's milk cures dysentery.
28	: <i>Piper betle</i>	Paan	Young and mature Leaves	Oil on betel leaves and heat on fire, it reduces cough and cold. Betel leaf treats bad breath
29	<i>Leucas aspera</i>	Dhulpi, dandokalash	Leaves	Leaf juice used as nasal drop cures headache.

30	<i>Momordica charanita</i>	Karala, Ucche	Fruits	Juice of bitter guard cures the intestinal worms. Bitter guard juice treats common fever and bile problem.
31	<i>Terminalia arjuna</i>	Arjun	Bark	Dried bark of Arjun tree is powdered and mixed with milk reliefs the heart disease and tuberculosis. Boiled water of Bark cures urine disorder.
32	<i>Ficus benghalensis</i>	Bot	Flower bud, Gum	Flower bud paste treats dermatitis.
33	<i>Ficus religiosa</i>	Peepal	Roots, Stem Bark	2spoon of crushed bark treats diarrhea. Brushing of teeth with the stem cures pyrea.

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**Biosynthesis of Iron Nano Particles by Microbial Reduction Process**

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**ABSTRACT:**

Multifunctional iron oxide nanoparticles have emerged as to be one of the promising materials with a wide range of applications in the fields of biomedicine, bioremediation, and effluent water treatment owing to their ideal properties of higher surface area, smaller bandgap, and stability. Recent advancements in the field of microbiology have led us to develop a safer and cost-effective alternate method for the biochemical synthesis of magnetite iron oxide nanoparticles. This paper reports the microbial bio-synthesis of nanoscale zero-valent iron by a bio-reduction process using bacterial species: *Escherichia coli*, and *Bacillus subtilis*. The concentration of the microbial substrate, ferric chloride was varied in the range of 1mM, 3mM, 5mM, and 7mM. Further, the effect of the concentration of glucose and incubation period on the synthesis of iron oxide nanoparticles were also studied. The synthesized nanoparticles were characterized by UV-visible spectroscopy and Fourier transform infrared spectroscopy. The nanoparticles produced were in the size range between 50-60nm range which was confirmed by performing scanning electron microscopy. The synthesized iron oxide nanoparticles by the microbial bio-reduction process could be employed in the bioremediation process of textile effluent water treatment.

**KEYWORDS:** Bioremediation, Nano scale zero valent iron, bio-reduction, Nano adsorbent.

**INTRODUCTION:**

Nanoparticles are tiny particles between 1 and 100 nanometres(nm) in size with a surrounding interfacial layer. The branch of technology deals with dimensions and tolerances of less than 100. It deals with various structures of matter having dimensions of the order of a billionth of a

meter. From the advent of nanotechnology, people realized that certain materials can exhibit different properties based on their size and shape. There are different types of nano-particles and they can be classified according to their size, morphology, and physical and chemical properties. Some of them are carbon-based nanoparticles, metal nanoparticles, semiconductor nanoparticles, ceramic nanoparticles, liquid-based nanoparticles, and polymeric nanoparticles [1-3].

Metal Nanoparticles are sub-micron scale entities made of pure metals like gold, platinum, silver, titanium, zinc, cerium, iron, and thallium or their compounds like oxides, hydroxides, sulfides, phosphates, fluorides, and chlorides [4,5]. All types of nanoparticles can be characterized based on their size, morphology, and surface charge, using such advanced microscopic techniques as atomic force microscopy (AFM), scanning electron microscopy (SEM), and transmission electron microscopy (TEM). Properties such as size distribution, average particle diameter, and charge affect the physical stability and the in-vivo distribution of the nanoparticles [6-8]. Properties such as surface morphology, size, and overall shape are determined by electron microscopy methods. Features like physical stability and dispersibility of polymer dispersion as well as their in-vivo performance are affected by the surface charge of nanoparticles. Nanoparticles are primarily evaluated by particle size distribution and morphology [9,10]. With the aid of electron microscopy it's now possible to ascertain the morphology as well as the size of nanoparticles.

#### **MATERIALS AND METHODS:**

Microbial cells-*E.coli* and *Bacillus subtilis* were grown in batch culture maintained at 37°C. The compositions of minimal salt media was as follows:

#### **COMPOSITION OF 5X SALT MEDIA:**

Na <sub>2</sub> HPO <sub>4</sub> ·7H <sub>2</sub> O	64g/l.
KH <sub>2</sub> PO <sub>4</sub> -	15g/l
NaCl	2.5g/l
NH <sub>4</sub> Cl -	5.0g/l

1L of minimal media was obtained by mixing 200 ml of 5X minimal media and 20 ml of 20% glucose solution, and the solution is made up of 1L by adding sterile distilled water [11-14]. The pH was adjusted to 7.2 with sodium hydroxide [15]. Two sets of media were prepared such that one with glucose and another without glucose. The growth parameters like incubation time at intervals of 48hours were tested with their corresponding absorbance at the range of 230-700 nm.

### **SYNTHESIS AND SEPARATION OF MAGNETITE NANOPARTICLE:**

The concentration of ferric chloride was varied in the range of 1mM, 3mM, 5mM, and 7mM in the prepared 1 X minimal media and were labeled according. Corresponding blank and controls were prepared. The blank was prepared without the addition of bacterial samples containing only the chemical reagents.. In contrast, the control was prepared without the addition of ferric chloride containing only the minimal media and bacterial sample. All sets of the media were properly labeled and were incubated at 37°C [16-18]. Sets of growth experiments were conducted to examine the ability of the organisms to tolerate the challenge of the iron nanoparticle.

The biomass separation was performed with the aid of Whatman filter paper and membrane filter. The pore size of the membrane was very small in a range of 0.45 micrometer [19-20]. Initially, the impurities were removed by filtering through ordinary filter paper. Then the biomass was separated by membrane filter paper [21-25]. The end filtrate of this process contains the desired magnetite nanoparticle. The filtrate was allowed to dry and the dried powder obtained was further characterized by performing UV spectroscopy, FT-IR analysis, and SEM analysis.

### **CHARACTERISATION OF MAGNETITE NANOPARTICLES:**

#### **UV SPECTROSCOPY ANALYSIS:**

Ultraviolet-visible spectroscopy involves the spectroscopy of photons in the UV-visible region [26-28]. The absorption in the visible ranges directly reflects the color of the chemicals involved. In this region of the electromagnetic spectrum, molecules undergo electronic

transitions. This technique is complementary to fluorescence spectroscopy, in that fluorescence deals with transitions from the excited state to the ground state, while absorption measures transitions from the ground state to the excited state [29-30].

#### **FOURIER TRANSFORM INFRA RED SPECTROSCOPY:**

Fourier transform infra-red spectroscopy deals with the vibration of chemical bonds in a molecule at various frequencies [31]. After absorbing electromagnetic radiations the frequency of vibration of a bond increases leading to a transition between the ground state and several excited states [32-34]. These absorption frequencies represent the excitation of vibrations of the chemical bonds and thus are specific to the type of bond and the group of atoms involved in the vibration. The energy corresponding to these frequencies corresponds to the infra-red region (4000-400  $\text{cm}^{-1}$ ) of the electromagnetic spectrum.

The term Fourier transform refer to a recent development in the manner in which the data are collected and converted from an interference pattern to an infra-red to an infrared absorption spectrum. The FT-IR measurement can be utilized to study the presence of protein molecules in the solution, as the FT-IR spectra in the 1400-1700  $\text{cm}^{-1}$  region provide information about the presence of CO and NH groups [34].

#### **SCANNING ELECTRON MICROSCOPY:**

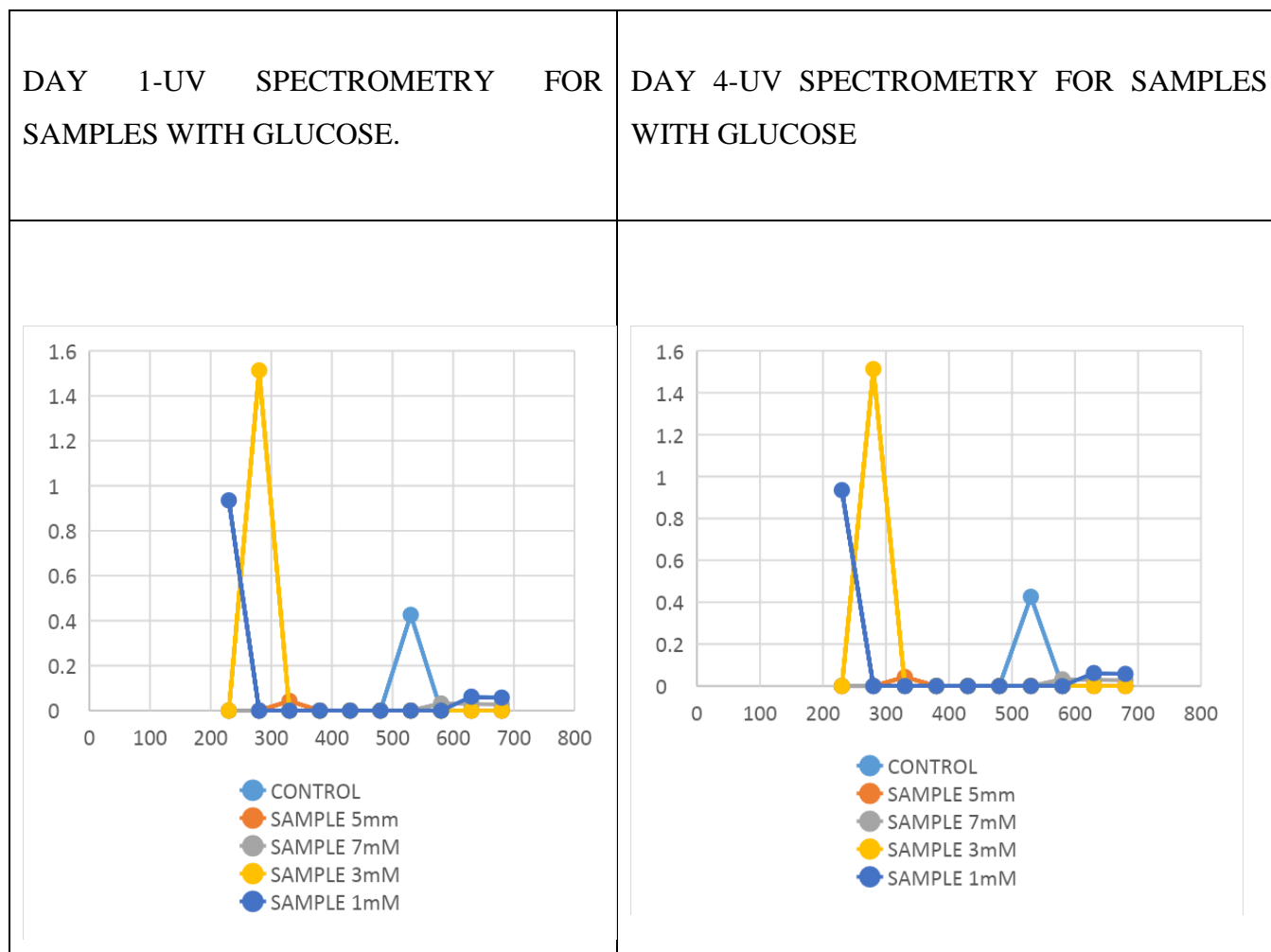
Scanning electron microscopy is one of the most widely used techniques for the characterization of nanomaterials and nanostructures. The resolution of the SEM approaches a few nanometres, and the instruments can separate at a magnification that is easily adjusted from ~10 to over 300,000. This technique provides not only topographical information as optical microscopes do, but also information on chemical compositions near the surfaces. A scanning electron microscope can generate an electron beam scanning back and forth over a solid sample. The interactions between the beam and the sample produce different types of signals providing detailed information about the surface structure and morphology of the sample. When an electron from the beam encounters a nucleus in the sample, the resultant Colombe attraction leads to a deflection in the path of the electron known as Rutherford elastic scattering. A fraction of these

electrons will be completely backscattered re-emerging from the incident surface of the sample. Since the scattering angle depends on the atomic number of the nucleus the primary electron can also interact with the loosely bound conduction band electron in the sample. And only those secondary electrons that are produced within a very short distance from the surface are able to escape from the sample. As a result, high-resolution topographical images can be obtained in the detection mode.

**RESULT AND DISCUSSION:**

**UV SPECTROPHOTOMETER ANALYSIS RESULTS:** After the visible color change of the bacterial filtrate, the medium was filtered and the supernatant was subjected to UV Visible absorption spectrum.

***E. COLI* SAMPLE SUPPLEMENTED WITH GLUCOSE RESULTS:**

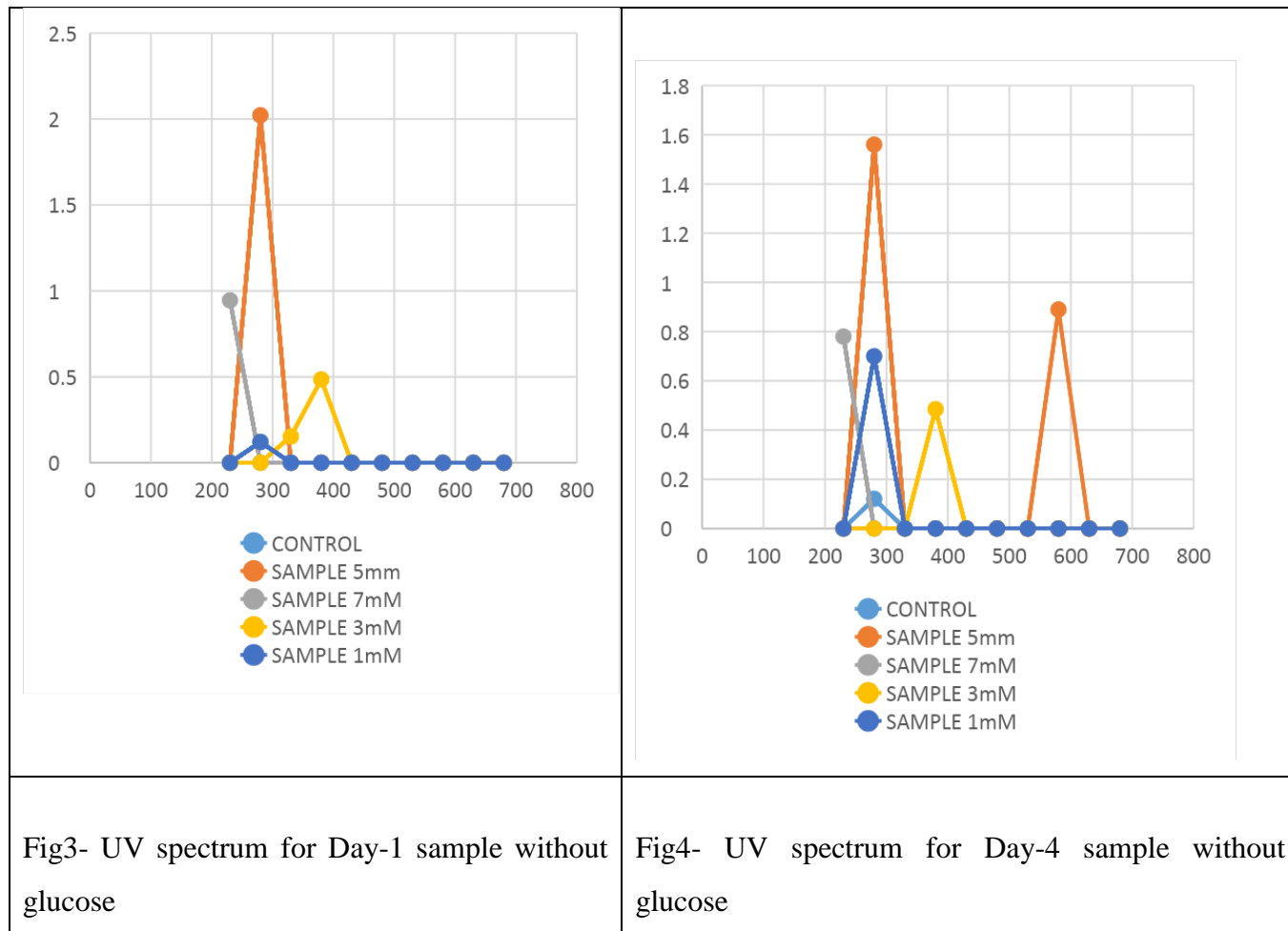


<p>Fig1- UV spectrum for Day-1 sample with glucose</p>	<p>Fig2- UV spectrum for Day-4 sample with glucose</p>
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From the absorption spectrum of ferric chloride showed in the above fig1 and fig2 of *E.coli* sample supplemented in 20% glucose, the maximum peak of absorbance at 280-300 nm in 3mM FeCl<sub>3</sub> supplemented day 1- *E.coli* sample. The absorbance shift in the range of 280-300 nm in the culture supplemented with ferric chloride and glucose was observed. This suggested that the organism *E.coli* reduced the ferric salts to magnetite as the growth of the organism proceeded which was also evidenced by color change. The shift in peak is present due to the release of magnetite nano-particle.

***E. COLI* SAMPLE WITHOUT GLUCOSE RESULTS:**

<p>DAY 1-UV SPECTROMETRY FOR SAMPLES WITHOUT GLUCOSE.</p>	<p>DAY 4-UV SPECTROMETRY FOR SAMPLES WITHOUT GLUCOSE.</p>
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From the absorption spectrum of ferric chloride showed in the above fig3 and fig4 of E.coli sample supplemented without the addition of 20% glucose, the maximum peak of absorbance at 280-330 nm in 5mM FeCl<sub>3</sub> supplemented day 1- E.coli sample. The absorbance shift in the range of 280-300 nm in the culture supplemented with ferric chloride and glucose was observed. This suggested that the organism E.coli reduced the ferric salts to magnetite as the growth of the organism proceeded which was also evidenced by color change. The shift in peak is present due to the release of magnetite nano-particle.

**BACILLUS SUBTILIS SAMPLE SUPPLEMENTED WITH GLUCOSE RESULTS:**

1-UV SPECTROMETRY FOR SAMPLES WITH GLUCOSE.	DAY 4-UV SPECTROMETRY FOR SAMPLES WITH GLUCOSE
Fig5- UV spectrum for Day-1 sample with glucose	Fig6- UV spectrum for Day-4 sample with glucose

From the absorption spectrum of ferric chloride showed in the above fig5 and fig6 of *Bacillus subtilis* sample supplemented with 20% glucose, the maximum peak of absorbance at 250-330 nm in 1mM FeCl<sub>3</sub> supplemented day 4- *Bacillus subtilis* sample. The absorbance shift in the range of 280-300 nm in the culture supplemented with ferric chloride and glucose was observed. This suggested that the organism *Bacillus subtilis* reduced the ferric salts to magnetite as the growth of the organism proceeded which was also evidenced by color change. The shift in peak is present due to the release of magnetite nano-particle.

**BACILLUS SUBTILIS SAMPLE WITHOUT GLUCOSE RESULTS:**



1-UV SPECTROMETRY FOR SAMPLES WITHOUT GLUCOSE.	DAY 4-UV SPECTROMETRY FOR SAMPLES WITHOUT GLUCOSE
<p>Fig7- UV spectrum for Day-1 sample without glucose</p>	<p>Fig8- UV spectrum for Day-4 sample without glucose</p>

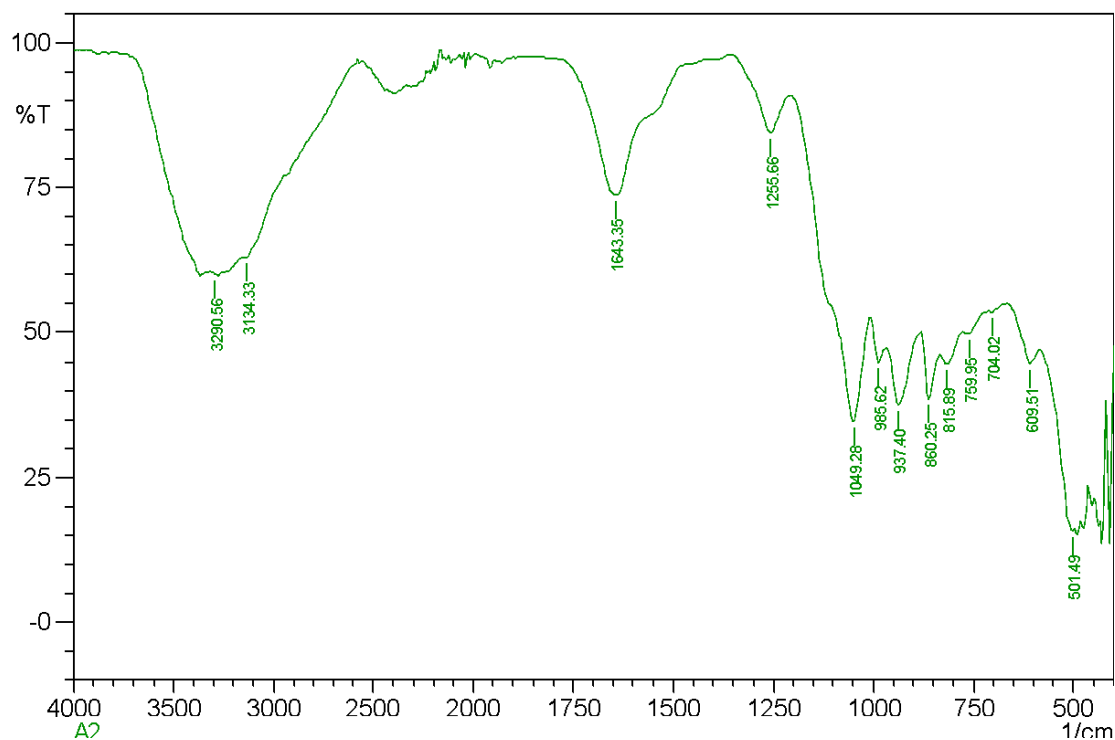
From the absorption spectrum of ferric chloride showed in the above fig7 and fig8 of *Bacillus subtilis* sample supplemented without 20% glucose, the maximum peak of absorbance at 250-390 nm in 3mM FeCl<sub>3</sub> supplemented day 4- *Bacillus subtilis* sample. The absorbance shift in the range of 280-390 nm in the culture supplemented with ferric chloride was observed. This

suggested that the organism *Bacillus subtilis* reduced the ferric salts to magnetite as the growth of the organism proceeded which was also evidenced by color change. The shift in peak is present due to the release of magnetite nano-particle.

### FT-IR ANALYSIS RESULTS:

The FT-IR analysis for the synthesized nanoparticles had been performed to examine the presence of amine/protein groups. The bacterial filtered which showed higher UV peaks (First day-*E.coli* sample of 3mM FeCl<sub>3</sub> and 5mM FeCl<sub>3</sub> supplemented without glucose, Forth day-*Bacillus subtilis* sample of 1mM FeCl<sub>3</sub> supplemented with 20% glucose and 3mM FeCl<sub>3</sub> supplemented without glucose) was chosen to perform FT-IR analysis (VIT-chemical division).

### FT-IR – RESULT OF DAY 1-SAMPLE WITH 3mM FeCl<sub>3</sub> SUPPLEMENTED WITHOUT GLUCOSE



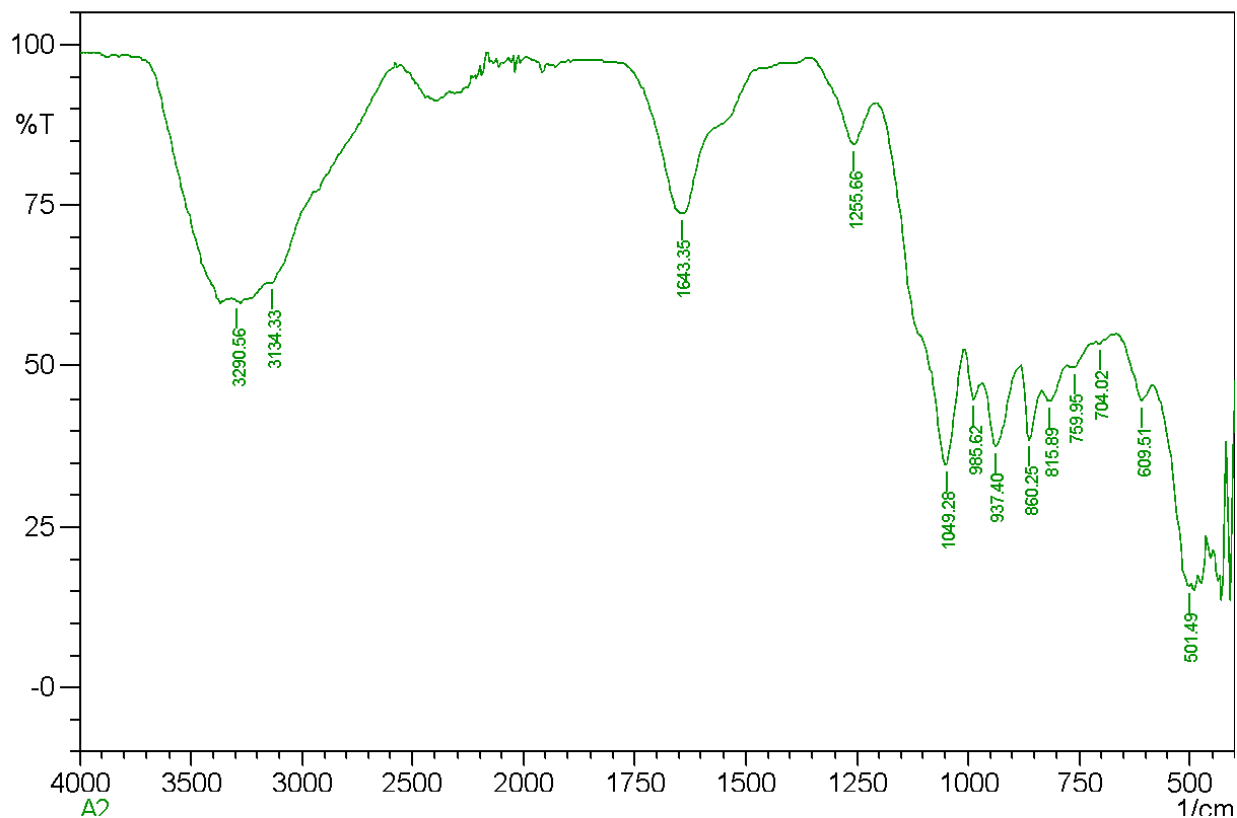
**DESCRIPTION OF THE COMPOUND CLASSES**

<b>S.N O</b>	<b>PEAK RANGE</b>	<b>COMPOUND CLASS</b>	<b>GROUP</b>
1	3253.91	ALCOHOL	O-H STRETCHING
2	2981.95	ALKENE	C-H STRETCHING
3	2366.66	CARBON DI-OXIDE	O=C-O STRETCHING
4	1645.28	ALKENE	C=C STRETCHING
5	1259.52	ALKYL ARYL ETHER	C=O STRETCHING
6	1049.28	ANHYDRIDE	C-O-CO BENDING
7	981.77	ALKENE	C=C BENDING
8	935.48	ALKENE	C=C STRETCHING
9	860.25	1,2-4 TRI SUBSTITUED	C-H BENDING
10	819.75	1,4 DISUBSTITUTED or 1,2,3- 4 TETRA SUBSTITUTED	C-H BENDING
11	765.74	1,2-3 TRI SUBSTITUTED	C-H BENDING
12	694.37	BENZENE DERIVATIVE	C- STRETCHING
13	599.86	HALO COMPOUND	C-I STRETCHING
14	503.42	HALO COMPOUND	C-I STRETCHING

The FT-IR analysis of the 3mM FeCl<sub>3</sub> of E.coli sample showed no presence of oxime/imine group in FT-IR analysis.

**FT-IR RESULTS FOR *ESCHERICHIA COLI* SAMPLE**

FT-IR – RESULT OF DAY1-SAMPLE WITH 5mM FeCl<sub>3</sub> WITHOUT GLUCOSE



**DESCRIPTION OF THE COMPOUND CLASSES**

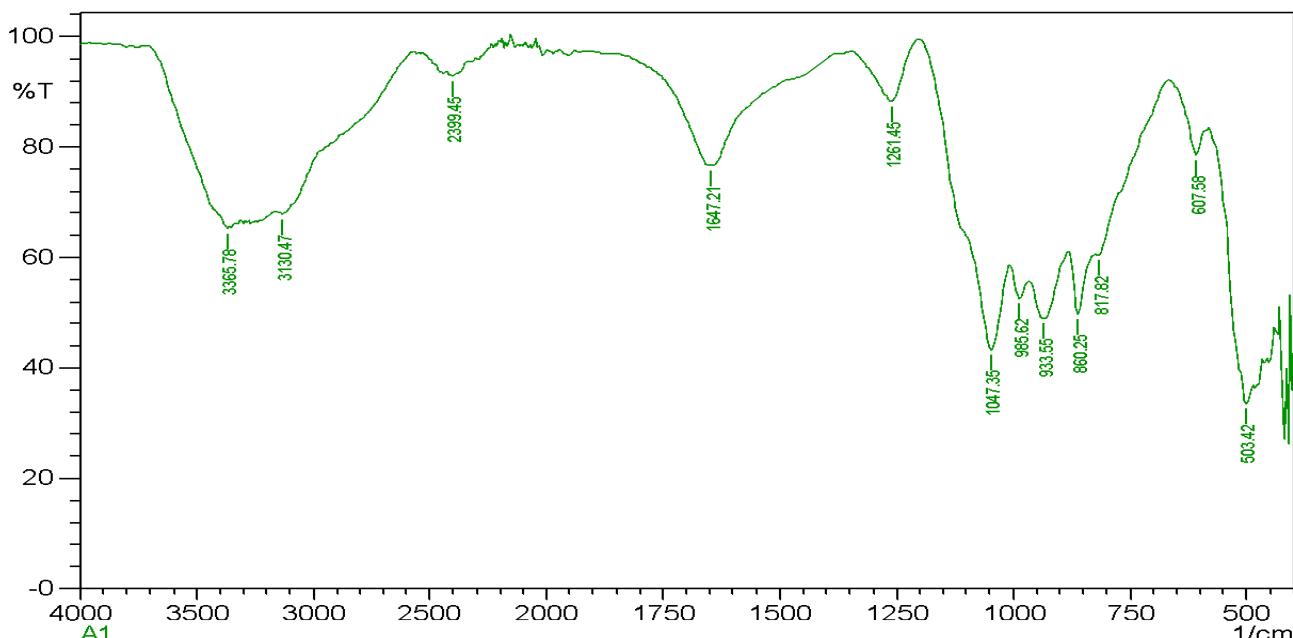
S.NO	PEAK RANGE	COMPOUND CLASS	GROUP
1	3290.56	ALCOHOL	O-H STRETCHING
2	3134.33	ALCOHOL	O-H STRETCHING
3	1643.35	IMINE/ OXIME	C=N STRETCHING
4	1255.66	ALKYL ARYL ETHER	C=O STRETCHING
5	1049.28	ANHYDRIDE	CO-O-CO STRETCHING
6	985.56	ALKENE	C=C BENDING
7	937.40	ALKENE	C=C BENDING
8	860.25	HALO COMPOUND	C-Cl STRETCHING
9	815.89	ALKENE	C=C BENDING
10	759.95	ALKENE	C=C BENDING

11	704.02	ALKENE	C=C BENDING
12	609.51	HALO COMPOUND	C-Br STRETCHING
13	501.49	HALO COMPOUND	C-I STRETCHING

The FT-IR analysis of the 5mM FeCl<sub>3</sub> of E.coli sample showed the presence of oxime/imine group in FT-IR analysis. Further confirmation for the presence of iron nano-particle was performed for this filtrate by performing SEM analysis.

**FT-IR RESULTS FOR *BACILLUS SUBTILIS* SAMPLE**

FT-IR – RESULT OF DAY4- SAMPLE WITH 1mM FeCl<sub>3</sub> SUPPLEMENTED WITH GLUCOSE



**DESCRIPTION OF THE COMPOUND CLASSES**

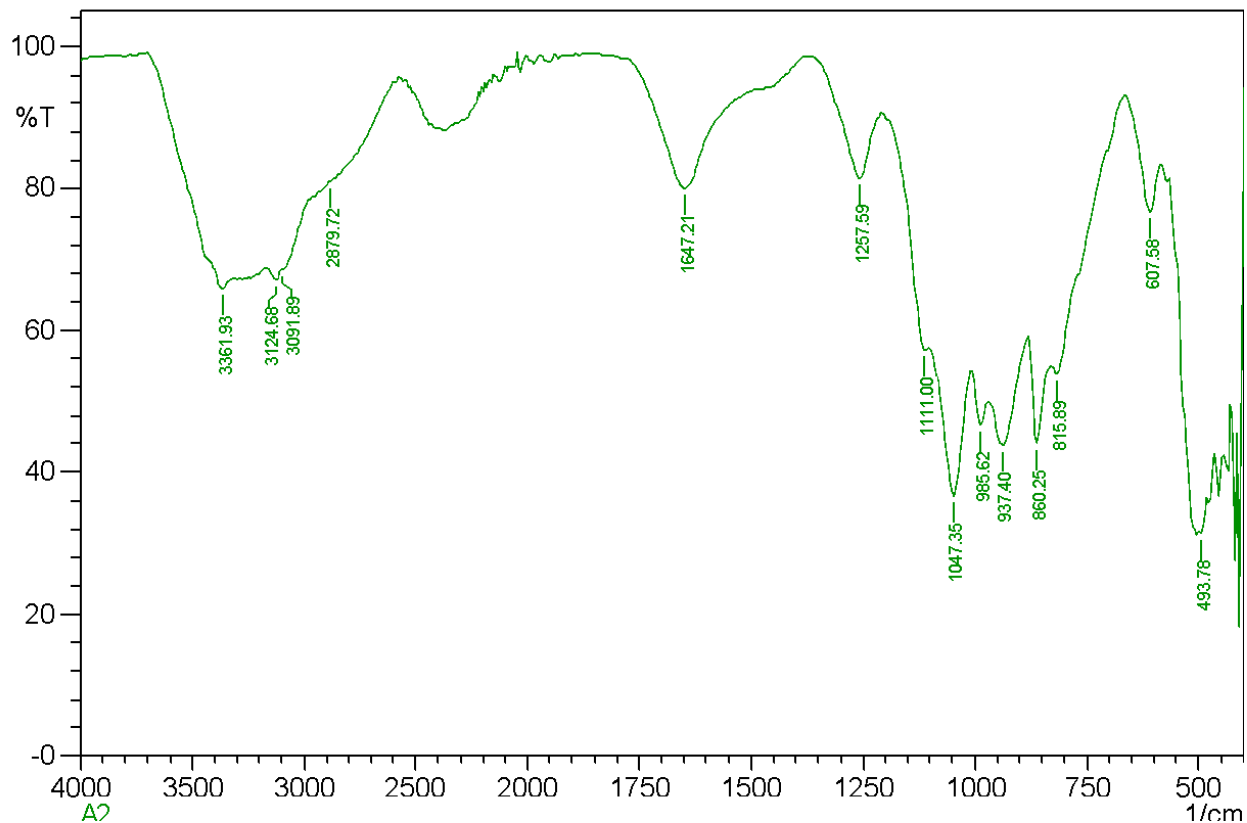
S.NO	PEAK RANGE	COMPOUND CLASS	GROUP
1	3365.78	ALCOHOL	O-H STRETCHING

2	3130.47	ALCOHOL	O-H STRETCHING
3	2399.45	CARBON DI-OXIDE	O=C=O STRETCHING
<b>4</b>	<b>1647.21</b>	<b>AMINE/IMINE/OXIME</b>	<b>C=H BENDING</b>
5	1261.45	ALKYL ARYL ETHER	C=O STRETCHING
6	1047.35	ANHYDRIDE	CO-O-CO STRETCHING
7	985.62	HALO COMPOUND	C=C BENDING
8	933.55	ALKENE	C=C BENDING
9	860.25	1,3-DISUBSTITUTED	C-H BENDING
10	817.82	1,4-DISTITUTED or 1,2,3,4-TETRA SUBSTITUTED	C-H BENDING
11	607.58	HALO COMPOUND	C-Br STRETCHING
12	503.42	HALO COMPOUND	C-I STRETCHING

The FT-IR analysis of the 1mM FeCl<sub>3</sub> of *Bacillus* sample supplemented with 20% glucose showed the presence of oxime/imine group in FT-IR analysis. Further confirmation for the presence of iron nano-particle was performed for this filtrate by performing SEM analysis.

**FT-IR RESULTS FOR *BACILLUS SUBTILISSAMPLE***

FT-IR – RESULT OF DAY 1- SAMPLE WITH 3mM FeCl<sub>3</sub> WITHOUT GLUCOSE



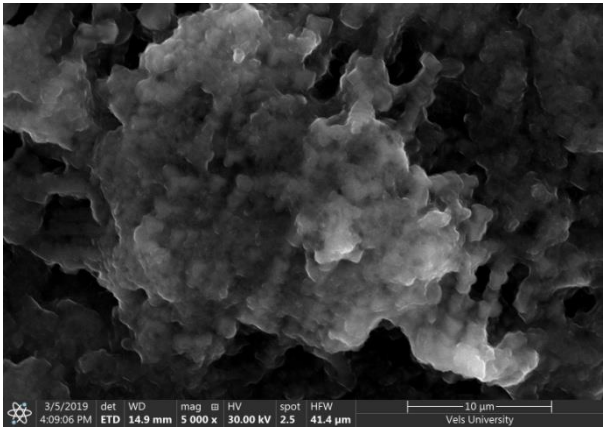
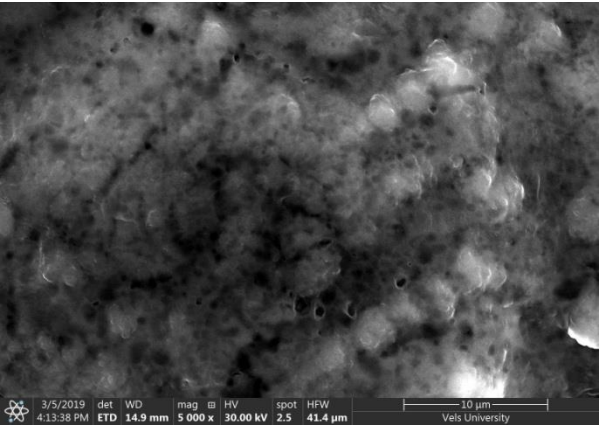
**DESCRIPTION OF THE COMPOUND CLASSES**

S.NO	PEAK RANGE	COMPOUND CLASS	GROUP
1	3361.98	ALCOHOL	O-H STRETCHING
2	3124.68	ALKENE	C-H STRETCHING
3	3091.89	ALKENE	C-H STRETCHING
4	2876.72	ALKENE	C-H BENDING
5	1647.21	CONJUGATE ALKENE	C=C STRETCHING
6	1257.79	AROMATIC ESTER	C=C STRETCHING
7	1111.0	SECONDARY ALCOHOL	C=O STRETCHING
8	1047.35	ANHYDRIDE	C=O STRETCHING
9	985.62	ALKENE	CO-O-CO STRETCHING
10	937.40	ALKENE	C=C BENDING

11	860.25	1,2,4-TETRA SUBSTITUTED	C=C BENDING
12	815.89	1,2,4-TETRA SUBSTITUTED	C-H STRETCHING
13	607.68	HALO COMPOUND	C-I STRETCHING
14	493.76	HALO COMPOUND	C-Cl STRETCHING

The FT-IR analysis of the 3mM FeCl<sub>3</sub> of *Bacillus* sample showed no presence of oxime/imine group in FT-IR analysis.

**SEM ANALYSIS RESULTS:**

<p><b>DAY-1 <i>E.COLI</i> SAMPLE with 5mM FeCl<sub>3</sub> without glucose.</b></p>	<p><b>DAY-4 <i>BACILLUS</i> SAMPLE- 1mM FeCl<sub>3</sub> supplemented with 20% glucose.</b></p>
	

The scanning electron microscopy analysis of the synthesized nanoparticles showed the presence of nanoparticles in the range of 50-60 nanometres. Further application studies on the synthesized iron nano-particle have to be performed.

**CONCLUSION:**



The present experimentation on microbial reduction- biosynthesis method showed that the iron component of the nanocomposite can be easily reduced from ferric chloride by using bacterial samples; *E.coli*, *Bacillus subtilis*. Variations in media compositions and process parameters- incubation time corresponding to the peak range in UV analysis, showed that the presence of glucose as an additional carbon source increases the microbial reduction in *Bacillus subtilis* sample. In contrast, the presence of glucose in the minimal media inoculated with *E.coli*, the glucose interferes with the microbial reduction of ferric chloride to ferrous oxide-magnetite iron nano-particle. The general characterization studies for the synthesized nanoparticle by FT-IR, and SEM confirmed the presence of iron nanoparticles in the range of 50-60 nanometers. Further studies to ascertain the properties and application of the synthesized iron nanoparticles are needed to be carried out. To achieve a reasonable steady-state continuous yield of nanomaterials, more research is needed to explore more local and commonly available resources for the production of iron nanomaterials. In conclusion, green nanotechnology processes, as described in this paper, provide a strong foundation for the production of a variety of biochemical or functionalized nanoparticles that can serve as building blocks in the development of new biological products that can be employed in environmental restoration sectors.

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**UTILISATION OF RICE WATER IN COSMETICS**

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Rice (*Oryzasativa*) is a fundamental food in southern region of India and it most popularly consumed by all our people. Rice water (either rinsed or boiled) is a processed by product that can be used for various purpose including skincare. Traditionally rice (washed/rinsed) water was used for cosmetic component. The present investigation focused on boiled rice water used as a base substrate to prepare face cream. Different (combination of various components like Vitamin E, Aleovera, corn starch and etc.,) formulations were developed with ricewater and to evaluate its biological properties such as physical parameters antioxidant activity. Boiled rice water rich in starch, minerals. Vitamin E and Aleovera(*Aleobarbadensis miller*), Glycerin are selected as the additional ingredients for the formulation face cream with boiled rice water. Totally seven different formulations prepared and analysed. The formulated of rice water based cosmetic cream was tested for the preliminary parameters like pH, Homogeneity, Appearance, spreadability, washability, Irritancy test and further stability was conducted. Antioxidants activity was also performed to the formulated cream. Further, the total antioxidant activity and phenolic content of face cream was determined. Fourier transform infrared spectroscopy (FTIR) was used to characterize the functional groups individual components and formulated cream.

**Keywords:** Rice water, Aleovera, Vitamin E, Formulation, Face cream, Skin Benefits

**A Conceptual Study of Reckoning the Effect of the Novel Coronavirus on the Education Sector in India"**

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**Abstract**

The Covid-19 has spread across the globe, forcing humanity to maintain social distance. The pandemic has wreaked havoc on several facets of human life, including Education. It puts education to the test in a way it's never been done before. Outbreak of this virus has impacted more than 120 crores of students and youths across the globe. In India, more than 32 crores of students have been influenced by the countless restraints and the nationwide lockdown for pandemic. Campuses have been closed at numerous educational institutions around the world, and teaching and learning has shifted to the internet. Change is unescapable, as the onset of pandemic had shown us. Despite these obstacles, Educational Authorities have responded well and have been able to sustain teaching-learning, research, and societal service with the help of some tools and strategies during the epidemic. This endeavor highlights steps taken by educational authorities to ensure that educational services are provided in a consistent manner throughout the country. Many new ways of learning, new viewpoints, and new trends have evolved as a result of the pandemic. Thus, certain post-pandemic tendencies that may allow for new approaches of teaching and learning in higher education in India are discussed. Further, some useful tips for carrying out educational activities during COVID 19 crisis are deliberated.

**Keywords: Coronavirus, Effect, Education Sector, Initiatives etc.**

### **Introduction**

With 1.35 billion inhabitants, India is the world's second-largest functioning democracy after China (Census Report of India, 2011; Pew Research Center, 2018) via the people of India's inherent right to education (Wikipedia.org). Despite the fact that the education sector faces a number of challenges, including ineffective educational infrastructure, an unequal teacher-student ratio, a lack of current teaching technology, a lack of interest in education among rural people, pessimism and laziness about learning, and so on, with these challenges, the country is currently dealing with the worst crisis of the novel (COVID-19) pandemic, which originated in China's Wuhan city. Covid-19 was declared a pandemic on March 11, 2020 by the World Health Organization. With over 4.5 million people have been afflicted by Covid-19 globally (WHO). The epidemic has wreaked havoc on all sectors, notably education, around the globe, affecting people's socioeconomic conditions.

According to a UNESCO estimate, Covid-19 has impacted about 68 percent of the entire global student population as of the first week of June 2020. The severe restrictions and the nationwide lockdown for Covid-19 have affected over 32 crores of pupils in India (Wikipedia). In an effort to limit the spread of the pandemic, most governments throughout the world have temporarily closed educational institutions. The global student population has been severely harmed by this shutdown. Governments all around the world are attempting to mitigate the acute impact of educational institution closures, particularly for more vulnerable and underprivileged groups, by facilitating the continuation of education for all through various online teaching approaches.

Even if the economy has adapted to the new learning, there seems to be a roadblock in the way of complete success because only 45 crore people out of the country's total population have access to the internet/e-learning. Rural residents are still largely without access to technology, which is hampered the cause of online education. With technological innovation and developments, the pandemic has been propelling the education industry ahead. The epidemic has had a tremendous impact on higher education. In light of this, the study examines the impact of epidemic, highlights measures undertaken by educational authority to make sure that educational

services are offered consistently, as well as post-pandemic tendencies that may allow for new approaches to teaching and learning in education sector in India.

### **Review of Literature**

**Bokde et al (2020)** in their research study highlights the impact of pandemic and lockdown on the educational institutions as well as on the students. Furthermore, the research suggested some measures to overcome with the impact of this adversity and concluded that some hygiene related factors and socio-economic are required to reshape the education sector.

**Jena (2020)** in his research study shows the core effects of Covid on education sector along with the steps taken by higher education authorities for the uninterrupted educational services. In addition to this, suggestions are provided to rebuild the educational sector. The results of the study revealed that MHRD have launched many virtual platforms which helps in turn in the smooth educational services.

**Tari and Amonkar (2021)** in their research study discusses the pros and cons of the pandemic on the education sector accompanied by the measures taken by policymakers for the continuous educational services. Further, the study suggests some tips how to recover from this adversity.

**Tarkar (2020)** in her research study explains the influence of pandemic on education sector in a crisp manner along with the suggestive methods to overcome from this pandemic.

### **Research Objectives**

On the basis of the review of literature, the present study has the following objectives:

- To highlight the influence of pandemic on education sector.
- To outline the numerous growing Indian approaches to higher education.
- To compile a list of trends in higher education Institutions following pandemic.
- To propose some useful tips for carrying out educational activities during COVID 19 crisis.

### **Research Methodology**

Research Design: The research design of the study is descriptive in nature.



Sources of Data Collection:To acquire data on the current study, researchers combed through many reports from national and international agencies on the Covid-19 epidemic. Information regarding the impact of Covid-19 on India's higher educational system was gathered from a variety of reliable websites, periodicals, and e-contents.

### **Major impact of pandemic on education sector in India**

Without a question, education is critical for people's socioeconomic progress in any country. As a result, there is stress on state education ministries and the education system in India to make education possible and accessible to all Indians as a matter of socioeconomic equity and fairness. Under such circumstances, the following are the major effects of the current pandemic, namely corona viruses, on the educational sector:

#### **Effect on students, working professionals and parents:**

- Due to the nationwide lockdown, admission procedures for numerous schools, universities, and educational institutions have been delayed.
- Exams at numerous academies, boards, and universities have been postponed or cancelled as a result of the pandemic's precautionary measures.
- Entrance tests for admittance to numerous colleges, research institutes, and educational institutions across India were impacted.
- Due to the lockdown and social alienation, competitive examinations for various government and non-government departments were accentuated during this period.
- Due to several concerns associated to the epidemic, Indian students and parents who are preparing to go overseas for specialized studies are panicking, and demand for admission to international institutions for higher education and specialized courses would've been reduced.
- Indian students studying abroad are concerned about the epidemic because most countries are impacted.

#### **Effect on educational institutions:**

- Job losses, wage cuts, and bonuses and increments may be delayed or decreased for some faculty and employees in the private school sector.
- Schools, colleges, and other institutions and universities may have delays in student admissions, internships, training, apprenticeships, and placements;
- The education sector may experience issues with low fee collection, which can complicate the operation and management of institutions.
- The challenges that education systems confront may have an impact on infrastructure development, teaching styles, assessment approaches, and educational quality.
- As a result of economic stagnation in the sector, certain educational institutions may have to slash positions or reduce workforces.
- Due to the industry's economic slump and crisis, some institutions may be forced to close entirely.
- According to the Centre for Monitoring Indian Economy, unemployment rose from 8.4% in mid-March to 23% in early April, with the urban jobless rate reaching 30.9 percent (ET Government.com, 2020).

### **Numerous growing Indian approaches to Higher Education**

Covid-19 has numerous complications. Higher Education Institutions have reacted favourably to the epidemic and have implemented a number of measures to deal with the problem. The Ministry of Human Resources Development (MHRD) and the University Grants Commission (UGC) have made many arrangements by launching a number of virtual platforms that include online depositories, e-books, and other online teaching and learning materials. The MHRD's ICT effort is also a one-of-a-kind platform that brings together all digital educational resources. During COVID-19, the following are some of the UGC and MHRD's digital efforts for higher education:

- **e-GyanKoshis** an Indian Open and Distance Learning Institutions-developed national digital repository for storing and sharing digital learning content. All rights reserved by Indira Gandhi National Open University for items in eGyanKosh are protected by copyright (IGNOU).

- **Gyandarshanis** a web-based TV station dedicated to Open and Distance Learner educational and developmental requirements. A web-based television station dedicated to the society today developmental and educational requirements.
- **Swayam** offers Massive Open Online Courses (MOOCs) with credit transfer from 140 universities. SwayamPrabha provides excellent educational programming via 32 DTH channels that broadcast quality content. Postgraduate students can use e-PG Pathshala. E-books, online courses and study resources are available to postgraduate students through this platform.
- **e-Adhyayan (e-Books)** is an online portal that offers over 700 e-Books for Post-Graduate courses. The e-Books are all based on the e-PG Pathshala courses. It also allows you to create a video playlist.
- **The National Digital Library of India (NDLI)** is a multidisciplinary repository of e-content for all types of users, including students (at all levels), instructors, researchers, librarians, library users, professionals, differently-abled users, and all other lifelong learners. The Indian Institute of Technology at Kharagpur is working on it. It is intended to aid students in their preparation for entrance and competitive examinations, to allow people to learn and prepare from best practises from around the world. It's a searchable virtual library of learning resources with a single-window interface.
- **FOSSEE** stands for Free and Open Source Software for Education, and it was created to promote open source software for both educational and professional use.
- **e-ShodhSindhuis** a long-term access collection of electronic journals, archives, and books. There are over 10,000 e-journals and over 31,35,000 e-books available. It offers academic institutions discounted subscriptions to high-quality electronic resources such as full-text, bibliographic, and factual databases.
- **VIDWAN** is a renowned database and national research network that contains profiles of scientists/researchers and other faculty members from India's top academic institutions and R&D organisations.
- **SAKSHAT** is a one-stop education portal that caters to all of a student's, scholar's, teacher's, and lifelong learner's educational and learning needs. The portal contains the

most recent news, press releases, accomplishments, and other information on the Ministry of Human Resources and Development.

### List of trends in higher education Institutions following pandemic

The prospects presented by the pandemic will lead to a brighter future. The education sector will be able to envisage new ways of teaching and learning as a result of the new trends, which include the following.

- **May promote holistic education:** Learning does not have to be limited to classrooms or predefined bounds. In the new age, pupils may be virtual learners, with one teacher instructing dozens of students. To fulfil the learners' objectives and needs, the learning modules can be adjusted to fit different learning styles and the learning contents can come from a variety of sources. Students may choose to continue their education under the new approach.
- **Attendance of students might be directly impacted:** Many parents may be hesitant to bring their children back to school/college immediately after the lockdown ends. Some impoverished parents who lost their jobs as a result of the pandemic may not be able to afford to send their children to institutions. This could lead to home schooling for a few more months.
- **Student mobility for higher education on a national and international level may be constrained:** Student safety and well-being are crucial decision considerations for students and their parents when considering whether or not to pursue higher education at an overseas university. New forms of social distancing will persist for some time, and they may have an impact on on-campus face-to-face teaching and learning. Due to the pandemic, most parents will want to locate workable alternatives closer to their homes and may restrict migration within the country. The crisis has had an impact on foreign education as well. Many international higher education conferences have been cancelled or converted into a sequence of webinars.
- **Multiple schedules each day may be used by educational institutions:** Because of the necessity for social distance, there may be fewer pupils in each class. As a result, most

educational institutions may work in multiple shifts throughout the day, putting additional pressure on the institution's teaching and administrative staff to manage.

- **Probably epidemic will widen the divide between rich and less fortunate students:** Students from poor families and socially disadvantaged are particularly vulnerable, as they may not be able to afford a high-speed internet connection or the necessary technical equipment for online learning. It will exacerbate the divide between rich and poorer students, resulting in inequity.
- **Conceivable that technologies will be used to facilitate teaching and learning:** For teaching, learning, entertaining, and communicating with the outside world, more students will rely on technology and digital solutions. Students will use the internet to communicate electronically with their teachers and classmates via E-mail, WhatsApp, Videoconference, Instant Messaging, Webinars, and other means.
- **Open and distance learning and online learning might get an upsurge:** Human society has been obliged to preserve social distance as a result of Covid-19. Maintaining social distance has made it more difficult to continue imparting learning. To tackle these issues, there is a growing demand for ODL and online education, and this trend is likely to continue in the future.
- **Blended learning could take the lead:** Blended learning presents the benefits of both face-to-face and online learning. Covid-19 has pushed the implementation of digital technology in education delivery and encouraged educational institutions to embrace a blended learning approach. Teachers and kids alike grew increasingly tech-savvy. The traditional face-to-face mode, combined with post-Covid-19 technology, will lead to a mixed mode of teaching and learning, potentially transforming the educational system.

### **Some useful tips for carrying out educational activities during COVID 19 crisis**

In this moment of crisis, significant and rapid measures are required to minimize the effects of a pandemic. For the enrichment of young minds, more capacity-building, skill development, practical knowledge enhancement, motivating programmes, use of new tools and techniques, and other welfare programmes are desired. The following are some important suggested measures:

- Both Educators and students should be taught how to use technology to facilitate online teaching and learning. Governments and educational institutions should develop policies to provide free internet and digital devices to all students in order to encourage online learning, which will keep people interested and safe during a pandemic.
- Many online learning platforms provide multiple programmes on the same subject with varying levels of certificates, methodologies, and assessment criteria. As a result, the quality of programmes on various online learning platforms may vary. Because of the growing proliferation of online learning platforms, HEIs in India should develop and supply quality assurance procedures and quality benchmarks for online learning programmes.
- If the Covid-19 pandemic persists, educational institutions will need to adapt new techniques to academic assessment. Students' academic performance can be assessed in a variety of ways, including online, via quizzes, and through minor projects.
- The government should assist Higher education institutions in bolstering their resources to conduct virtual educational activities. Students also require improved access to the internet and technology, as most students cannot afford these amenities. Higher education institutions should focus more on virtual educational activities such as television, radio, and web-based education during this epidemic.
- The World Health Organization recently stated that the Covid-19 virus may never be eradicated, and that humans will have to live with it. "It's critical to state the obvious: this virus might become just another epidemic infection in our communities, and it could never go away don't believe there are any guarantees or deadlines in this. In an online briefing, WHO emergency expert Mike Ryan stated, "This sickness may settle into a protracted problem, or it may not". In light of this statement, several countries are now considering continuing their education via distance or virtual means, and India should consider doing the same.
- Indian traditional knowledge is well renowned around the world for its scientific inventions, values, and benefits in developing sustainable technologies and treatments,

and this knowledge system should be incorporated with today's mainstream higher education system in various sectors.

### **Conclusion**

The effects of virus on higher education in India have been discussed in this study. There are some educational gaps in India, and the country is currently dealing with a pandemic which provides a chance for pedagogical techniques to shift and virtual education to be used at all levels of schooling. The Ministry of Human Resources Development (MHRD) and the University Grants Commission (UGC) have made many arrangements by launching a number of virtual platforms that include online depositories, e-books, and other online teaching and learning materials. In this moment of crisis, due to the breakout of Covid-19, virtual schooling is the favoured style of education. Following Covid-19, education appears to be based on generally acknowledged online/virtual education, which may or may not represent a parallel system of education. The study also offered ways to lessen the effects of a pandemic. The country will go forward and achieve general improvement in the education sector if these suggested actions are implemented.

### **Future Direction**

This work does not include any statistical analysis of the influence of Covid-19 on higher education; however, a more in-depth investigation including statistical research might be conducted in the near future.

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**MICROMACHINING -A REVIEW**

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**Abstract**

Metal micromachining is a direct operation for producing small parts. A complete evaluation of micro machining for metal cutting has been carried out in the current article. A good understanding of the mechanic behaviour of a specific material plays a critical role in the production of parties. Due to scaling effects related with tool geometry, tool material, and work piece material characteristics, the material removal mechanisms of micro machining and conventional machining differ significantly. Machining tests were undertaken in the literature to investigate the impact of a variety of cutting parameters on cutting force, surface roughness, temperature, tool life, vibration, and tool wear.As a result, micro machining is a growing subject that has proven to be a viable method for producing features on objects with machining quality in the range of a few to a few hundred microns.

**Keywords:**Machining, Micromachining, Micro fabrication, Mechanic behaviour

**INTRODUCTION**

Micro level devices in sectors such as optics, electronics, medicine, biotechnology, communications, and avionics, to name a few, now necessitate the fabrication of mechanical components with produced features in the a few microns to a few hundred microns.Fast, direct, and mass manufacture of tiny functional devices from metals, polymers, composites, and ceramics is becoming increasingly important [1,2]. Micro-product size and quality are determined by the properties of the machine tools used to create them, including overall accuracy and dynamic performance.Microscale fuel cells, fluidic micro chemical reactors needing

microscale pumps, valves, and mixing devices, micro fluidic systems, fibre optic micro holes, high-temperature jet micro nozzles, micro molds, deep X-ray lithography masks, and other micro level manufacturing uses exist. NonMEMS or non-lithography-based micro manufacturing is a new category of micro manufacturing technology that has just emerged. Micro EDM, micro mechanical cutting, micro laser cutting/patting/drilling, micro extrusion, micro embossing, micro stamping, and micro injection moulding are examples of non-lithography-based micro manufacturing. In many ways, these production techniques differ significantly from MEMS micro fabrication [3]. Mechanical micro cutting with geometrically specified cutting edge(s) (micro turning, micro milling, and micro drilling, for example) conducted on conventional precision machines or micro machines is referred to as micromachining. Micromachining provides several advantages in terms of material options, relative precision, and complexity of produced geometry, despite the fact that lithography-based production can attain smaller feature sizes. Although micromachining procedures are similar to traditional (macro) machining manufacturing techniques, size effects prevent straightforward scaling of parameters or process models. There are two techniques to dealing with size effects in research. In some areas, these two approaches overlap and aim to handle comparable concerns, such as cutting tool edge, size effect, minimum chip thickness, and so on. [3].

### **MICROMACHINING CHARACTERISTICS**

Despite being kinematically identical, the essential distinction between micro milling and traditional milling is the scale of the process. Micro milling, on the other hand, has a substantially higher ratio of feed per tooth to cutter radius than conventional milling, which frequently leads to errors in calculating cutting forces. Because of its very unexpected cutting action, micro-milling is linked to rapid tool failure. In contrast to conventional milling, chip creation in micro-milling is dependent on a minimum chip thickness, therefore the chip is not always formed whenever the tool and work piece are engaged. When compared to traditional milling, the tool deflection in micro-milling has a significant impact on chip formation and surface precision. As the chip thickness approaches the cutting edge radius, the tool edge radius (usually 1–5  $\mu\text{m}$ ) and its uniformity along the cutting edge become increasingly essential. The size

effect and ploughing forces become substantial on both surface and force generation in micro-milling because the chip load is modest relative to the cutting edge radius. When the cutting edge gets worn and blunt, micro-milling can result in surface creation with burrs and increased roughness due to ploughing-dominated cutting and side flow of the deformed material. Precision cutting tools and machine tools are essential in micro-mechanical cutting operations because they determine the surface quality and feature size of micro structures because of their hardness over a wide temperature range, tungsten carbide cutting tools are commonly employed for micro-mechanical cutting. Coatings to reduce wear and friction became more popular in the early 1990s, and most of these coatings are identified by their chemical composition, such as TiN (Titanium Nitride), TiCN (Titanium CarboNitride), TiAlN (Titanium Aluminum Nitride), or TiAlCrN (Titanium Aluminum Chromium Nitride), among others. Arumugam, et al. [5] studied the performance of polished CVD diamond tool carbide inserts in dry turning of A390 aluminium, a silicon hypereutectic alloy, and concluded that polished chemical vapour deposition (CVD) diamond tool inserts improve tool life and minimise cutting forces. Coatings for micro machining tools must not only have desirable properties like high hardness, toughness, and chemical/erosive and abrasive wear resistance, but they must also be dense, have a fine micro structure, and present a smooth surface to the work piece, with a lower coefficient of friction than an uncoated tool [4-6]. Many research have been done to show to what extent these parameters influence the quality of machined components and the implications on the tool. Weule et al. [7] described the surface roughness that can be achieved in terms of the minimal cut depth. They discovered that the minimum chip thickness or cut depth is determined first by tool sharpness and then by material parameters. In their diamond turning studies on aluminium alloys, Yuan et al. [8] discovered that the minimum chip thickness was between 20 and 40% of the cutting edge radius. Cutting parameters such as feed rate and machining methods were adjusted to optimizemicro milling by Cardoso and Davim [9] in order to do a comprehensive analysis on surface roughness of the machined surfaces. Al 2011 aluminium alloy was employed in this study. A cemented carbide K10, 0.8 mm diameter end mill was used to manufacture the work piece the influence of drill diameter and crystal structure on burr formation in micro drilling was studied by Sugawara and Inagaki [10]. Experimental and modelling research on

meso/micro milling of Al 2024-T6 aluminium and AISI 4340 steel by Dhanorker and zel [4] to predict chip formation and temperature fields. They also looked at the effects of size and the minimum chip thickness. Adams et al. [11] made micro grooving and micro threading cutting tools out of high speed steel and tungsten carbide with a diameter of 13 $\mu$ m.

## **CONCLUSIONS**

The large number of input variables reflects the difficulty of the analysis in terms of their impact on the output parameters. Materials, spindle technology, tool holder, and machining parameters (cutting speed, feed rate, and depth of cut, for example) are the most important inputs in the micromachining process. Micromachining, on the other hand, addresses concerns such as minimum chip thickness and size effect, cutting temperatures and cutting forces, which influence tool wear and failure, which influences burr development and, as a result, surface quality. Because of the high quality of the surface layer and the great precision of the surface, the micro milling process distinguishes itself from other traditional methods.

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**SINGLE COMMODITY INVENTORY SYSTEM DEALING NON-INSTANTANEOUS DETERIORATING ITEMS WITH FULL BACKLOGGING IN BETWEEN THE CYCLE DURING SERVICE BREAK**

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**Abstract:**

A single Commodity inventory system of Non-instantaneous deteriorated items is considered with the implementation of Service Break (SB) in between the replenishment cycle. SB is small compare with the whole replenishment cycle period. Initially the system starts with fixed lot size of items which will optimize the total cost of the inventory cycle. Two types of demands are considered namely constant rate of demand and linear time dependent demand. Throughout the cycle, deterioration rate of items is assumed as a constant. Arriving demands in that service break are backlogged and satisfied in the end of the expiry of the service break and deterioration in that period is unavoidable. We derive the optimal order quantity and cycle duration and minimum total cost. Analytical procedure for optimizing the total cost of the inventory system is derived.

**1. Introduction**

Inventory control models for deteriorating products have been widely investigated. Deterioration is the purpose of decay or damages to the items. Paper[1] deals with exponentially increasing demand and constant holding cost. They have not permitted shortages in the stockout period. Provided the effect of parameter changes in the model by the sensitivity analysis. Main system characteristics, including price discounts, backordering or lost sales, single or multiple items, one or two warehouses, single or multi-echelon, average cost or discounted cash flow, and payment

delay are discussed in [2]. Article [3] discusses an alternate technique for determining the optimal number of replenishments and optimal replenishment periods for a finite-horizon inventory issue with linearly growing demand that allows for totally backlogged shortages. Numerical examples are presented. A sensitivity analysis has also been performed to investigate the influence of changes in system characteristics on the optimal cost. A compulsory waiting period (CWP) for reordering is introduced in [4]. Reorder for instantaneous replenishment can be placed only after the expiry of the CWP. Stationary mean number of replenishment, mean number of demand satisfied and mean number of demand lost are found explicitly. A continuous review of a single product perishable stochastic inventory system is studied [5], in which also a reorder can be placed only after the expiry of a compulsory waiting period (CWP), even though the system's inventory situation requires a reorder. Mean number of replenishment, the mean number of demand met, and the mean number of demand lost are specifically identified. Complete and up-to-date survey of published inventory literature for the deteriorating inventory models are reviewed in [6]. The basic features, extensions and generalization of various models are discussed. An optimum approach for determining the replenishment schedule for an inventory system with shortages, where products decay at a constant rate and demand rates decrease over a given and finite planning horizon was given due importance by [7] . To demonstrate the method, a numerical example is provided.

## 1. Notations and Assumptions of the Model

### 2.1 Notations

The following Notations are used to represent the parameters of the model

- $I(t)$  - On hand inventory level at time  $t$
- $T$  - Length of the replenishment cycle
- $q$  - Number of items at the beginning of the period
- $C$  - The cost of deterioration for single unit per unit of time
- $C_1$  - Inventory holding cost per unit per unit time
- $C_2$  - Shortage cost per unit item



- $C_3$  - Set-up cost per cycle
- $\beta$  - After SB, demand increases with time
- $\eta$  - Shortage rate
- $\mu$  - The time point at which Service Break(SB) starts
- $\theta$  - Deterioration rate
- $K(t)$  - The total cost of the system per unit time
- $T^*$  -Optimum value of  $T$
- $q^*$  - Optimum value of  $q$
- $K(t^*)$  - Optimum total cost per unit time

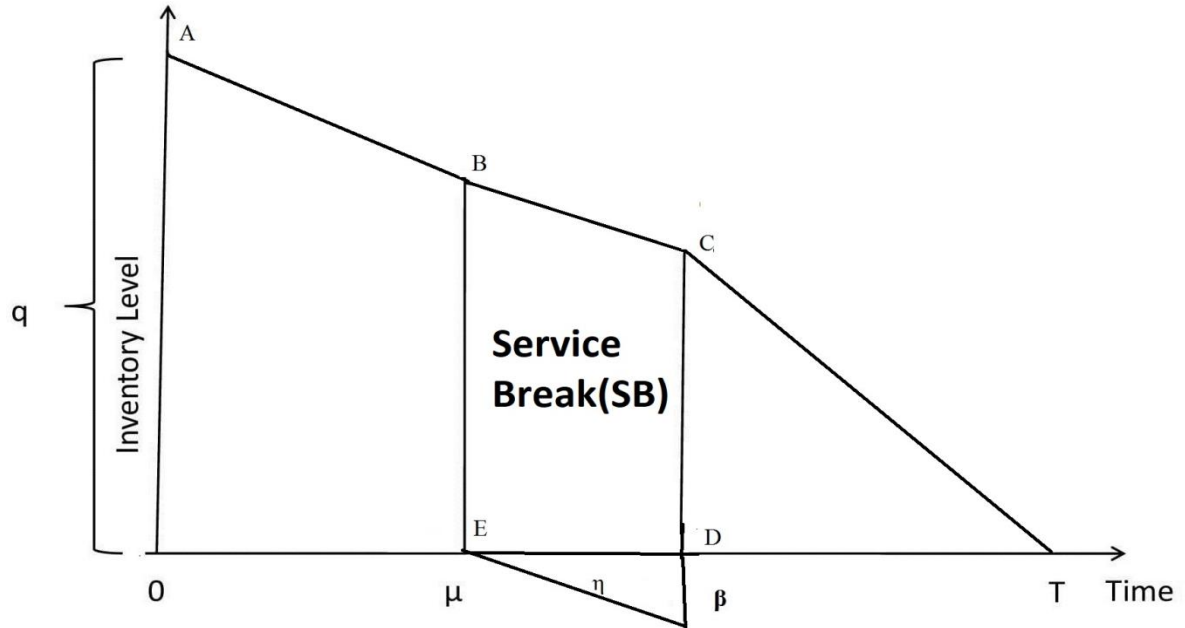
## 2.2 Assumptions

The following assumptions are considered in the construction of Model

- Single product inventory is considered with items deterioration.
- Instantaneous replenishment policy is entertained while reordering.
- No Repair and replacement of deteriorated items.
- In the deterministic study, we considered the system behaviour in a replenishment cycle of length  $T$  as the time horizon of the inventory is infinite in nature.
- No fluctuation in holding cost of the item in a unit of time, ordering cost per cycle and unit cost of purchasing the item.
- $SB$  is small and assumed to be proportional to  $T$ .
- For the time interval  $[0, \mu]$ , demand is constant at the rate of  $a$  units per unit of time.
- $SB$  is followed in the interval  $[\mu, \beta]$ , in this interval shortages occurs at the rate of  $\eta$  and deterioration occurs in the rate of  $\theta$ .
- For the time interval  $[\beta, T]$ , demand rate is a linear function of time, with the form as  $R(t) = a + b(t - \beta), \beta < t < T$ .
- The holding cost, ordering cost, shortage cost and unit cost

remain constant over time.

## 2. Model Description



We considered a single product inventory system with items get deteriorated only after certain time period of replenishment due to that we assume Non-Instantaneous deterioration. System behaviour is depicted in the above diagram. After replenishment, no deterioration occur up to time  $t = \mu$  and at the same time demands arrive with the constant rate  $a$ . Level of inventory at the time point  $t = \mu$  is  $I_0 - a\mu$ , since total number of demands satisfied in the interval  $[0, \mu]$  is  $a\mu$ .

Holding cost for the period  $[0, \mu]$

$$= C_1 [\text{area of trapezium ABEO}]$$

$$= C_1 \mu \left[ (q - a\mu) + \frac{a\mu}{2} \right]$$

Holding cost in  $[\mu, \beta]$

$$= C_1 t_1 (\beta - \mu) \left[ \frac{(q - a\mu)}{2} - \theta(\beta - \mu) - \eta \right]$$

Holding cost for the period  $[\beta, T]$

$$= \frac{C_1 t_1}{2} [(q - a\mu) - \theta(\beta - \mu) - \eta(\beta - \mu)]$$

Total Holding Cost

$$= C_1 \mu [(q - a\mu) + \frac{a\mu}{2}] + C_1 t_1 (\beta - \mu) [\frac{(q - a\mu)}{2} - \theta(\beta - \mu) - \eta] + \frac{C_1 t_1}{2} [(q - a\mu) - \theta(\beta - \mu) - \eta(\beta - \mu)]$$

The differential equation governing the stock status during the period  $\beta \leq t \leq T$  is given by

$$\frac{dI(t)}{dt} = -\theta I(t) - [a + b(t - \mu)], t \leq t_1 \quad (1)$$

where  $t_1 = T - \beta$ .

The origin is shifted for the sake of simplicity.

The boundary conditions are given as follows

$$\begin{cases} I(0) = q - a\mu - \theta(\beta - \mu) - \eta(\beta - \mu) \\ I(t_1) = 0 \end{cases} \quad (2)$$

The solution of the differential equation (1) is given by

$$I(t)e^{\theta t} = -\int_0^t [a + b(t - \mu)]e^{\theta t} dt + c \quad (3)$$

Using (2) in (3)

$$c = q - a\mu - \theta(\beta - \mu) - \eta(\beta - \mu)$$

Therefore

$$I(t)e^{\theta t} = -\int_0^t [a + b(t - \mu)]e^{\theta t} dt + q - a\mu - \theta(\beta - \mu) - \eta(\beta - \mu) \quad (4)$$

Using the condition that  $I(t_1) = 0$

$$q - a\mu - \theta(\beta - \mu) - \eta(\beta - \mu) = \int_0^{t_1} [a + b(t - \mu)]e^{\theta t} dt \quad (5)$$

Expressing the exponential term in (5) in the form of infinite series, it is seen that

$$\begin{aligned} q - a\mu - \theta(\beta - \mu) - \eta(\beta - \mu) &= \int_0^{t_1} [a + b(t - \mu)] \sum_{n=0}^{\infty} \frac{(\theta t)^n}{n!} dt \\ &= (a - b\mu) \int_0^{t_1} \sum_{n=0}^{\infty} \frac{(\theta t)^n}{n!} dt + b \int_0^{t_1} \sum_{n=0}^{\infty} \frac{\theta^n t^{n+1}}{n!} dt \end{aligned}$$

On integration

$$q - a\mu = (a - b\mu) \sum_{n=0}^{\infty} \frac{\theta^n t_1^{n+1}}{n! (n+1)} + b \sum_{n=0}^{\infty} \frac{\theta^n t_1^{n+2}}{n! (n+2)} + \theta(\beta - \mu) + \eta(\beta - \mu) \quad (6)$$

The total amount of inventory that has deteriorated during this cycle is

$$\begin{aligned} & (q - a\mu) - \theta(\beta - \mu) - \eta(\beta - \mu) - \int_0^{t_1} [a + b(t - \mu)] dt \\ & = (q - a\mu) - \theta(\beta - \mu) - (a - b\mu)t_1 - b \frac{t_1^2}{2} - \eta(\beta - \mu) \end{aligned} \quad (7)$$

The total shortage cost is =  $c_2\eta(\beta - \mu)$ .

Hence the total cost per unit of the inventory system is given by

$$K(T) = \text{Inventory carrying cost} + \text{Deterioration cost} \\ + \text{Setup cost} + \text{Shortage cost}$$

$K(T)$

$$\begin{aligned} & = \frac{1}{T} \left\{ (q - a\mu) \left[ c_1\mu + c_1(\beta - \mu) + \frac{c_1 t_1}{2} \right] + \frac{c_1 \mu^2 a}{2} - \frac{c_1 \theta (\beta - \mu)^2}{2} - \frac{c_1 t_1 \theta (\beta - \mu)^2}{2} \right. \\ & \left. - \eta(\beta - \mu) + c \left[ (q - a\mu) - \theta(\beta - \mu) - (a - b\mu)t_1 - \frac{b t_1^2}{2} - \eta(\beta - \mu) \right] + c_2 \eta(\beta - \mu) + c_3 \right\} \end{aligned}$$

Using (6)  $K(T)$  becomes

$$\begin{aligned} K(T) & = \frac{1}{T} \left\{ \left[ (a - b\mu) \sum_{n=0}^{\infty} \frac{\theta^n (T-\beta)^{n+1}}{n! (n+1)} + b \sum_{n=0}^{\infty} \frac{\theta^n (T-\beta)^{n+2}}{n! (n+2)} + \theta(\beta - \mu) - \eta(\beta - \mu) \right] (c_1\mu + \right. \\ & \left. c_1(\beta - \mu) + c) + \frac{1}{2T} \left[ \left\{ \frac{\theta^n (T-\beta)^{n+1}}{n! (n+1)} + b \sum_{n=0}^{\infty} \frac{\theta^n (T-\beta)^{n+2}}{n! (n+2)} + \theta(\beta - \mu) \right\} \frac{\theta^n (T-\beta)^{n+1}}{n! (n+1)} + \right. \\ & \left. b \sum_{n=0}^{\infty} \frac{\theta^n (T-\beta)^{n+2}}{n! (n+2)} + \theta(\beta - \mu) \right] + \frac{1}{T} \left[ \frac{c_1}{2} \mu^2 a - \frac{c_1}{2} \theta (\beta - \mu)^2 - \frac{c_1}{2} (T - \beta) \theta (\beta - \mu) - \theta (\beta - \mu) C - \right. \\ & \left. (a - b\mu)(T - \beta)C - \frac{bc}{2} (T - \beta)^2 + c_2 \eta(\beta - \mu) + C_3 \right] \end{aligned}$$

Since the deterioration rate is practically very small the terms involving  $\theta^n$  with  $n > 1$  become negligible and therefore can be neglected .

$$K(T) = \frac{1}{T} \left[ \left\{ (a - b\mu) \left( (T - \beta) + \theta \frac{(T - \beta)}{2} \right) + b \left( \frac{(T - \beta)^2}{2} + \frac{\theta}{3} (T - \beta)^3 \right) + \theta(\beta - \mu) - \eta(\beta - \mu) \right\} (c_1\mu + c_1(\beta - \mu) + c) \right] + \frac{1}{T} \left[ \left\{ (a - b\mu) \left( (T - \beta)^2 + \frac{\theta(T - \beta)^3}{2} \right) + b \left( \frac{(T - \beta)^3}{2} + \frac{\theta}{3} (T - \beta)^4 \right) \right\} + \frac{\theta c_1}{2} (\beta - \mu)(T - \beta) \right] \frac{c_1}{2} + \frac{1}{T} \left[ \frac{c_1}{2} \mu^2 a - \frac{c_1}{2} \theta (\beta - \mu)^2 - \frac{c_1}{2} (T - \beta) \theta (\beta - \mu) - \theta (\beta - \mu) C - (a - b\mu)(T - \beta) C - \frac{bc}{2} (T - \beta)^2 + c_2 \eta (\beta - \mu) + C_3 \right]$$

If  $P = c_1\mu + c_1(\beta - \mu) + C$  and  $A = a - b\mu$  then

$$K(T) = \frac{1}{T} \left[ P \left\{ A(T - \beta) + \theta(\beta - \mu) + \frac{A\theta}{2} (T - \beta)^2 + \frac{b}{2} (T - \beta)^2 + \frac{b\theta}{3} (T - \beta)^3 \right\} \right] + \frac{1}{T} \left[ \frac{c_1}{2} \left\{ A(T - \beta)^2 + \frac{A\theta}{2} (T - \beta)^3 + \frac{b}{2} (T - \beta)^3 + \frac{b\theta}{3} (T - \beta)^4 \right\} \right] + \frac{1}{T} \left[ c_1 \mu^2 a - \frac{c_1}{2} (\beta - \mu)^2 \theta - \theta (\beta - \mu) c - c_2 \eta (\beta - \mu) - cAT + c\beta A - \frac{1}{2} cb(T - \beta)^2 + \eta(\beta - \mu) + c_3 \right] \quad (8)$$

The necessary conditions for  $K(T)$  to be minimum is  $\frac{dK(T)}{dT} = 0$ . On differentiating (8) with respect to  $T$ ,

$$T \frac{dK(T)}{dT} + K(T) = AP + \frac{AP\theta}{2} + bP(T - \beta) + bP\theta(T - \beta)^2 + AC_1(T - \beta) + \frac{3AC_1\theta}{4} (T - \beta)^2 + \frac{3bc_1}{4} (T - \beta)^2 + \frac{2bc_1}{3} (T - \beta)^3 - AC - bc(T - \beta)$$

The condition  $\frac{dK(T)}{dT} = 0$  gives a bi-quadratic equation in  $T$ , which is of the form

$$\begin{aligned}
 & T^4 \left[ \frac{1}{2} c_1 b \theta \right] + T^3 \left[ \frac{2}{3} P b \theta + \frac{1}{2} c_1 A \theta + \frac{1}{2} c_1 b - \frac{4}{3} c_1 b \theta \beta \right] \\
 & + T^2 \left[ \frac{1}{2} P b - \frac{1}{2} C b - P b \theta \beta + \frac{1}{2} c_1 A - \frac{3}{4} c_1 A \theta \beta - \frac{3}{4} c_1 b \beta + c_1 b \theta \beta^2 \right] \\
 & + [P A \beta - \frac{1}{2} P A \theta \beta - \frac{1}{2} P b \beta^2 + \frac{1}{3} P b \theta \beta^3 - P \theta \beta + P \theta \mu - \frac{1}{2} c_1 A \beta^2 + \frac{1}{4} c_1 A \theta \beta^2 + \frac{c_1 b}{4} \beta^3 - c_2 \eta (\beta - \mu) \\
 & - \frac{1}{6} c_1 b \theta \beta^4 - c_1 \mu^2 a + \frac{1}{2} c_1 \theta \beta^2 - \frac{1}{2} c_1 \theta \mu^2 - \frac{1}{2} c_1 \mu^2 a - C_1 \theta \beta \mu + \theta \beta C - \theta \mu C - C A \beta + \frac{1}{2} c b \beta^2 - c_3] = 0
 \end{aligned}
 \tag{9}$$

And it can be written as

$$U T^4 + V T^3 + W T^2 + Y = 0$$

The above can be solved by Newton Raphson's method for a positive value of  $T (=T^*$  say), where  $T^*$  will be an optimal solution, provided the following condition is satisfied for  $T=T^*$

$$\frac{d^2 K(T)}{dT^2} > 0$$

The optimal initial commodity in the inventory is obtained as

$$q^* = a\mu + (a - b\mu) \sum_{n=0}^{\infty} \frac{\theta^n T^{*(n+1)}}{n! n+1} + b \sum_{n=0}^{\infty} \frac{\theta^n T^{*(n+2)}}{n! n+2} + \theta(\beta - \mu) - \eta(\beta - \mu)$$

And

$$\begin{aligned}
 K(T^*) = & \frac{1}{T^*} \left[ P \left\{ A(T^* - \beta) + \frac{A\theta}{2} (T^* - \beta)^2 + \frac{b}{2} (T^* - \beta)^2 + \frac{b\theta}{3} (T^* - \beta)^3 \right\} \right] \\
 & + \frac{1}{T^*} \left[ \frac{c_1}{2} \left\{ A(T^* - \beta)^2 + \frac{A\theta}{2} (T^* - \beta)^3 + \frac{b}{2} (T^* - \beta)^3 + \frac{b\theta}{3} (T^* - \beta)^4 \right\} \right] \\
 & + \frac{1}{T^*} \left[ c_1 \mu^2 a - \frac{c_1 \theta}{2} (\beta - \mu)^2 - \theta(\beta - \mu) - c A T^* + c A \beta - \frac{1}{2} c b (T^* - \beta)^2 + c_2 \eta (\beta - \mu) + c_3 \right]
 \end{aligned}$$

### 3. Conclusion

Explicit expressions for optimum cycle duration  $T^*$  and the level of initial stock  $I^*$  to minimize the total cost  $K(T^*)$  of single product deterministic inventory system have been derived in a replenishment cycle with the consideration of items have non instantaneous deterioration and demands are of constant and time dependent in nature on different

intervals. Realistic consideration of Service break (*SB*) in between the replenishment cycle on demand satisfaction is implemented by assuming the arrival demand in break time is fully satisfied as backlogged.

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**The Role of Green HRM Practices in Enhancing Organizational Performance – A Review**

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**ABSTRACT:**

Green HRM is the most recent buzzword in the corporate sector. Green practices are being implemented, and businesses are developing human resource strategies to support environmental management programmes that will lead to long-term sustainability. Previously, the success of a corporation was mainly relied on the promotion of economic value. However, in order to stay competitive in the corporate sector and allow shareholders to gain, today's enterprises must consider the reduction of ecological footprints and give equal weight to social and environmental concerns, as well as economic and financial factors.

This review paper aims to investigate the issues and challenges that businesses face when implementing green human resource management practices, as well as the benefits and drawbacks of implementing green human resource management practices in an organisation. Furthermore, this research investigates the methods for successful implementation of Green Human Resource Management practices in a firm. This research encourages businesses to implement Green Human Resource Management practices by emphasizing the positive outcomes that may be obtained by using Green Human Resource Management practices. Since 2008, there has been an increase in study on Green Human Resource Management, but there is still a long way to go. As a result, research on Green Human Resource Management is vital in emerging nations such as India. This study is timely because there has been a significant increase in the level of environmental pollution and waste generated by factories, which has resulted in an increase in the implementation of policies by both the public and private sectors with the goal of reducing the rapid depletion of nonrenewable resources and the negative societal consequences.

**Key Words:** Green Policies, Green Practices, Green Initiatives, Green Performance Management, Green Compensation Management.

**Introduction:**

Businesses are realising that, in addition to focusing on financial profits, they must consider all social and environmental impacts for long-term sustainability. Sustainability is defined as "the capacity to fulfill the demands of the present without affecting future generations' ability to meet their own needs." Organizations must understand their social and environmental risks and possibilities for all business choices they make, and the simultaneous strategy of providing good results for the three P's – People, Planet, and Profit – is referred to as a "triple top line" of a company.

**Green Human Resource Management:**

Green Human Resource Management is developing as a key management thrust area that may have a significant influence on people concerns in a business. The phrase Green HRM is frequently used to refer to the contribution of HR policies and practises to the larger corporate environmental agenda of natural resource conservation and prevention. Green HR can play an active role in reaching this goal by developing a Green HR platform in which the staff are more satisfied and engaged, resulting in improved productivity.

**Definition of Green HRM:**

According to Gill man dip, "It involves reducing carbon footprints via less printing of paper, car sharing, job sharing, telecommuting and videoconferencing and interviews etc." Hence GHRM involve two essential elements i.e., HR practices which are friendly to environment and the conservation of knowledge capital.

Ramachandran defines Green HRM as "the integration of environmental management into human resources management".

Anjana Nath defines Green HR as "environment-friendly HR initiatives leading to better efficiencies, less cost, and heightened employee engagement levels".

It involves undertaking environment-friendly HR initiatives resulting in greater efficiencies, lower costs and better employee engagement and retention, which in turn, help organizations to reduce employee carbon footprints by the likes of electronic filing, car-sharing, job-sharing, teleconferencing, and virtual interviews, recycling, telecommuting, online training, energy-efficient office spaces, etc.

Green HR initiatives help companies find alternative ways to cut costs without losing their top talent. Focus on Green HRM as a strategic initiative promotes sustainable business practices. Therefore, developing a new organizational culture through GHRM practices becomes a manager's concern. Developing a green culture can affect employee behavior and introduce certain values that build an internal culture.

Green behavior is assumed to be instrumental in the implementation of the green HRM culture and adopting formal environmental strategies.

**Objectives of the Study:**

1. To execute a more in-depth investigation of the idea of Green HRM.
2. To examine the problems and challenges associated with implementing GHRM in enterprises.
3. To explore the HRM Outcomes and Green Initiatives.

**Need for Green HRM:**

Green HRM is commonly used to refer to the contribution of HRM policies and practices to the larger corporate environmental objective. It refers to the use of all employees to promote sustainable practices and raise employee understanding and commitment to the matter of sustainability. Green HRM strategies are required in modern enterprises to aid with:

1. Reducing ecological footprints.
2. Pay attention to social and environmental variables.
3. A constructive collaborative effort by everyone.
4. Employees are more devoted and happy with their jobs.
5. Gaining an understanding of environmental challenges.
6. Identifying how to create human resource policies to promote environmental initiatives

**Review of Literature:**

Aravamudhan (2016) Green HRM involves addressing the company carbon footprint by cutting down on usage of papers, reducing unwanted travel. Green HRM is about the holistic application of the concept of sustainability to organization and its workforce. Sustainability and Green Business practices as a way to improve their operations and enhance their competitiveness.

The studies by Jabbar et al., (2017) identified the impact of human resource management on principles of environmental management implementation in company and identify the link to operational performance. The study adopted a primary empirical approach and identified that HRM practices including recruitment, feedback and compensation were found to have an impact on environmental management practices of the company.

Dr kulshrestha S Shweta, Srivastava Shruti (2018) analysis the reelection on the concept of green human resource management that is great concept which helps to sustain our environment and if worked on that have a great potential to serve initially the individual then to the society and largely on the environment along with the business. The paper focuses and explores the meaning of the green HRM, reason for moving toward greening.

Arulrojah Anton. A, Dr.Nawaratne N.N, (2015) analyzed Green Human Resource Management practices. A review of this paper to explore green human resource management practices of organization based on the existent literature explores the scope and depth of green HRM in materializing sustainable environmental performance of organization.

Bangwal Deepak Tiwari Prakash, (2015) analysis Green HRM – A way to greening the environment. The paper focus upon the GHRM, various green Human Resource process in going green and suggest some social Implication of green human resources practices for green organization.

Rani Sushma, Dr. Mishra k, (2014) examined the Green HRM- Practices and Strategic implementation in the organization. An attempt has been made to promote the importance of Green HR involves two essential elements environment friendly HR practices and preservation

of knowledge capital. This study focus on Green HRM as a strategic initiative by the corporate to promote sustainable business practices.

**How to Implement Green HRM:**

According to Jabbour and Santos (2008), HRM can help companies with environmental management if they:

- a. Recruit and select people who care about the environment;
- b. Train and evaluate employees' performance based on environmental criteria; and
- c. Implement remunerated and non-remunerated methods of rewarding individual and group environmental performance;
- d. Encourage ongoing environmental management education;
- e. Consider environmental issues to be corporate culture principles; and
- f. Encourage teamwork in dealing with environmental issues and strive for continual development of environmental management operations.

**Advantages of GHRM:**

The following are the advantages of GHRM:

- 1. Assisting businesses in reducing expenses while retaining talent.
- 2. Organizations have great development prospects by going green and developing a new friendly atmosphere, which aids in massive operational savings by lowering their carbon footprint.
- 3. It contributes to increased employee work satisfaction and dedication, which leads to increased productivity and sustainability.
- 4. Foster a culture of concern for the well-being and health of coworkers.
- 5. Increase in the staff retention rate.
- 6. *Improved public image:* When a company implements a green initiative in the workplace, the occasion may be used to build favorable public relations. Organizations can use press releases to

advertise environmental efforts to the media in order to gain the attention of potential consumers and possibly new sales.

7. Increase staff morale.

8. *Improvement in attracting better employees:* Dolan's (1997) research of MBA students in the United States discovered that the majority of graduates would accept a lesser income to work for environmentally responsible firms.

9. Reducing the company's environmental effect.

10. Increased competitiveness and overall performance.

11. *Significant reduction in utility expenditures:* Even small firms may greatly cut their utility costs by implementing energy-efficient and waste-reduced technology.

12. *Tax Breaks and Refunds:* Going green is made simpler with the help of governments, local municipalities, water supply authorities, and electric providers that provide tax breaks and rebates.

13. *Increased business opportunities:* Some government agencies, commercial corporations, and charitable organizations require that only companies that fulfill specified green criteria compete on their contracts. Some organizations additionally require that their purchasing departments exclusively purchase green items or employ products and services offered by firms that satisfy specified green criteria.

14. *Environmental damage reduction:* Encouraging staff to identify ways to limit the usage of ecologically hazardous items through training and pay.

### **Disadvantages of GHRM**

The following are the significant drawbacks:

1. *Initial costs:* Perhaps the most significant downside of turning green is that it frequently necessitates a substantial initial investment. Installing a new roof or new insulation to minimize heat from fleeing our home, for example, would be considered a green home improvement, but the work would be expensive.
2. *Inadequate savings:* In many circumstances, such as building an energy-efficient house or purchasing a hybrid car, the goal of turning green is to lessen environmental impact

while saving money in the long run. Because green buildings and cars consume less energy, the initial investments are frequently recouped over time through energy savings. The problem is that the savings gained by becoming green are frequently smaller than projected; they do not immediately recoup the original investment, making them economically feasible.

3. *Increased capital outlays:* Some green conversions need an initial financial outlay, which reduces the firm's bottom line performance while the investment pays for itself. This can reduce a company's earnings or yearly profits.
4. *Uneven competition:* In the business sector, being green might be an appealing objective to earn goodwill and consumer support, but it can put a corporation at a competitive disadvantage unless green upgrades are economically viable. For example, if one company decides to adhere to strict, self-imposed pollution standards that necessitate the installation of new technology and workers, while another sets loose standards, the second company will benefit from lower production costs.
5. *Marginal Impact :* While being green is aimed at decreasing environmental harm, the influence that each individual may have on the environment by turning green is typically insignificant. The argument is that if everyone went green, it would have a major and obvious influence; however, not everyone can be persuaded to go green, and many argue that it has little meaningful impact outside of economics. As a result, many people will make the decision to go green on their own.
6. *Apathy and hesitation among employees:* Many employees believe that it is not their job to safeguard the environment when they are at work. However, when it comes to choosing employment, the newly educated workforce places a high value on environmental protection.

### **Green HR Policies:**

Without a question, organizations are the primary source of environmental issues. As a result, they should play a significant role in tackling environmental management challenges.

Bebbington (2001) recognized a variety of GHRM practices. The following are some of the Green HR Policies:

- *Human resource sourcing and acquisition:* Because higher-level executives are increasingly responsible for green projects, green goals should be incorporated in the management job description. Environmental consciousness may be included into the organization's competence model as a personnel requirement.

- *Green recruitment and selection:* Companies can utilize their websites to encourage individuals to apply for open vacancies. Resumes may be filed online, reducing the need for paper documents. Web portals may also be used by businesses for onboarding material such as offer letters, credentials, and testimonials addressing qualifications and experiences, as well as acceptance letters for selected candidates. To choose personnel, an organization might use "Green awareness" as a preference factor. Companies look for personnel that are environmentally conscious.

- *Orientation:* The employee induction program should be designed in such a way that new workers may be inducted into a culture of green consciousness. Employers should emphasize in the orientation program their workers' attention for green concerns such as their health, safety, and green working environment.

- *Learning and development policies* might include programs, workshops, and sessions to assist employees in developing and obtaining knowledge in environmental management, green skills, and attitudes. Job rotation in the green assignment should become an essential component of the professional development plan for future skilled green managers.

To improve staff abilities and knowledge in green management, training content should be developed. Environmental management training may benefit from extensive use of online and web-based training modules, as well as interactive media. Green training can focus on environmental issues including as safety, energy efficiency, waste management, and recycling. Training managers should rely increasingly on online course content and case studies rather than printed handouts, decreasing the usage of paper even further.

- *Green Performance Management:* The purpose of the Performance Management (PM) system in green management is to monitor ecological performance standards across the business and



obtain meaningful information on managers' green performance. The PM system should provide green performance indicators. Green PM systems may be effectively implemented by defining performance indicators for each risk area in environmental education and awareness. It is critical to explain green initiatives to all levels of personnel. Green objectives and responsibilities can be established by managers/employees.

- *Green Compensation and Reward management*: The remuneration package should be tailored to reward employees for acquiring and demonstrating green capabilities. Environmental incentive schemes that are monetary, nonmonetary, and recognition-based, as well as monthly managerial bonuses, can be granted depending on performance results in environmental balance. Carbon emission standards and renewable energy sources are the primary considerations for CEO compensation as a reward for environmental initiatives. Employees who achieve green targets may be rewarded.

**Green HRM Practices:**

Researchers (Cohen and Taylor, 2010; Ehner, 2009; Behrend, 2009; Philips, 2007) suggest a few Green HRM practices, which are mentioned below:

1. Encouraging staff to develop ways to limit the usage of ecologically harmful chemicals in their goods through training and compensation.
2. Assisting staff in researching ways to recycle materials that may be utilized to build playgrounds for children who do not have access to healthy play areas.
3. The goal of designing a company's human resource management system is to reflect fairness, development, and well-being, therefore contributing to the long-term health and sustainability of both internal (employee) and external communities.
4. Emphasizing long-term employment stability helps employees, their families, and communities minimize disturbance.
5. The use of company employment portals for recruiting, as well as the use of telephone, internet, and video interviews, which can reduce the candidate's travel needs while also impacting paperwork reduction.

6. Companies may give green incentives to workers by arranging for a nature-friendly workplace and lifestyle perks such as providing carbon credit equalizers, free bicycles, and pollution-free automobiles for commuting to the office in order to engage employees in the green agenda.
7. Talented, competent, and experienced personnel are now environmentally sensitive, and they seek self-actualization in order to remain devoted to their profession. Green HR may help to foster this dedication by adhering to green ideals and practices.
8. Green activities may be carried out with the use of as little paper and printed documents as possible in recruiting, training and development, and performance assessment.
9. A firm may establish a green business environment by limiting the usage of printed documents, increasing recycling, adopting eco-friendly shopping and lunch bags, and restricting the use of bottled water and plastic in the office.
10. In the office, fluorescent light bulbs and other energy-saving green gadgets can be employed.
11. Companies may encourage their workers to improve their travel and mobility habits by decreasing official automobile trips, utilizing public transit for business travel, carpooling, giving interest-free loans to acquire hybrid vehicles, and cycling or walking to work.
12. Wherever practical, conduct company meetings and conferences through the internet, phone, or video conferencing to decrease business travel.
13. Provide employees with flexible work possibilities such as telework or work from home via emails and corporate portals via intranet and internet.
14. Wellness programs for workers, their families, and the general public can be designed to emphasize physical activity, adequate nutrition, and living a healthy lifestyle. Environmental management, as a key green goal, can be incorporated in the company's mission statement as part of their social duty. Organizations can organize cleaning and waste management initiatives in their workplaces and communities to raise awareness about environmental concerns.
15. Encourage employees to switch off lights, laptops, and printers after work hours and on weekends to save even more energy.
16. Encourage staff to turn off computers and printers when they will be absent for an extended period of time.

17. Turn off workplace lights during meetings, at night, and on weekends. When a room is not in use, turn off the lights in the toilets, conference rooms, libraries, and so on.
18. Work with IT to move to laptops instead of desktop PCs because laptops use up to 90% less electricity.
19. Use prudence while installing an air conditioning system.
20. Instead of separate containers, buy large or refillable containers of creamer, sugar, salt, pepper, and butter.
21. Organize green-themed activities to encourage ecologically responsible behavior and teamwork among employees.
22. Offer green promotions such as loan reductions on fuel-efficient vehicles and energy-saving home modifications, as well as discounts at local green businesses.
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**VOCAL TO LOCAL AS EFFECTIVE RETAIL MARKETING STRATEGIES**

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**Abstract**

The primary research objective is to determine the influence of Vocal to Local strategy on retail sector in India. The setting for this study was the retail industries of Maharashtra. Qualitative semi-structured in-depth interviews were conducted with seven retailer industry of Maharashtra. The result of study shows retail industry had experienced the impact of Vocal to Local strategy on buying behavior of customers, customer satisfaction and customer retention. This study concludes that Vocal to Local strategy has a positive impact on retail industry.

**Keywords:** Vocal to local, Retail industry, Local strategy, Buying behavior, Customer

**Introduction**

Vocal for Local' is a concept which dates back to the era of the Swadeshi movement which started in 1905 as part of the Indian independence movement. As an economic strategy, it

helped develop Indian nationalism at the time. After 1947, in the 1950s and 60s we followed a conscious, socialist pattern of development to create and grow a base of domestic big industry. However, this minimized competition and also encouraged protectionism. The era of the 1990s saw a liberalization of the economies across the world, including in India. This led to an infusion of FDI and big investments from MNCs and corporate houses and several joint ventures which made India very competitive.

So 'Vocal for Local' would have been a brilliant strategy for some sectors in India but definitely not in most of the sectors. While 'Vocal for Local' is a great idea, we have to recognise that the realities of the global environment have changed significantly. It is no longer possible to create globally competitive products without access to globally competitive resources, and without creating globally competitive synergies

Indians must use domestically made products to replace foreign ones as their resolution for the New Year said Prime Minister Narendra Modi on his Maan Ki Baat program on 27<sup>th</sup> Dec.2020 Sunday, reiterating his government's plan to become "self reliant" in manufacturing." he appeal to the citizen to make a list of goods of daily-use imported articles that have unconsciously become part of their lives and made them their captive. He urge the citizen let us find out their Indian alternatives and resolve to use products produced by the hard work of Indians,".

The people of India have taken many steps forward and are getting vocal for local. Due to that the manufacturers are also thinking about making top quality products. This will boost the efforts towards Aatmanirbhar Bharat. The focus on Made-in-India products the manufacturers should not compromise with the quality of materials produced by them with zero effect, zero defect' policy. In this connection different retail industries are taking various steps to promote local product in their marketing strategy.

The Covid-19 has negatively impacted the retail sector. With all the retail shops and sectors being closed to ward off the crisis, sales and manufacturing have plummeted to the ground.

Retail industries hope to see a positive change now as restrictions have been eased and shops being reopened. Although not at full swing but customer footfall has started. Similarly, online business is resuming at a good pace.

Further to support local for vocal – retail industries are also engaged with local supplier and manufacturers. They had partnered with them to fulfill their business requirements along with educating and developing them to achieve fast, cost effective and best quality output.

The COVID 19 pandemic is forcing changes in the world. People are living differently, thinking differently and in many ways buying differently. Consumers are looking at products and brands through a new lens. The factors that influence brand decisions are also changing as “Buy Local trend accelerates”.

### **Literature Review**

Srivastava, D. (2020) emphasized the Indian heritage and marketing goods with the clear 'Made in India' slogan. In terms of customer preference following the failure during the shutdown, Swadeshi goods are also demanded to support the economy.

Chakraborty (2020) investigated global trends from an Indian viewpoint it attempts to discover emerging issues in local governance. A decade of indecisiveness and the corruption along with the role of social media exposures to perceived threats from cross-border terror have given birth to central political forces and the current era has seen an increase in the Capacity of state the Indian administration is not permitted to judge on local issues from a grassroots level.

Behrman, A. (2021) stated after getting the slogan of becoming ‘Atma-Nirbhar’ to mitigate the impact of COVID-19, it seems that in future ‘Made in India’ will be a significant factor to influence the consumer buying behaviour. They tried to explore the changes in advertising campaigns adopted by selected FMCG companies to boost the Indian economy and common themes to support the ‘Vocal for Local’ movement.

Chatterjee, A. (2020) stated maintaining the public health infrastructure requires easy availability of medicines at affordable cost, especially in times of epidemics. This makes the pharmaceutical industry an important strategic asset to support the ‘Vocal for Local’ movement.

### **Objectives of study**

- I. To study impact of local product on customer satisfaction in retail store
- II. To analyze the influence of local product on customer retention in retail store.

### **Hypotheses**

H1 - There is a significant positive relation between the presence and absence of a local product in a retail store and customer satisfaction

H2- The constant offering of local products helps increase customer retention.

### **Scope and Need of the study**

This research aim to explore the impact of Vocal to Local strategy on buying behavior of customers, customer satisfaction and customer retention in small retail industries of Maharashtra, it also provide a path to implement Vocal to Local strategy and managing retail industries smoothly. This paper also explained and provides different insight to small retail industries of Maharashtra.

### **Research Methods**

This explorative, comparative qualitative paper explores business practices and marketing strategies by small retail business owners in India and the role of localization, using three key themes – place, people and promotion.

### **Analysis Method**

To achieve the objectives described above, and to analyze their importance among consumers in retail sectors, 5 point Likert-scale used to allow the author of this study to gather the necessary data to calculate the mean and correlations among the questions described previously, as well as other statistical information that was needed to interpret respondents' perceptions such as standard deviation for the overall results on each topic.

### **Results**

Participant Profile Demographic results of a total of 114 valid surveys were as follows: -

**Gender:** Male 48.00%, Female 52.00% -

**Marital Status:** Married 58.02%, Single 41.98% -

**Age:** Under 20 0.88%, 21-30 35.96%, 31-40 33.33%, 41-50 26.32%, Above 50 3.51% -

**Educational Level:** Secondary Education 21.93%, Bachelor Degree 64.04%, Master Degree 14.04% - **Occupation:** Professional 8.77%, Retired 0.88%, House Wife 1.75%, Student 5.26%,

Worker 16.67%, Self-Employed 22.81%, Unemployed 5.26%, Private Sector Employee 35.96%, Other 2.63%

**Income Level:** Less Than Rs 10000per Month 33.33%, Rs 10000-Rs-15000 per month 30.70%, Rs-15000-20000 per month 25.44%, Rs-20000-Rs-25000 per month 6.14%, Rs-25000-Rs30000 per month 2.63%, above 30000 1.75%

For **H1**, "There is a significant positive relation between the presence or absence of a local product in a retail store and customer satisfaction ", correlation between local product and customer satisfaction was analyzed and a result of +8.002% was obtained. Therefore, it can be inferred that by having a positive correlation between local product and customer satisfaction, which means that when there is a greater impact of vocal to local strategy on retail industry. For **H2**, "The constant offering of local products helps increase customer retention ", correlation between local products and customer retention analyzed and a result of 15.176% was obtained. Therefore, it can be inferred that when local products and customer retention are highly correlated with each other. Therefore, the hypothesis may also be considered as valid.

### **Conclusions and Discussion**

As a result of all what has been described within this document, it can be concluded that when local product has a greater impact on customer satisfaction's perception tends to grow on the positive side, confirming that a localized marketing strategy taking into consideration local customs and values, helps increase up to certain point the attractiveness towards a new product within a new market, and makes valid the fact than in India, Another aspect to consider is the fact that induction of local product also influence customer's retention. Therefore, it is clear that vocal to local as effective retail marketing strategies for small retailing business in India. As a result of this, innovation cannot be ignored since it comes to stimulate the necessary brand differentiation and demand in any marketing strategy that may involves local products, especially within a business environment. Consequently, this innovation process should be dynamic and constant, when necessary, to remain competitive and retain actual customers especially on those areas where the business has developed a competitive advantage (Bowonder, Dambal, Kumar &Shirodkar, 2010; Francesca, Ciommi, Donatella & Enrico, 2010). Last but not



least, through this research has also been validated the fact that vocal to local as effective retail marketing strategies for small retailing business in India and may have a competitive advantage, benefit of being associated with a better service or quality, thus increasing customer's perception and satisfaction. Nevertheless, it becomes fundamental to understand that local brands are developed with time, and that depending on the culture and customs of the market being penetrated, if such cultural aspects are not handled correctly they become a advantage compared to other options (Akaka & Alden, 2010; Jun, Lee & Gentry, 2005; Harish, 2008). Finally, a good product brings with it more customer loyalty, and such customer loyalty means more sales, growth, and even survival within difficult times.

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**Study of Customer Aspects of Cyber Securities in E-Banking**

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**Abstract:**

The Internet seems to be the new delivery channel in the banking sector. Factors such as the security of personal data or the reliability of a financial institution have been identified as the determinants of electronic-banking adoption. In this paper, we have tried to analyse customers perception and awareness towards e-banking, problems faced by them while using e-banking along with security and privacy concern faced by them. A series of new factors, such as the difficulties of using the Internet, are shown to play a crucial role in the consumer's attitude – adoption or rejection – of this new alternative channel.

**Keywords:** Internet, e-banking, Cyber Security, Privacy

**Introduction**

Online banking systems have become quite popular in the last ten years. It is an online payment system that enables different customers to conduct online financial transactions on a website. Customers from an online bank can manage their accounts with their own electronic devices as long as an Internet connection is available. Online banking is also referred as e-banking, virtual banking, Internet banking and by other terms.

Internet banking has proved to be an ideal and profitable means of banking in the banking industry. Most banks have quickly migrated to this technology in order to reduce cost and improve customer experience.

The process of adoption of technology depends on information gathering and set of belief that will help the user in either accepting or rejecting it. The technology acceptance determines that the user acceptance of technology is driven by two factors namely ease of using that technology and usefulness of the technology. Adoption of technology is the greatest challenge for the

banking industry. Some of the risk associated with the Internet banking users are users themselves; their behaviour when it comes to E-banking.

Internet banking security risk can cause financial losses if the risk is real. Financial sectors and banking sectors are more prone to security attacks. User acceptance is one of the key factors in the acceptance of technology. To work on Internet banking requires a certain level of information technology literacy. Users may not be comfortable in trusting a totally automated system.

Despite the fact that banks in emerging countries have integrated security features yet users' behaviour causes security vulnerabilities. A lot of internet security threats and vulnerabilities still continue to persist. An example is Internet banking users sharing their login credentials with others knowingly or unknowingly. This may lead to compromising of the user account and may lead to security breaches. As new threats continue to emerge, banks will need to adopt new measures to protect users.

### **Literature Review:**

Review of literature is backbone of every research study. It is important to review the existing literature to have an overview of what kinds of studies have been conducted and what are the gaps in literature. Therefore, various studies in the domain of e-banking which were conducted in India and abroad have been reviewed.

Karjaluoto et.al, (2002) explored the effect of different factors in the attitude formation toward internet banking in Finland. For study purpose a sample of 1167 bank customers were taken. Attitude formation was studied with the help of Structural Equation Modelling (SEM). The study found that prior experience & knowledge of computer and attitude toward computer influence attitude toward online banking. The study also found that demographic factors such as occupation and household income impact heavily on online banking behaviour.

Mattila et al., (2003) in their study analysed the mature customers' Internet banking behaviour in Finland. The survey sample consisted of three consumer segments (non-users, new users, old

users) that differed in terms of Internet banking experience and sample size was 1,167 bank customers. Household income and education were found to have a significant effect on the adoption of the Internet as a banking channel, so that over 30 percent of wealthy and well-educated mature males make e-banking their primary mode of making payments. Perceived difficulty in using computers combined with the lack of personal service in e-banking was found to be the main barriers of Internet banking adoption among mature customers. Internet banking was also found to be more unsecured among mature customers than bank customers in general.

Geeta (2003) reviewed the current scenario of phishing attacks in India and provided some countermeasures that can be adopted by online firms to fight this kind of attack. The study found that there has been an increase in identity theft in the last few years which could pose a serious problem in the future, resulting in loss of trust by the customer towards net banking. Most of the Indian banks are taking initiatives to address the problem but still more work is to be done in the case of small and rural banks. In the end, the study furnished guidelines to tackle the situation.

Gerrard et al., (2006) attempted to find out factor which were responsible for not using internet banking. For study purpose, a survey was used to acquire data from 127 consumers who were not internet user. Using a content analysis procedure, eight factors were identified which explain why consumers were not using internet banking. 67 the identified factors were perceptions about risk; the need; lacking knowledge; inertia; inaccessibility; human touch; pricing and IT fatigue.

Celik, Hakan (2008) in his study provided an insight into the determinants of customers 'acceptance to internet banking. The study has addressed a research need 69 for extending the technology acceptance model (TAM) by adding contextual factors for the case of Internet banking. The additional contextual factors added to model were perceived behavioural control (PBC), perceived playfulness (PPL) and perceived risk (PR). The partial least squares (PLS) procedure is used to analyse 161 cases collected from individual Internet banking users through a web-based survey. The results indicated that perceived usefulness (PU) and perceived ease of use (PEOU) are immediate direct determinants of customers 'attitudes towards using Internet banking. PU, PR and ATT determine the large proportion of behavioural intentions to use Internet banking. Although PPL positively influences only PEOU, PBC exerts positive direct effects on PEOU and PU and indirect effects on PU and ATT. Study also found that Perceived

Risk i.e., concern for security and privacy could be one of the obstacles for IB adoption and its adverse effects should not be underestimated by practitioners.

Kesharwani and Bisht (2012) attempted to extend the technology acceptance model (TAM) in the context of internet banking adoption in India under security and privacy threat. The study revealed that perceived risk had a negative impact on behavioral intention of internet banking adoption and trust had a negative impact on perceived risk. A well-designed web site was also found to be helpful in facilitating easier use and also minimizing perceived risk concerns regarding internet banking usage. (Kumar et.al.2022)

### **Research Problem**

What are the different aspects of Cyber Securities in E-Banking Services from Customers' perspectives?

### **Research objective:**

The study was conducted with following objectives: -

- To analyse the customers' perceptions and awareness towards Internet banking security
- To understand the problems faced by customers while using internet banking services
- To know impact of the internet banking securities among the selected customers
- To study the security & privacy issues and regulatory environment of e-banking services in India.
- To find out the relationship between security & privacy concern and security & privacy satisfaction.
- To understand the opinion of non-users of e-banking services.

### **Research methodology:**

- This is Descriptive research. The present study examines the security and privacy issues in e-banking. With a view to develop a sound theoretical framework for investigation, review of literature in related to e-banking services and security issues has been carried out.

Important studies related to adoption of e-banking services, security issues in e-banking services etc. conducted have been reviewed.

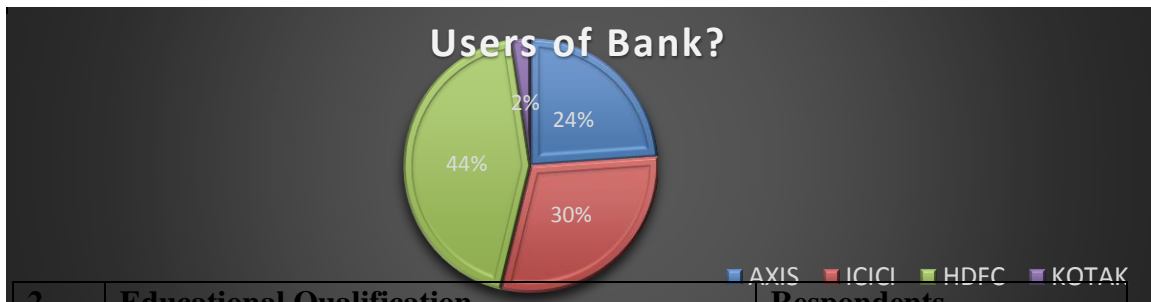
- Population, Sampling and Sample Size- The population for the study comprised of customers of selected private sector banks . For study purpose, four banks of private sector were selected i.e., ICICI, AXIS,HDFC,KOTAK. More specifically, the target population for the study was defined as —Bank customers who have used at least one e-banking service two times in the last quarter.
- The prime objective of the study was to examine the perception of bank customers regarding security and privacy concern in selected banks. Therefore, a sample of 100 bank customers divided equally among selected banks was planned. However, the researcher could obtain only 57 valid questionnaires. Thus, the findings of this study are based on opinion of 57 respondents.
- Sampling Unit: Sampling unit for data collection was individual bank customers.
- Instruments Design: To collect the data from bank customers, a structured questionnaire was prepared. The questionnaire was prepared in consultation with Dr.Atul Kumar. Researcher also took into account the inputs of e-banking users to include important aspects of e-banking security in the questionnaire.
- The first part of the questionnaire dealt with the demographic profile of the respondents.
- The second part of the questionnaire consisted of eight constructs which were used to measure the level of security & privacy concern and level of satisfaction regarding security & privacy concerns of e-banking services. Respondents were asked to indicate their opinion on Five-Point Likert Scale ranging from “strongly agree” to “strongly disagree”.

### **Research design**

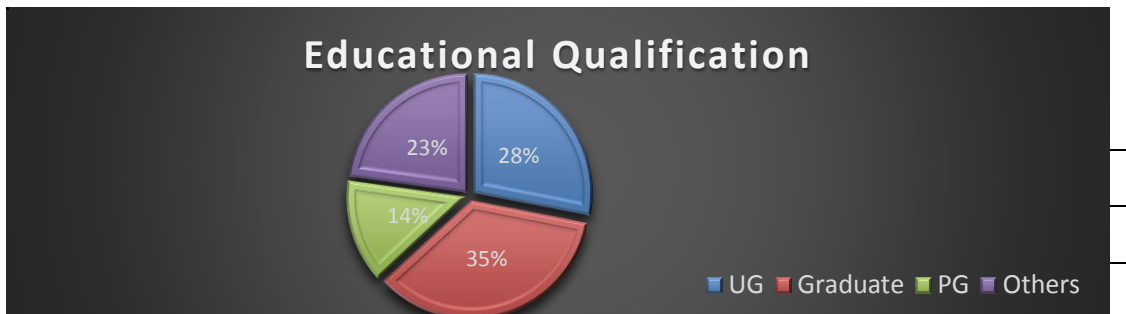
A research design is the overall plan for obtaining answers to the questions being studied and for handling some of the difficulties encountered during the research process. The main purpose behind the study was to know the awareness and customers perception regarding the cyber threats related to e banking.

**Data Analysis & Interpretation**

1.	Name of your bank?	Respondents
	AXIS	48
	ICICI	60
	HDFC	88
	KOTAK	32
	<b>TOTAL</b>	<b>228</b>

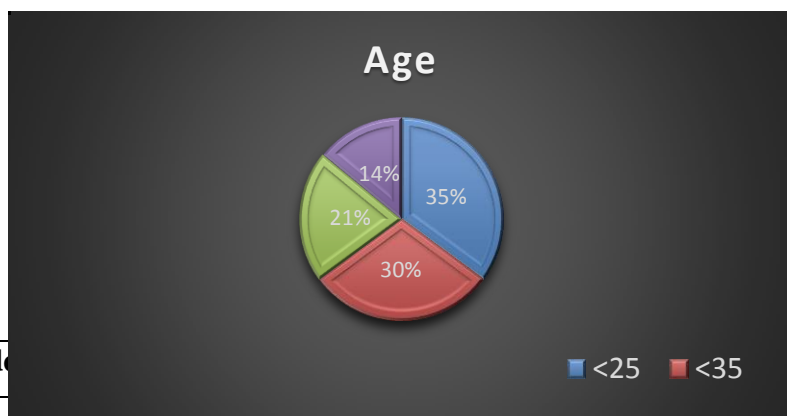


2.	Educational Qualification-	Respondents
	Undergraduate	64
	Graduate	80
	Post-Graduate	32
	Others	52
	<b>TOTAL</b>	<b>228</b>

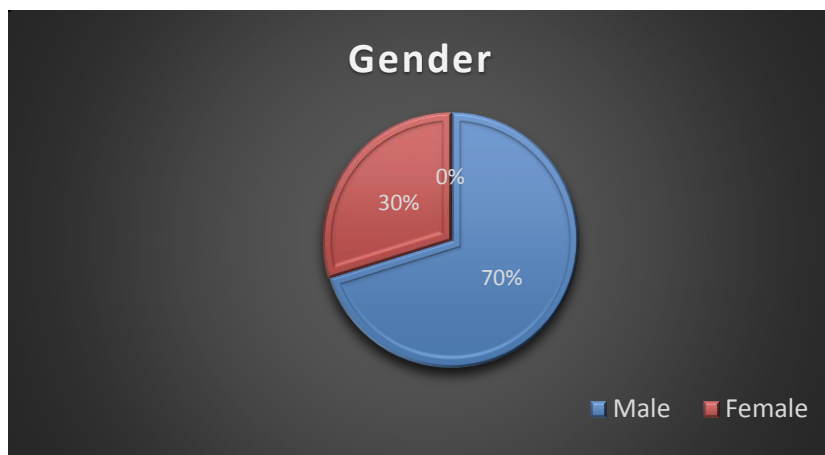


	<50	48
	>50	32
	<b>TOTAL</b>	<b>228</b>



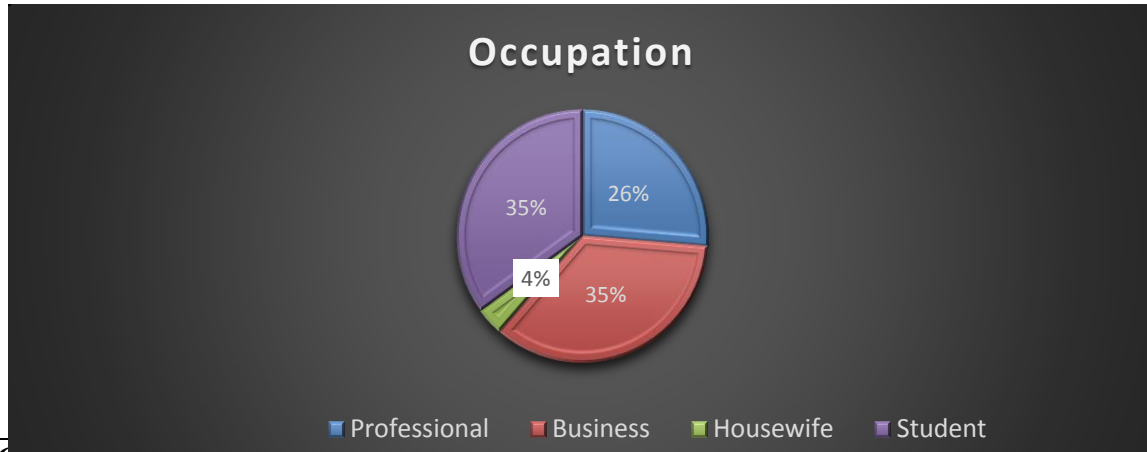


4.	Gender	Respondents
	Male	100
	Female	68
	Others	-
	<b>TOTAL</b>	228

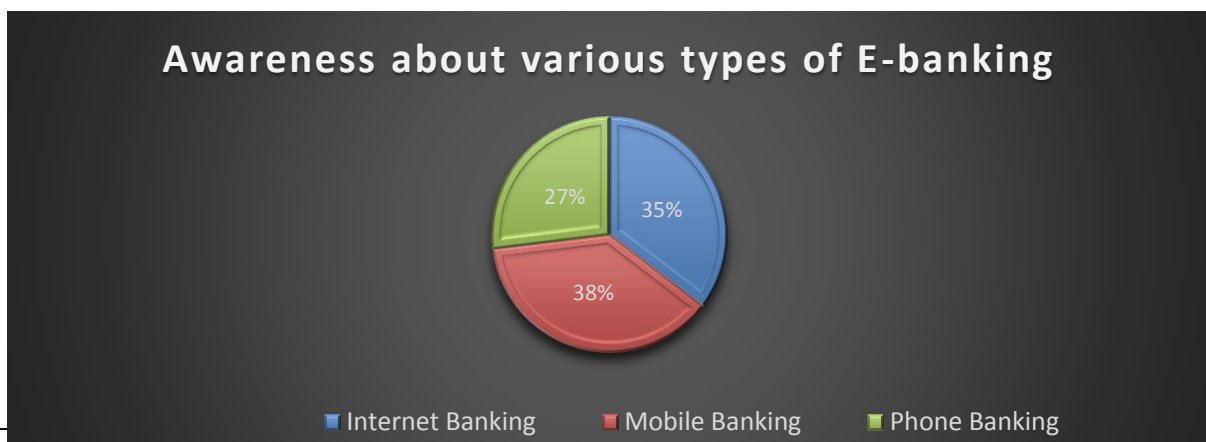


5.	Occupation	Respondents
	Professional	60
	Business	80
	Housewife	8
	Student	80

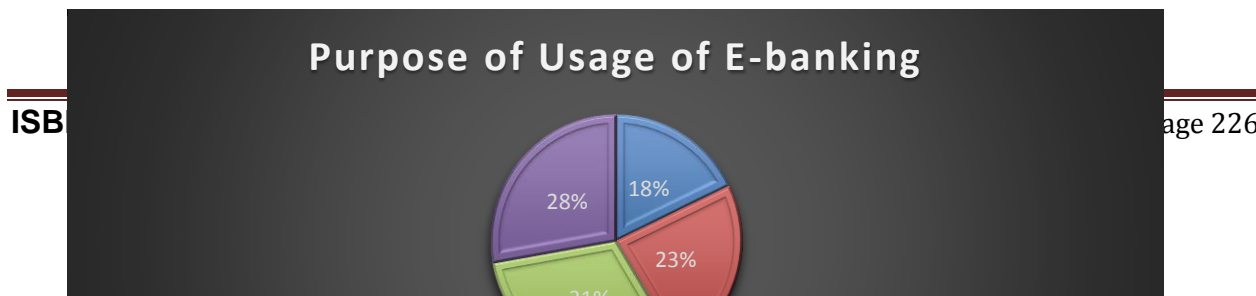
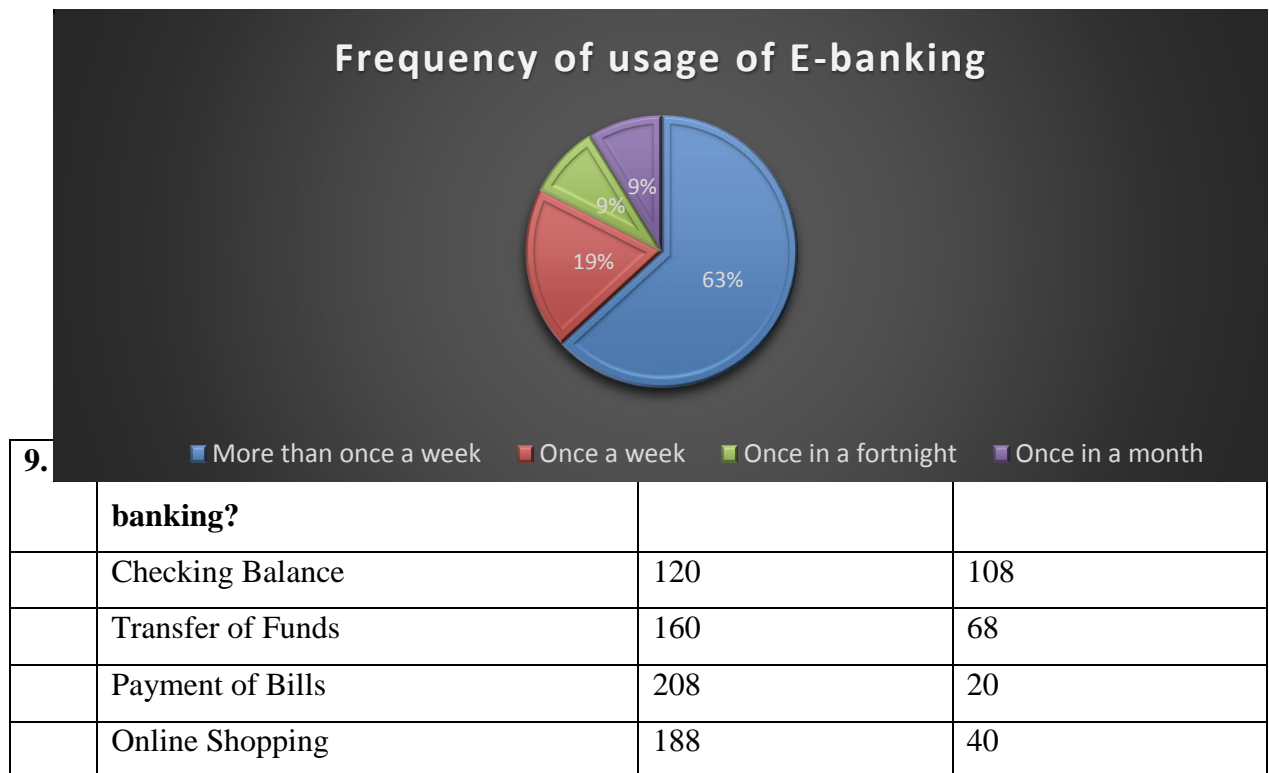
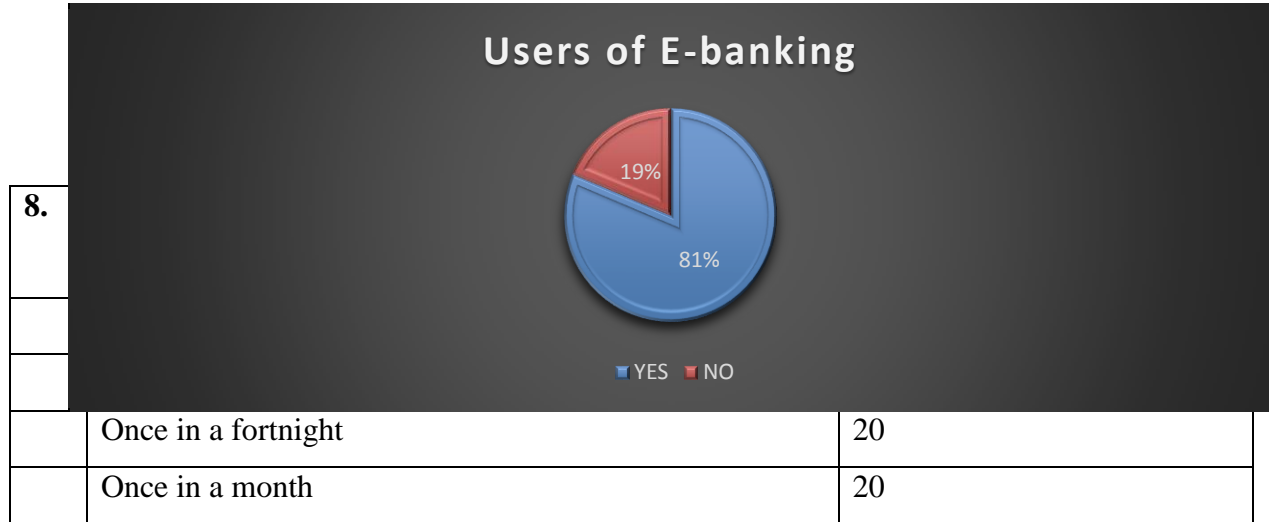
<b>TOTAL</b>	228
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6.	Which of the following new technology-based banking channels are you aware?	YES	NO
	Internet Banking	92	22
	Mobile Banking	98	16
	Phone Banking	70	24
	<b>Total</b>	260	62



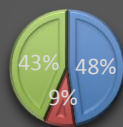
7.	Do you use Internet Banking?	YES	NO
	<b>Respondents</b>	192	44



12.	Please rate your overall satisfaction about the Internet banking services of your principal bank.	Respondents
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10.	Which of the security feature(s) of internet banking are you aware of?	Yes	No
	One Time Password (OTP)	108	8
	Profile Password	68	188
	PIN	20	28

### Awareness about Security feature of E-Banking



■ OTP    ■ Profile Password    ■ PIN

	Highly Satisfied	80
	Satisfied	80
	Neutral	40
	Dissatisfied	28

No. 11	Statement	Stro ngly Agree	Agr	Neu	Disa	Stro ngly
1	It is safe to use internet banking of my bank	0	0	0	0	
2	My internet banking password may be stolen	0	0	8	0	0
3	Funds may be fraudulently transferred from my account to other's account	0	0	0	0	8
4	One can monitor my financial transaction history	0	0	0	0	8
5	Bank will not refund my money back if there is online fraud	0	0	0	8	
6	Internet banking is vulnerable to fraud	0	0		0	0
7	The site provides security guidelines on home page	8	0		0	0
8	OTP (One Time Password) is required, if logging from different browsers/computers	0	0	0	0	
9	Bank remind me to change					

	password from time to time	4	4	0	0	8
10	Bank provide me the facility of choosing strong password for internet banking	0	0	2		8

**Conclusion**

Here it can be concluded that around 70 % of people have positive perception & are satisfactory with E-Banking Services. Still people of these areas are not using all the E-banking services frequently because they less knowledge about computer and internet; so they feel hesitation in using E-banking services. So banks should improve their promotional and communication strategies to make aware the customers regarding IT services and build-up positive perception to improve the level of usage of E-Banking with high level of satisfaction.

At present Indian banks are investing huge amount in the infrastructure to host internet banking activities. However, adoption rate of e-banking services is very low in India as compared to developed countries. Various research studies showed that apart from other factors concern for securities and privacy is most important factor influencing the adoption of internet banking. The present study also found that except ATM, the level of concern for security and privacy regarding use of e-banking services is high. In this context, the findings of the study have implications for banking industry in two ways. Firstly, the comparison of security and privacy features will help the bankers to make their online portal more secure by incorporating the security features which other banks are using. Secondly, the study will be helpful to the bankers to understand the behavior of internet banking users and behaviour of non-internet banking users. It will help bankers to understand the security and privacy aspect of various e-banking services where customers have high level of concern. It will assist the bankers to retain the existing bank customer and to convert the potential users to actual e- banking users.

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SECURITY AND PRIVACY ISSUES IN E-BANKING: AN EMPIRICAL STUDY OF CUSTOMERS' PERCEPTION

**A study of various perspectives and research propositions on the future of digital and social media marketing research.**

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**Abstract**

In this age of digitalisation and social media, the buyer conduct and the freedom to association have seen lot of change due to decreased costs and also the increased utility due to the web and web-based media. This has further affected and modified the brand awareness and expanded deals. Nevertheless, there exist certain bottlenecks that crop up due to negative electronic verbal exchange which affects adversely impacts the web brand presence. This article is an attempt to study the issues that impacts online media showcasing due to digitalisation. The study offers a perspective on nitty gritty account on the important such as those including computerized reasoning, B2B advertising, electronic verbal exchange etc. This study offers a new viewpoint for the upcoming research by giving a different direction with respect to the area of computerised and social advertising.

**Keywords:** Brand awareness, Digitalisation, consumer behaviour, buyer conduct.

**Introduction**

Web, online media, portable applications, and other computerized correspondences advances have become part of regular day to day existence for billions of individuals all throughout the planet. As indicated by ongoing insights for January 2020, 4.54 billion individuals are dynamic web clients, incorporating 59 % of the worldwide populace (Statista, 2020a). Web-based media utilization has become a necessary component to the existences of many individuals across the world. In 2019 2.95 billion individuals were dynamic online media



clients around the world. This is conjecture to increment to practically 3.43 billion by 2023. Advanced and online media showcasing permits organizations to accomplish their promoting destinations for generally minimal price. Facebook pages have in excess of 50 million enlisted organizations and more than 88 % of organizations use Twitter for their showcasing purposes (Lister, 2017). Advanced and online media advances and applications have additionally been generally utilized for making consciousness of public administrations and political advancements. Individuals invest an expanding measure of energy web based looking for data, on items and administrations speaking with different purchasers about their encounters and drawing in with organizations. Associations have reacted to this adjustment of shopper conduct by making computerized and online media a fundamental and necessary part of their business advertising plans.

Associations can essentially profit with making online media promoting a fundamental component of their general business system. Web-based media empowers organizations to associate with their clients, further develop attention to their brands, impact customer's perspectives, get criticism, help to work on current items and administrations and increment deals. The decay of conventional correspondence channels and cultural dependence on blocks and-mortar activities, has required that organizations look for best practices utilization of advanced and online media promoting procedures to hold and expand piece of the pie (Naylor et al., 2012; Schultz and Peltier, 2013). Critical difficulties exist for associations fostering their web-based media methodology and plans inside another truth of expanded force in the possession of buyers and more prominent consciousness of social and cultural standards. These days, shopper grievances can be immediately imparted to a huge number of individuals (negative electronic verbal) all of which can have adverse results for the business concerned.

This examination unites the aggregate bits of knowledge from a few driving specialists to talk about the huge chances, difficulties and future exploration plan identifying with key parts of computerized and online media advertising. The experiences recorded in this paper cover a wide range of computerized and online media showcasing points, mirroring the perspectives from every one of the welcomed specialists. The exploration offers huge and opportune commitment to the writing offering key understanding to analysts in the progression of information inside this

showcasing space. This point is situated as an opportune expansion to the writing as the computerized and web-based media advertising industry develops and accepts its situation as an essential and basic part of an associations showcasing procedure.

**Literature review:**

This part integrates the current writing zeroing in on advanced and online media advertising and talks about each subject recorded in a survey of the surviving writing. Studies remembered for this part were distinguished utilizing the Scopus data set by utilizing the accompanying mix of catchphrases "Online media", "advanced showcasing" and "web-based media advertising". This methodology is like the one utilized by existing audit papers on various key points the general subjects were partitioned into four topics: climate, organization, results, and showcasing procedures.

**1. Environment:**

The presentation and progression of computerized advances has essentially impacted the climate in which organizations work. The investigations in this topic centre around the progressions of shopper conduct and client collaborations through online media and eWOM interchanges.

Customer conduct has altogether changed because of mechanical advancement and omnipresent reception of hand-held gadgets, straightforwardly adding to how we collaborate and utilize social business to settle on choices and shop on the web. The expanding utilization of computerized showcasing and web-based media has emphatically impacted buyer perspectives toward web based shopping with expanding portion of the overall industry for e-commerce driven associations. The expanding number of shopping channels has likewise impacted customer conduct, making a more diffused purchaser shopping experience. Portable channels have become the standard and are presently inserted inside buyers everyday lives by means of the utilization of versatile devices, shopping applications, area based administrations and versatile wallets - all affecting the customer experience.

## **2. Marketing strategies**

Organizations utilize various online media stages for web-based media advertising, for example, Facebook, Snapchat, Twitter and so forth the selection of stages relies upon target shoppers and advertising system. Chen and Lee (2018) examined the utilization of Snapchat for web-based media promoting while at the same time focusing on youthful buyers. The investigation discoveries featured that Snapchat is considered as the most private, relaxed, and dynamic stage giving client's data, socialization, and amusement. The examination distinguished that youthful buyers appear to have an uplifting perspective towards Snapchat inciting comparative inclinations toward buy goal and brands publicized on the stage.

Tease and Wien (2018) dissected different methodologies utilized by organizations, for example, ground-breaking - where the experience and personality of the central brand displays positive mental attributes; educational - presents genuine item; administration data in clear terms and interactional - where web-based media promoting develops progressing collaborations with clients and message techniques. The examination attempted by Kusumasondjaja (2018) tracked down that intelligent brand presents were reacted on more habitually than enlightening message content. Twitter was more successful for instructive allure. The discoveries featured that Facebook turned out better for intelligent amusement posts and that Instagram was more appropriate for intuitive substance consolidating educational diversion bids. Intuitive brand posts with blended claims got the most reactions on Facebook and Instagram, while a self-situated message with educational allure got the least allure.

## **3. Company**

Various methodologies have been taken on by associations in the utilization of computerized and online media showcasing where organizations have displayed fluctuating mentalities to web-based media system. The investigation by Matikiti et al. (2018) inspected factors that influence demeanour of travel services and visit administrators in South Africa. By utilizing surveys gathered from 150 offices the examination found that there are interior and outer components affecting disposition. Inside factors are administrative help and administrators' degree of training. Outer components are pressure from contenders, seen benefits and saw

usability. The examination by Canovi and Pucciarelli (2019) researched the demeanor towards online media showcasing with regards to little wine organizations. The examination found that while most of winery proprietors perceive the social, financial and passionate advantages of online media, they are a long way from taking advantage of its maximum capacity.

The writing has distinguished changes in demeanour to online media, contingent upon the size and sort of the organization. B2B organizations will in general see web-based media as having a lower by and large viability as a showcasing channel and classify it as less significant for relationship working than other correspondence models. Inspirations like apparent financial advantage, feeling of control, personal development, convenience and saw handiness, will in general impact private companies to utilize online media showcasing.

Associations utilize different devices for investigating and catching information from online media and overseeing multi-channel correspondence. Be that as it may, organizations will in general need adequate information on arising advancements like Artificial Intelligence (AI) with numerous associations showing low degrees of reception and usage of Machine Learning (ML) logical instruments. These advancements could be utilized by organizations for robotized curation of brand-related web-based media pictures to recognize more compelling deals limited time focuses to propose customized motivators for clients and for distinguishing important eWOM interchanges.

#### **4.Outcomes**

The impacts of computerized and online media advertising can bring about various positive and adverse results for associations. Studies have tracked down that online media advertising positively affects client maintenance and furthermore on buy goal with regards to lodgings, extravagance design brands and colleges. Advanced and online media advertising can positively affect an organization's image. This can appear as angles, for example, brand significance, brand value, brand devotion and brand manageability. The examination embraced by applied the outline hypothesis and multidimensional way to deal with brand value where the impact of web-based media interchanges on brand value was considered utilizing study information of 249 global vacationers. The outcomes distinguished a beneficial outcome of the

force of web-based media use on brand mindfulness and expectation to participate in eWOM correspondence. Studies have tracked down that online media can impact brand dependability, maintainability and business viability.

There are adverse results and coming about outcomes of computerized and online media advertising that should be considered by associations. Feature that advanced showcasing can have an adverse consequence whenever performed by incompetent specialist organizations. The examination features that in case advertising isn't created and overseen appropriately, it neglects to give benefits, destructs esteem, builds exchange costs, coordination costs, loss of non-contractible worth and adverse consequence on long haul benefits.

## **5. Social network analysis**

Informal organization examination includes contemplating organizations of individuals, where every individual is a hub. The social design of associations and ties between hubs are explored and described in informal organization examination. Interpersonal organization examination has been explored comparable to electronic verbal, recognizing powerhouses and researching how people impact others, the connection among impact and tie strength and the progression of data through online media. Be that as it may, there are still holes in the informal community examination of web-based media use writing.

One potential road for exploration might be to investigate what purchasers' inspirations for sharing data through web-based media mean for others' impression of the message, which is especially intriguing given the incredible development of the force to be reckoned with industry. An augmentation of this exploration is to inspect if and how forces to be reckoned with utilization of paid promotions, sponsorships and associations influences supporters in the interpersonal organization. Trial or semi exploratory plans might be utilized to decide whether hubs focus on the paid notices via online media, and how this might associate with the hubs' responses, offers and remarks on the powerhouses' non-natural posts. Past powerhouses, it is productive to investigate the possible adverse consequences of what happens when a hub sees similar message via online media on numerous occasions. Is there a point where there is an adverse consequence of openness to a similar data shared by an excessive number of hubs?

Maybe the data about the quantity of offers, remarks and responses via web-based media might weaken the effect of the pertinent data. The possible discoveries of such examination might have both hypothetical and administrative ramifications for getting purchasers.

It is captivating to analyse how negative versus positive electronic informal goes through an interpersonal organization on the web. The speed of data stream, volume of data shared, network bunches and cross-posts on various online media might be broke down and analysed for negative and positive electronic informal. To direct this exploration, a long range informal communication stage that permits all watchers to see the hubs, ties and recurrence of responses and remarks might be utilized. A semi test configuration approach might be utilized to choose the hubs; an occasion or essential news story would be shared to these hubs. Information on the occasions the hub saw, shared and remarked on the occasion and the effect of these numbers might be investigated to all the more likely see how popular advertising functions. It is intriguing to conceivably gauge the speed of the data stream, which might be conceivable with the high level specialized plans of the web-based media stage. In view of the exploration restrictions and holes illustrated over, the two recommendations are defined from now on to assist with directing future examination on this subject.

## **6. Research propositions**

At the point when people make decisions, the weakening impact happens when individuals neglect to utilize indicative data within the sight of no symptomatic data. For web-based media advertising, the weakening impact might happen when buyers see the quantity of responses and remarks about a message, which fill in as the no symptomatic subtleties. The message is the analytic data. Nonetheless, if the quantity of responses and remarks on the web-based media stage is too high, maybe that might serve to weaken the impact of the demonstrative message subtleties and serve to contrarily affect the person's judgment of the data.

The promptness of web-based media makes it simpler for individuals to follow up on their benevolent motivation and use it to spread messages and proliferate goodness. Then again, people may likewise choose to utilize web-based media with the end goal of philanthropic discipline, which is focusing on an individual or association whose conduct is socially

unsatisfactory. The selfless discipline accessible using negative messages via online media permits implementation of the gathering's normal practices. To authorize the accepted practices on the culpable individual or association, the negative verbal data is spread all the more rapidly through an interpersonal organization, when contrasted with positive informal data.

### **7. Innovative advertising**

For an advanced promoting effort to be fruitful, the fundamental and most significant viewpoint is to interface with the right crowd. With AI fuelled publicizing, it very well may be straightforward and straight forward for advertisers to focus on the right crowd. Artificial intelligence apparatuses can accumulate data, break down the information and anticipate future practices. With this information, advertisers can target ads according to the interest and anticipated utilization examples of the crowd. Additionally, ads can be improved with Augmented Reality (AR) and Virtual Reality (VR) in this way gathering more data from the clients and AI can ultimately use the information for a seriously captivating and customized ad insight.

### **8. Enhanced shopping experience**

Man-made intelligence fuelled advertising will change the customary method of shopping by further developing the web based shopping experience. Various brands are attempting various conceivable outcomes with different arrangements of AI to overhaul the shopping experience for clients, permitting them to communicate with items by means of the utilization of AR before buy.

### **Conclusion:**

In accordance with the methodology embraced, this ebb and flow research presents different perspectives on advanced and web-based media advertising from welcomed specialists. The specialists' point of view incorporates general records on this space just as viewpoints on more explicit issues including Artificial Intelligence, expanded reality showcasing, computerized content administration, versatile promoting and publicizing, B2B advertising, e-WOM, and

perspectives identifying with the morals and the clouded side of advanced and online media promoting. Every one of the individual points of view talk about the many difficulties, openings and future examination plan, pertinent to the many subjects and center themes. The master viewpoints inside the generally speaking chosen subjects of: Environment, Marketing methodologies, Company and Outcomes, expand on large numbers of the key angles and current discussions inside the more extensive advanced and online media showcasing writing. Every point of view presents singular understanding and information on explicit subjects that address a considerable lot of the momentum banter inside the scholarly and expert centered exploration. Various viewpoints talk about the numerous basic climate related intricacies encompassing eWOM, and its positive just as adverse ramifications for web-based media advertisers. The viewpoint from Anjala S. Krishen examined some of the mankind centered issues just as social parts of advanced showcasing, referring to eWOM with regards to our capacity to comprehend and connect with numerous societies and social orders. This perspective set the significance of handling the issue of data over-burden and that devices and new instruments can fabricate valid information and thus work with educated information driven choices. The points of view from Raffaele Filieri and Gina A. Tran feature the intricacies and numerous social elements identifying with buyer demeanour and confidence in the eWOM setting. The different yet similarly significant builds of both negative and positive eWOM are talked about, just like the interesting planned of additional examination that fosters a more profound information on how each are imparted through interpersonal organizations. The point of view from HajerKefi likewise examines eWOM setting the requirement for a rebalancing of examination accentuation on parts of advanced and web-based media advertising, attesting that reviews have discarded fostering a more profound degree of quantitative and subjective zeroed in research on the negative parts of online media. The web-based media advertising research angle is analyzed by Jenny Rowley, where the point of view traces the key components identifying with research on the conduct ramifications of customers just as client conduct attributes inside associations. This commitment features a portion of the restrictions of existing examination where studies have would in general bring to the table a limited division center and a penchant to depend on



understudies because of the simplicity of information assortment, precluding key web-based media shopper fragments.

Various key promoting angles have been analyzed by a scope of benefactors where the vital subjects of client commitment practices, innovative effects on B2B advertising, criticality of positive client ventures, AI driven web-based media execution and moral measurements identifying with advanced and online media showcasing are examined. The different points of view from Jamie Carlson and furthermore from Mohammad Rahman articulate how advanced and online media promoting can foster more prominent incentive for associations through the more extensive arrangement and development of client commitment practices and positive client ventures. These angles are basic to online media advertisers as the adverse consequences of helpless client excursions can seriously mark validity and trust. The effects of more prominent utilization of innovative advancements like AI, AR, enormous information investigation and blockchain have acquired huge foothold inside the showcasing centered writing. The points of view from Jari Salo, Philipp A. Rauschnabel diagram a large number of the advanced and web-based media ramifications of reception and utilization of innovation. The ground-breaking capability of AI as laid out by Vikram Kumar and Ramakrishnan Raman diagrams the gigantic importance for advertisers and associations that execute ML innovations inside their promoting methodologies, where advanced stages can screen showcasing efforts and perform constant enhancement dependent on client conduct and stage execution.

The moral measurements and logic intricacies of taking on AI related innovations are bantered by Yinchuan Wang, where this point of view sets the potential for enhanced web-based media promoting correspondence to create more prominent accomplish market returns for firms that endeavour to execute reasonable AI inside their advertising techniques. The viewpoint from Jenna Jacobson likewise moves toward the moral components of web-based media information for micro targeting purposes, featuring the significance of information straightforwardness and how this could assume an inexorably significant part inside moral hierarchical practice.

The versatile parts of associating with advanced and online media advertising are examined inside various commitments. The viewpoint from Heikki Karjaluo explains the job of

incorporated portable innovations, using wearable sensor gadgets and area based promotion focusing inside continuous help collaborations, attesting the potential for more sure brand correspondence. The effect of the versatile commercial model is surveyed inside the point of view from Varsha Jain, where the impression of clients is investigated with regards to buy goal, featuring the requirement for extra examination to comprehend the in-application impact on the improvement of inspirational perspectives.

Critical difficulties exist for associations and advertisers the same as they foster their advanced methodologies and brand mindfulness inside the cutting edge period of data over-burden and web-based media correspondence. The inborn intricacies and huge chances of the multi-stage online media age, present a division to advertisers, where direct admittance to a wide and different client base has never been simpler; while the dangers from negative eWOM can amplify continuously with enormous ramifications for the association. Advertisers creating brand mindfulness through advanced and online media should be ever insightful of the criticality in quickly captivating straightforwardly with shoppers because of negative postings, consequently, safeguarding trust and notoriety of the association. Advertisers that foster their computerized and web-based media methodologies close by the more profound examination of human conduct knowledge and conveyed collaboration through informal organizations, are expanding their odds of achievement. It tends to be seen that critical parts of the ebb and flow writing identifying with advanced and web-based media promoting are prescribing future examination to research various stages, different kinds of clients, their own attributes and investigation of social implications.

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**A study of Relationship Marketing and its impact on Brand Building**

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**Abstract:**

The study is based on the impacts of relationship marketing on brand building. Relationship Marketing has got its value strongly rooted in business and market place right from past four decades. It is the core sphere of operation for all kinds of trade and no organization overlooks this concept. Holding this importance of relationship marketing as a core idea, the study aims at discerning impact of relationship marketing variables on brand building. Brand building is a process which every organization goes through and to get it done in the right direction organizations focus on customer centricity. Through customer centric behavior they get customer retention which eventually leads to customer loyalty. The descriptive research highlighted the link between relationship marketing and brand building. The quantitative analysis was based on questionnaire method where we have randomly distributed questionnaire with 150 people of different demographics and different locality, out of which we got 100 responses. The relationship marketing variable trust, brand attachment, brand recommendation, customer complaint handling, customer loyalty and customer centricity are considered for the analysis. Focusing on relationship marketing variables that contribute towards high brand performance would enable companies to think on this profit enabling areas that eventually leads to a livelihood growth for the organization. Ultimately based on the data analysis we have concluded that relationship marketing has a positive impact on brand building.

**Keywords:** Relationship Marketing, Brand Building, Customer Retention, Customer Loyalty, Brand Attachment.

**Introduction:**

The concept of relationship marketing was initially defined by Berry (1983) as the process of, establishing, and maintaining strong term profitable customer relationships. Later and

more thorough definition was introduced by Gronroos (1994), where relationship marketing was defined as the process of "establishing, maintaining and enhancing relationships with customers and other partners, at a profit, so that the objectives of the parties involved are met, and this is done by a mutual exchange and fulfillment of promises." Relationship Marketing is adopted to create a positive mentality in the minds of the consumers where they will get the feeling of belonging for the organization. Relationship Marketing has a good positive impact on building customer loyalty which eventually leads to the success in overall performance of the brand.

Specifically, the study intends to achieve objectives which include: (1) to study the impacts of Relationship Marketing on Brand Building (2) to understand the Customer Perspective on Relationship Marketing. In this study the focus is on customer perspective that how the behavior of the brand with its customers impacts the performance of the brand.

#### **Literature Review:**

- From the days of ancient trade, relationship is practiced by numerous business people and it is considered to be an oldest approach of marketing (Gronroos, 1994). The basic concept of relationship marketing is focused on retaining the existing customers instead of acquiring new customers (Berry 1983). Rashid (2003) found nine dimensions that place a vital role in the success of relationship marketing which includes commitment, experiences, social bonding, fulfilling promises, empathy, customer satisfaction, trust, communication and internal marketing. Ndubisi (2017) proposes four important dimensions which include communication, trust, conflict handling and commitment and service industry. Trust and empathy are one among the four dimensions proposed by Callaghan (1995). The study carried out by Sin (2005), prove that relationship marketing dimensions were critical for the success of the business. Trust and satisfaction are relationship marketing dimensions considered in many B2B and B2C context. The growths of B2C and service industries have paved way for the increasing attention on empathy (Bojei, 2012). According to Keller brand resonance has four dimensions which include brand loyalty brand attachment core brand community and brand engagement tracing out the linkage between relationship marketing dimensions and brand resonance

brand attachment is directly influenced by the core factors of relationship marketing includes trust and satisfaction (Tsai, 2011). In a study conducted in the field of online shopping portals found that trust enhances intentions of loyalty towards the brand and thus dependence on control systems are reduced which eventually reduces the transaction costs. Studies carried out in the context of internet application have validated positive link between loyalty intentions and overall satisfaction. (Harris and Goode, 2004). In the design fashion area, fashion products need to match the personal characteristics of each customer, so trust and a fashion brand is an integral part of the relationship between the designer and the customer. Moreover, Kim and Ko (2010) also proposed intimacy as an element of the emotional relationship as commitment. Therefore, customer relationship expressed through intimacy and trust of customers for design fashion brands. The main theme in customer relationship marketing is "to get and keep customers". Peng and Wang (2006) define relationship marketing as all marketing activities directed towards building customer loyalty (keeping and winning customers) by providing value to all the parties involved in the relationship exchanges".

**Research Problem:**

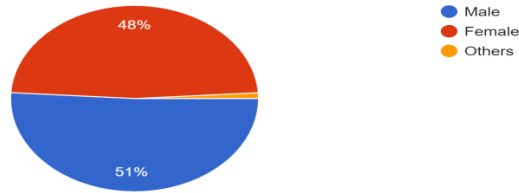
How Relationship Marketing Impacts Brand Building?

**Research Objective:**

- To study the impacts of Relationship Marketing on Brand Building.
- To understand the customer perspective on Relationship Marketing.

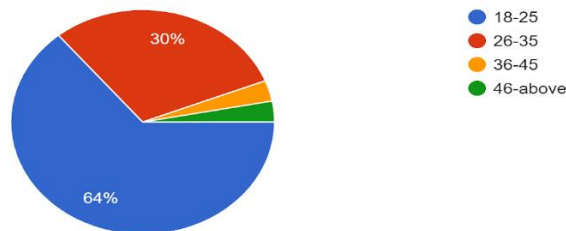
**Data Analysis and Interpretation:**

Gender  
100 responses



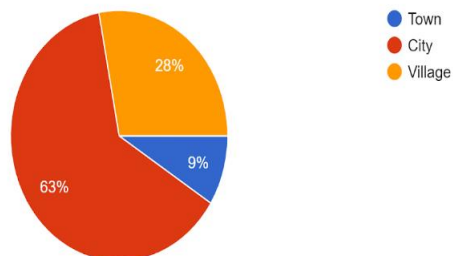
**Interpretation:** We floated the google form with several people and we found out that out of 100 respondents 51% were "Male" and 48% were "Female".

Age  
100 responses



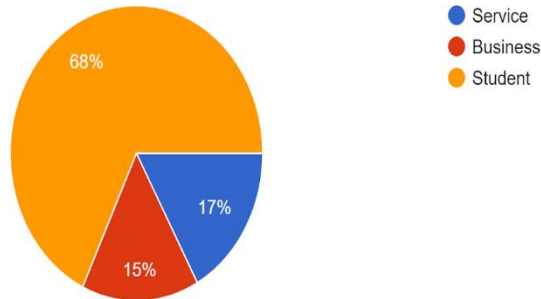
**Interpretation:** From this research we found out that maximum numbers of respondents were between the age group of 18-25 i.e. 64%. There were 30% respondents from the age group of 26-35.

Where do you live ?  
100 responses



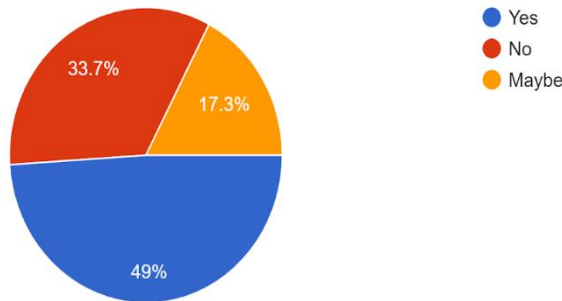
**Interpretation:** From this research we found out that maximum numbers of respondents were from the "Cities" i.e. 63%. We found out that respondents from "Village" area and "Town" were 28% and 9% respectively.

Occupation  
100 responses



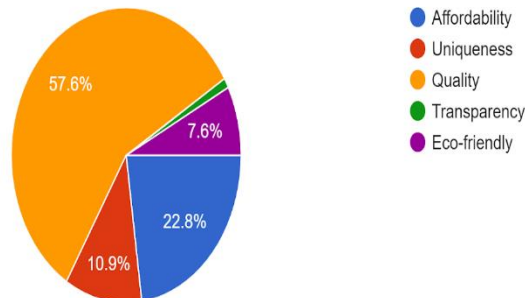
**Interpretation:** From this research we have found out that 57.6% respondents look for “Quality”, 22.8% look for “Affordability”, 10.9% look for “Uniqueness” and 7.6% look for “Eco-friendly” factors in a brand. Whereas respondents who look for “Transparency” in a brand is only 1%.

Do you have a favorite brand?  
98 responses



**Interpretation:** From this research we found out that maximum number of respondents was “Students” i.e. 68%. The number of respondents from “Service” and “Business” were 17% and 15% respectively.

If NO, what do you look for in a brand?  
92 responses



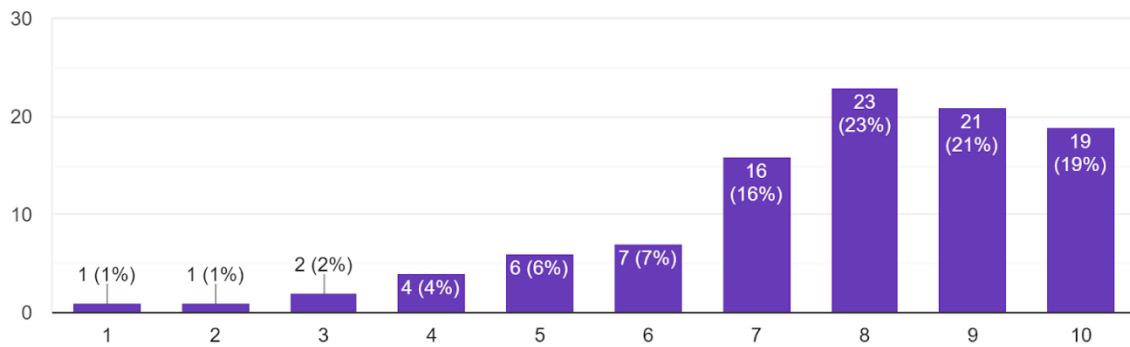
**Interpretation:** From this research we have found out that maximum number of respondents i.e. 49% has a “Favorite Brand”. The number of respondents who doesn’t have a favorite brand and the respondents who don’t know whether they have a favorite brand or not are 33.7% and 17.3% respectively.



**Interpretation:** From this research we have found out that highest number of respondents who are willing to refer their favorite brand to their friends is ranking between 8-10 on the scale of 1-10 where 1 being “never recommend” and 10 being “always recommend”.

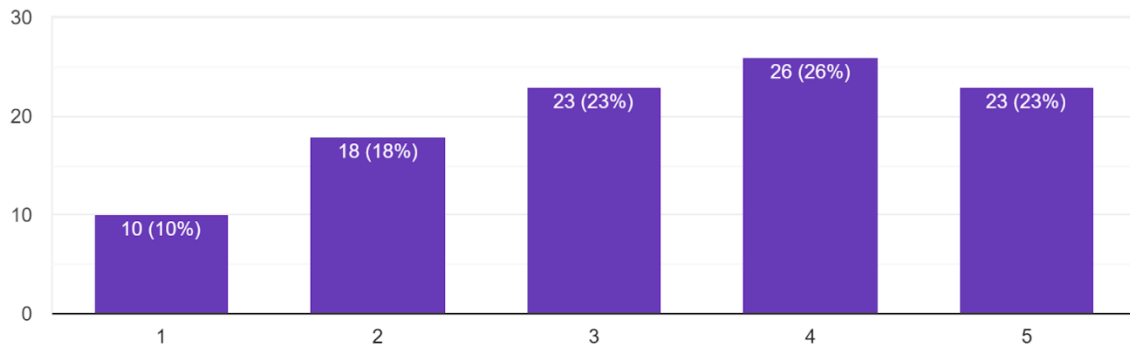
On a scale of 1-10, how likely are you recommend your preferred brand to your friends or colleagues ?

100 responses



On a scale of 1-5, how emotionally attached are you with your favorite brand?

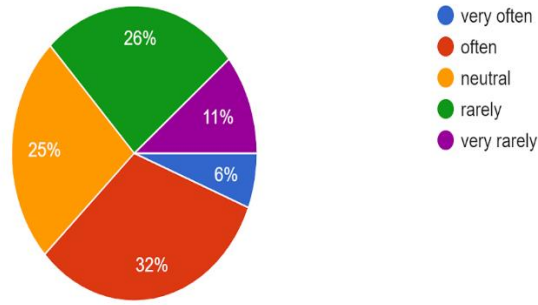
100 responses



**Interpretation:** From this research we have found out that highest number of respondents who are emotionally attached with their favorite brand is ranking between 3-5 on a scale of 1-5 where one being “not attached” and 5 being “highly attached”.

How likely are you to give feedbacks for the products you purchase?

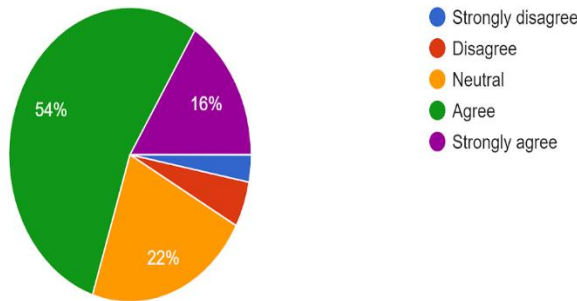
100 responses



**Interpretation:** From this research we have found out that 32% respondents “often” give feedback for the products they purchase and the respondents who are “rarely” to give feedback and those who are “neutral” on this are 26% and 25% respectively. The respondents who “very rarely” give feedbacks and those who “very often” give feedbacks are 11% and 6% respectively.

The best way to ensure brand building is through customer loyalty.

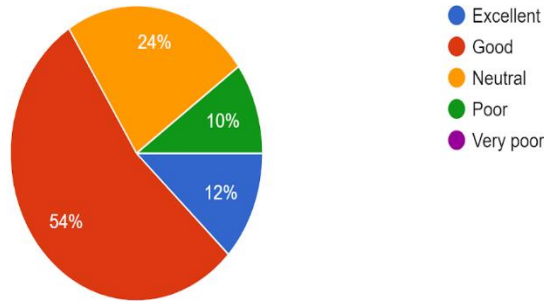
100 responses



**Interpretation:** From this research we have found out that the maximum number of respondents on the given statement “the best way to ensure brand building is through customer loyalty” is the ones who “agree” i.e. 54%. Whereas 22% respondents are “neutral” on this statement and 16% “strongly agree” on this.

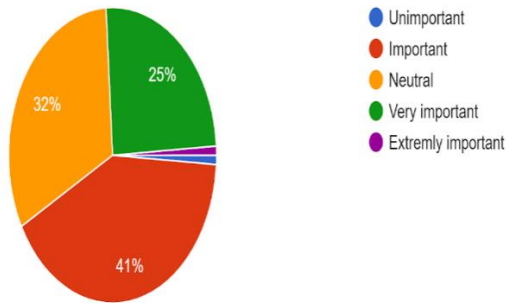
**Interpretation:** From this research we have found out that 54% of the respondents rate their favorite brand’s customer complaint handling as “Good”. Whereas 24% respondents are “Neutral” on this and 12% feel that their favorite brand’s customer complaint handling is “Excellent”. 10% of the respondents are of the view that their favorite brand’s customer complaint handling is “Poor”.

How will you rate your favorite brand's customer complaints handling?  
100 responses

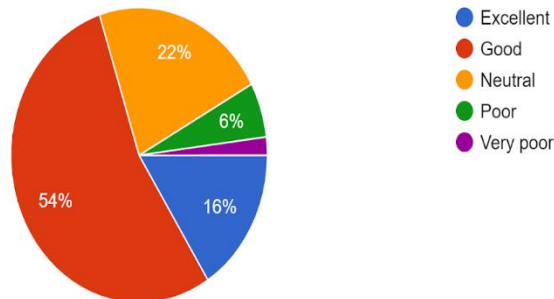


**Interpretation:** From this research we have found out that the purchase decision affected by the time involved in deploying the services is important for 41% respondents, whereas 32% respondents are neutral on this. For 25% respondents it is very important.

How likely will your purchase decision be affected by the time involved in deploying the services ?  
100 responses



How likely are you to rate the customer centricity of your favorite brand?  
100 responses



**Interpretation:** From this research we have found out that 54% of the respondents rate the customer centricity of their favorite brand as "Good", whereas 22% respondents are "Neutral" on this. The respondents who feel that their favorite brand's customer centricity is "Excellent" and those who feel that the customer centricity of their favorite brand is "Poor" are 16% and 6% respectively.

**Research Methodology:**

This is a descriptive research followed by quantitative analysis to gain further insights on the subject matter. An online survey has been done through questionnaire containing 15 questions, out of which 4 are generic questions and the rest are technical questions. The target audience was around 150 respondents but we only got 100 responses. Our analysis is based only on these 100 responses.

**Conclusion:**

The study seeks to demonstrate the functions of relationship marketing and its impacts on brand building. Here it can be concluded that around 50% of the people have a favorite brand and majority of them (57%) look for Quality in a brand whereas the second important factor to look for in a brand is Affordability. Most of the people are also emotionally attached with their favorite brand. We found out that the respondents have quite mixed view for giving the feedbacks for the products they purchase. On an average the three most important things they like about their favorite brand are consistency, quick service and reachability. Most of the respondents (above 50%) feel that their favorite brand's customer complaint handling is good. More than 50% respondents feel that their favorite brand takes care of their needs and wants while being customer centric. . At last by conducting this research we have found out that the best way to ensure brand building is through customer loyalty and for this relationship marketing plays a major role.

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**IMPACT OF COVID-19 ON DIGITAL MARKETING**

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**Abstract:**

Since the onset of digitalization, COVID-19 is the first major crisis which has hit the global and people belonging to all the strata at large. Lot of data is being studied with respect to how the marketing has shaped up due to the pandemic and what will it be its due course in the coming times. This involves the study of emerging course of the markets, assessing their activity and the optimum utilization of finances. Due to lock down not only the way the businesses operate has seen the changes but also the way they communicate. The most significant aspect of the study is that is that the major shift has been observed in the preferences of the people since the time the country wide lockdown was imposed. Price is no more the sole driver during any purchase and consumers feel less loyal to brands they have purchased before. Consumers are now more prone to shop online for their requirements rather than going out for shopping.

**Keyword:** Digital Marketing, Advertisement, COVID-19, Pandemic, Internet

**Introduction:**

The Internet is the only place which is not quarantined for quarantined consumers. This study thus involves various aspects of digital marketing and how the consumer preferences have shifted since the onset of Pandemic- Covid 19.

*Digital Marketing:*

Online Advertising is the form of advertising that uses Internet and World Wide Web to deliver marketing message to attract, and enhance the customers, and it is also known as Internet advertising, Digital advertising, or Web advertising . It includes email marketing, search engine marketing (SEM), social media marketing, many types of display advertising (including web banner advertising), and mobile advertising. Because of online advertising consumer can have

idea and information of even a small business enterprise with respect to large business enterprises regarding products and services. Digital marketing is target specific.

**Search engine optimization (SEO):**

SEO is the process of optimizing the content, technical setup, and reach of your website, so that your pages appear at the top of a search engine result for a specific set of keyword terms. Using SEO can drive visitors to your site when they display behavior implying that they're searching for relevant products, which can be a game changer considering that 90% of people searching haven't formed an opinion about a brand yet. SEO is defined as increasing a website's rank in online search results, and thus its organic site traffic, by using popular keywords and phrases. Strong SEO strategies are hugely influential in digital marketing campaigns since visibility is the first step to a lasting customer relationship.

**Paid search:**

Paid search, or pay-per-click (PPC) advertising, typically refers to the sponsored result on the top or side of a search engine results page (SERP). These ads charge you for every click and they can be tailored to appear when certain search terms are entered, so your ads are being targeted to audiences seeking something in particular. These ads can be extremely effective, as they rely on data gleaned from individuals' online behavior and are used to boost website traffic by delivering relevant ads to the right people at the right time. These ads also involve retargeting, meaning that depending on the customers' actions, marketing automation tools can craft unique, personal cross-platform ads.

**Content marketing:**

Effective content marketing is not outwardly promotional in nature, but rather serves to educate and inspire consumers who are seeking information. When you offer content that is relevant to your audience, it can secure you as a thought leader and a trustworthy source of information, making it less likely that your other marketing efforts will be lost in the static. In the



age of the self-directed buyer, content marketing gets three times more leads than paid search advertising, so it's well worth the additional effort.

**Social media marketing:**

The key to effective social media marketing goes far beyond simply having active social media accounts. You must also be weaving social elements into every aspect of your marketing efforts to create as many peer-to-peer sharing opportunities as possible. The more your audience is inspired to engage with your content, the more likely they are to share it, potentially inspiring their peers to become customers as well.

**Email marketing:**

After more than two decades, email is still the quickest and most direct way to reach customers with critical information. Today, successful email campaigns must be incredibly engaging, relevant, informative, and entertaining to not get buried in your customer's inbox. To succeed, your marketing emails should satisfy five core attributes. They must be trustworthy, relevant, conversational, coordinated across channels, and strategic.

Since the audience are changed in the era of digitalization, there are various trends which are being observed.

1. A New Customer Persona is Emerging: Lockdowns and social distancing have shifted consumer habits and demands. People are becoming more self-sufficient as they readily embrace digital trends. From working to shopping to entertainment, every option is now available online.
2. Consumers Are Now More Careful About Spending: Due to constricted and uncertain income due the havoc created in the pandemic, the consumers are all the more mindful about spending.
3. How Has Digital Marketing Altered to Align with This New Audience? In response to altering preferences and spending habits, digital marketing efforts are concentrated on offering more value to customers. Leveraging and curating content across several online platforms continues to accelerate and evolve. Moreover, customer experience on online channels is in the spotlight more than ever before. Brands are making advancements in the complete customer experience in order to draw new customers and retain existing customers.

Thus, there is a need for the redefined business goals: Since the consumers as well as the competitors are online the business owners need to focus on positioning their brands front and center so that they remain in the path of their target audience. Thus it is seen thus more virtual, remote, and contactless solutions are establishing themselves as commonplace in every aspect. This has helped digital marketers to reach out, engage, and connect with consumers wherever they may be and that is not going to change anytime soon.

What has really been a deal-breaker is that COVID was the perfect reason for brands to stand out in the crowd and connect with existing as well as potential customers. While some brands were left scrambling to get on board the digital network, those already established in the space were able to claim the customers their competitors were losing, whether it was by offering up-to-date information, products that consumers needed, or delivery options.

Due to this there is the evolution of a new concept which is Martech. Digital marketers have access to tools that can help them understand changes in consumer trends, behaviors, lifestyles, and attitudes since the lockdown. More importantly, these tools allow marketers to nurture leads and guide them deeper into the sales funnel. However, the challenge lies in choosing the best tools for the company's individual business needs and the ability to integrate the tools effectively to get the most out of the functionalities they have to offer. With the wide variety of software and technology available in the market, the number of ways brands can engage with consumers is limitless. Choices include CRM platforms, chat bots, augmented and virtual reality apps, personalized emails, analytics, and much more. Determine the toolsets that are going to be best for your business to see how you can leverage these tools to your advantage.

But let's not forget that digital marketing strategies also focus on producing valuable content. Digital marketers know they need to offer something other than just text-centric content. Infographics, memes, podcasts, and video content have gained more traction. Consider how you can leverage webinars, video recordings, short snippets of interactive content, and more to help engage the digital consumer.

### **Review of Literature:**

A comprehensive review of literature on impact of coronavirus disease 2019 ( Covid-19) on Digitalization. According to Kotler and Armstrong (2009) digital marketing is a form of

direct marketing that connects consumers with sellers electronically using technology like email marketing, website, online forum, etc. Digital marketing is a branch of traditional marketing and uses modern digital channels for Business to reach or target potential customers by collaborating with stakeholders. According to Banica et al. (2015) the Internet is a trusted source by which consumers go through before buying the product or service.

And in the current scenario technology plays a vital role in sustainability of company. It also keeps a track on sales, inventory, expenses and can save valuable time and extra efforts.

**Objective:**

The main objectives of the study are:

1. To study the concept of digital marketing.
2. To analyse the impact of Covid-19 on digital marketing.
3. To analyse the future role of digital marketing post Covid-19.

**Methodology:**

The study focuses on the Impact of Covid-19 on Digital media. In order to collect secondary sources of data to interpret and understand the study.

The data of the study were collected from published case studies, blogs, and articles, journals namely on Covid-19, Digital marketing and the Impact of Covid-19 on it. The survey has also been conducted to investigate the impact, that outbreak of Covid-19 pandemic had/has on digital marketing and to also understand the future of digital marketing post Covid-19 pandemic.

**Limitations of study:**

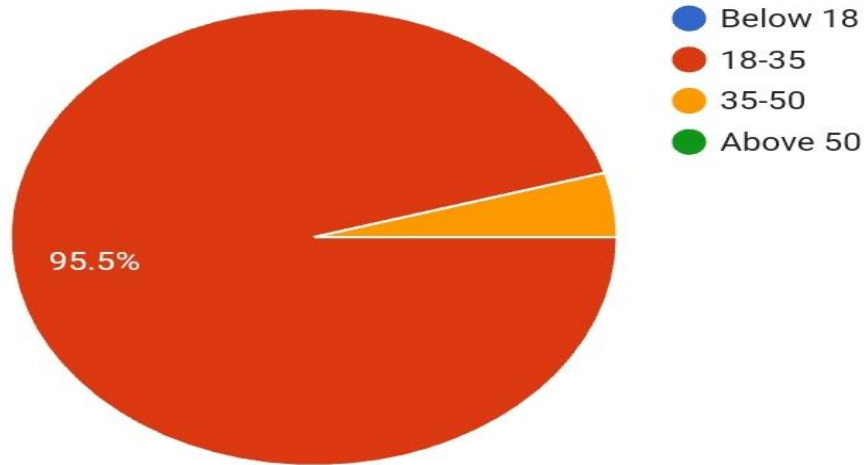
The study is limited to secondary data.

Generalization of all the data from this study is not preferable.

**Survey:**

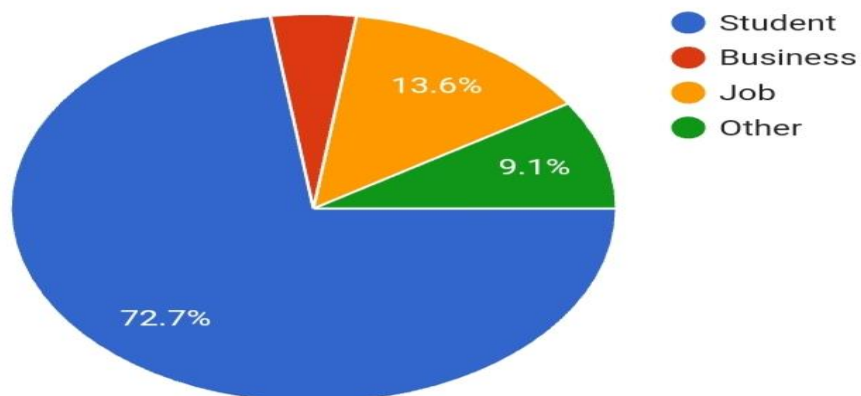
### Age

22 responses



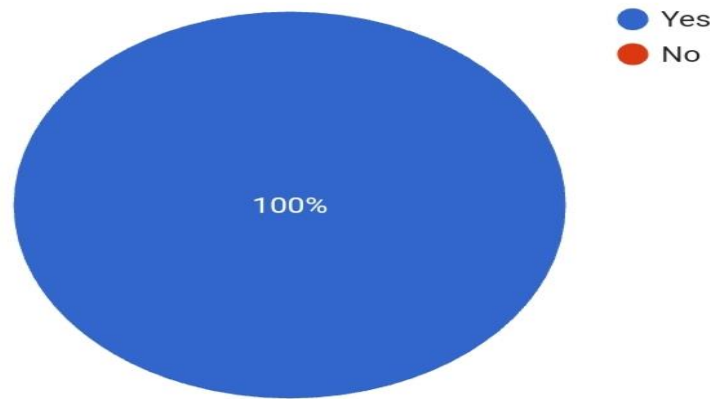
### Occupation

22 responses



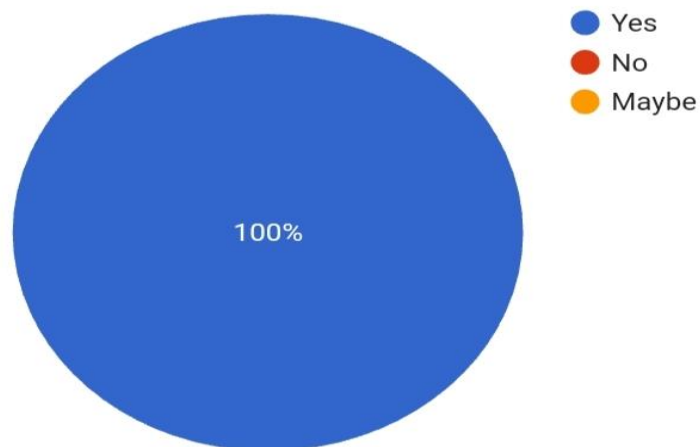
Are you aware of Digital marketing?

21 responses



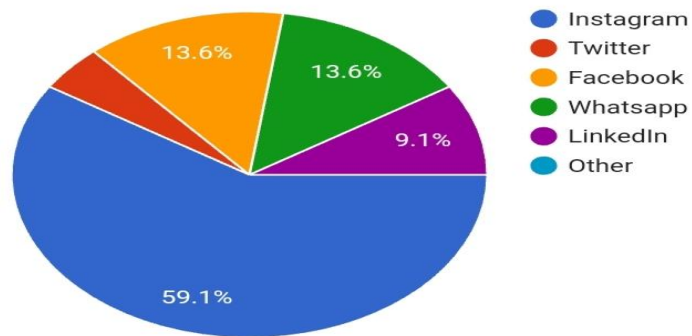
Have you ever come across Digital marketing?

22 responses



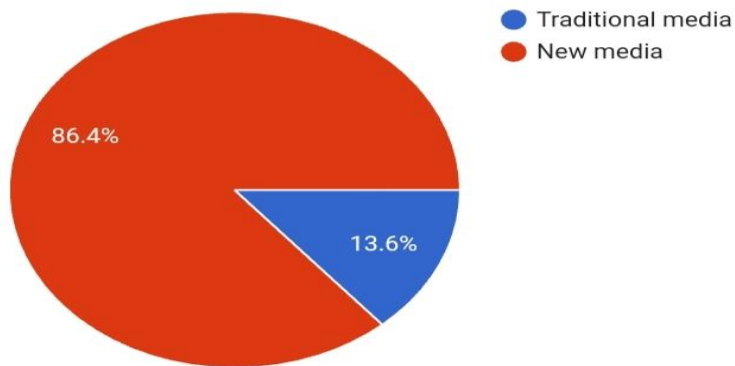
Which social media are you active on?

22 responses



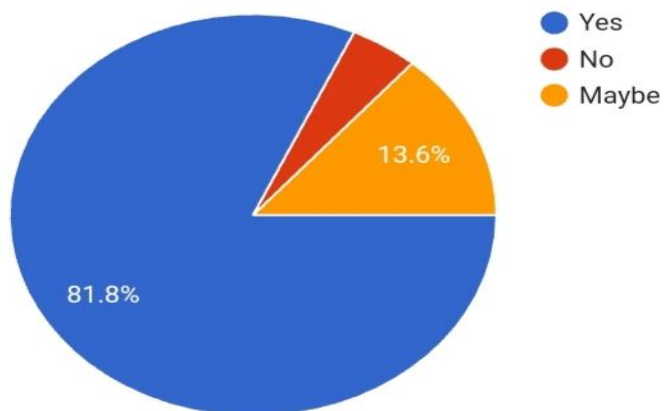
Which media do you prefer for marketing

22 responses



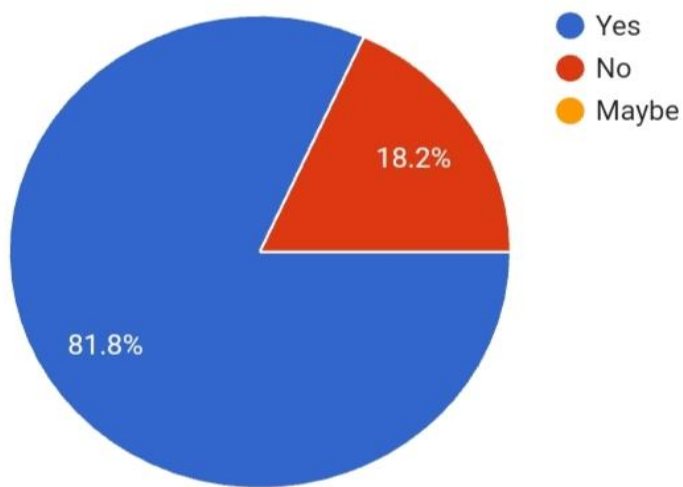
During pandemic do you find Digital media helpful?

22 responses



Do you think that Covid-19 has impacted Digital marketing?

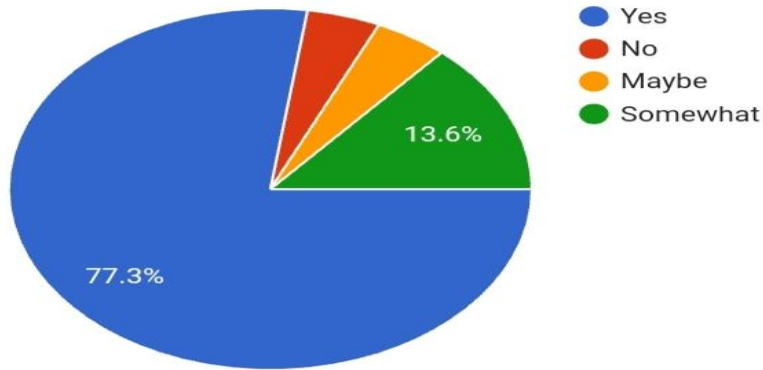
22 responses





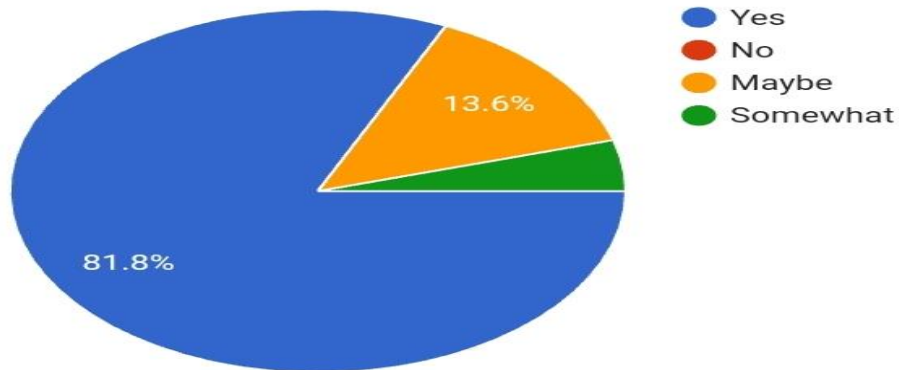
Is Digital marketing helpful for larg  
as well as small businesses?

22 responses



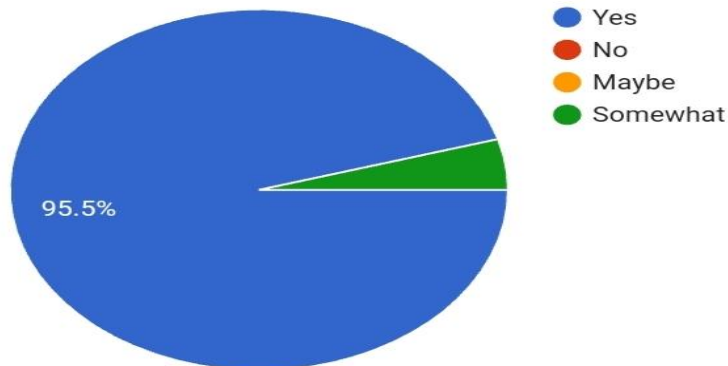
Do you think that Digital marketing  
is helpful to increase productivity in  
pandemic?

22 responses



### Is Digital marketing effective?

22 responses



### What do you find attractive about Digital marketing?

- Ease of use and low cost to use
- NA
- Less Cost and expense
- The attractive way to showcase their products
- in less effort can sell a lot
- Coverage and cost
- Short and targeted
- They are more creatives with no time barrier or content barrier

Captures attention of various people across large no. Of platforms.

Digital marketing is considerably less expensive than other marketing methods.

Easy to access

Easy to attract people and earn money

Easy to communicate with people

Way of medium

This field is absolutely evolving in accordance with the latest technologies. And this is the reason it is absolutely relevant now and even in the future.

The information gets shared to a mass of people within a small span of time.

On your fingertip

All

Easily to connect.

Captures attention of various people across large no. Of platforms.

Digital marketing is considerably less

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**What do you find most challenging about Digital marketing?**

Not everyone is familiar with this to use by own

NA

Knowledge

The behaviour of the customer

Pramoting ads

Authenticity

Avoiding them!!!

Connectivity and engagement

Biaaest challeneae in the diaital marketina

All

Content

Creating eye catching content .

how to stand out against bigger competitors without a commensurate digital marketing budget.

Lots of competition

Creating good content

reaching people who are inclined towards traditional media

Sometimes it hide the truth and mis-guide us

Biggest challenge in the digital marketing space is to get traffic to a site. Of course, there are several challenges to face and you should have a keen eye to know and understand if someone goes wrong and you couldn't see the desired outcomes, what could be the reason behind. Next challenge I guess is that the space of digital marketing is wide enough and there is so much to learn with new terms entering in every few months.

Sometimes the information is misleading.

Competition

All

Content

**Findings:**

The survey has been conducted between 50 people and found out that % knows about digital marketing. % thinks that Covid-19 has impacted digital marketing and % thinks that digital marketing was really helpful at the time of pandemic. % have responded that it is helpful for large as well as small businesses. % thinks that it i increased productivity in pandemic. Many

of them found digital marketing attractive in terms of easy to access, less cost and less expensive, more reach across multiple platforms, easy to target more customers at a time, there is no time barrier, etc. And some of them found it challenging in terms of Authenticity, many times people avoid the ads, to get traffic to a site, misleading of information, high competition, etc.

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**Green Marketing and its Impact on Consumer Behavior**

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**Abstract**

Due to rapid industrialisation and increasing consumption environment has been tremendously affected and thus become a matter of concern. Government from all the nations are taking the required measures to spread the awareness in the society to adapt to the pro-environmental behavior. As a result a new trend of green marketing which the firm are resorting to which will not only be a step towards protecting the environment but also will garner them the profit. Thus, green marketing is becoming a topic which is being researched and adopted by the companies in strive to find the optimum ways reach the customers and make them aware about benefits of being “green”. This has led to the increase in the pro-environment demand of the consumers and thus it has become important for the companies to understand how what are the perceptions of the consumers about the brand image and their loyalty while paying attention to “green” behavior. The study thus aims to investigate the effects of green marketing by the companies on the consumer behaviour.

**Keywords:** green marketing, consumer behaviour, environment, sustainability, buying decision.

**1. Introduction**

Green marketing refers to the process of selling products and/or services based on their environmental benefits. Such a product or service may be environmentally friendly in itself or produced and/or packaged in an environmentally friendly way. The obvious assumption of green marketing is that potential consumers will view a product or service's "greenness" as a benefit and base their buying decision accordingly. The not-so-obvious assumption of green marketing



is that consumers will be willing to pay more for green products than they would for a less-green comparable alternative product - an assumption that, in my opinion, has not been proven conclusively. While green marketing is growing greatly as increasing numbers of consumers are willing to back their environmental consciousness with their dollars, it can be dangerous. The public tends to be skeptical of green claims to begin with and companies can seriously damage their brands and their sales if a green claim is discovered to be false or contradicted by a company's other products or practices. Presenting a product or service as green when it's not is called green-washing. Simply put, green cleaning is about using products that are safe and healthy for you and the environment and about employing eco-friendly cleaning practices, like reducing water usage. It's also about using products from conscientious companies with sustainable business practices. Green is an umbrella term that refers to products and practices that are organic, sustainable and/or otherwise environmentally friendly. A product may be considered as green if it

- Conserves water and energy
- Prevents contributions to air, water and land pollution
- Uses renewable, responsibly sourced materials
- Produces little environmental impact

According to the American Marketing Association, green marketing is the marketing of products that are presumed to be environmentally safe. Thus green marketing incorporates a broad range of activities, including product modification, changes to the production process, packaging changes, as well as modifying advertising. Yet defining green marketing is not a simple task where several meanings intersect and contradict each other, for an example of this will be the existence of varying social, environmental and retail definitions attached to this term. Other similar terms used are Environmental Marketing and Ecological Marketing. Green marketing refers to the process of selling products and or services based on their environmental benefits. Such a product or service may be environmentally friendly in it or produced and/or packaged in an environmentally friendly way.

In the contemporary environment, green marketing has becoming increasingly significant globally. Green advertising is considered to be an effective method for the promotion of products, services, and business ideas, as it is deeply linked with the preservation of the natural environment. For businesses operating under the current economic conditions, green product consumers are a major focus because they are considered to be a driving force for consumption. For the global economy, emerging trends involving green consumers have created a new market opportunity. Since the 1980s, green marketing and environmental marketing strategies have been a major interest for scholars. Green marketing and related ideas have been growing since the early 1990s. Green marketing activities have been increasing at a significant rate and have obtained enough confidence from consumers to be sustainable and profitable since the 2010s. It has been observed that green marketing has experienced particularly rapid growth in the United States, and now constitutes a market worth USD 250 billion annually in the United States alone.

## **2. Literature Review**

Subooh Yusuf and Zeenat Fatima (2015) made a study to explore the concept of green marketing, or green products in relation to consumer behavior. They identified that the major sources from where the people get information about green products are school/university. 60% of the people under study are aware about green practices.

Anu Varghese and Santhosh J (2015), made a study on consumers' perception with reference to Kollam district in Kerala. 80 consumers were selected on a convenience basis. According to the study the majority of the respondents are aware about eco-friendly products. Organic vegetables and food products were mostly preferred by customers. The major factor influencing the buying behaviour of consumers is quality of the product, and the problem faced, by the consumers are lack of availability of products, high price and low promotion.

Another study by John Grant (2008) aims to look at how companies obtain a greener strategy and what is the future of green marketing.

A study by Peter Kangis (1992), proposes that the challenges both for marketing specialists and for consumers, raised by the concept of green marketing, are due to several issues, such as the lack of an acceptable definition for green marketing, the absence of a clear understanding of cause-and-effect relationships in matters affecting the environment, and the overt and covert reasons for concern about such issues. Suggested that, in the hands of unscrupulous marketers, green marketing can turn into green gold.

### **3. Problem statement**

To learn about green marketing and see how it affects the consumer's purchasing behavior.

### **4. Objectives of the study**

- To establish a relationship between consumer purchasing decision and green marketing.
- To study the consumer's awareness and attitude towards eco-friendly products.
- To find out the factors influencing the consumers on purchase decision of eco-friendly products.
- To know the importance of green marketing.

### **Green Marketing**

Green marketing refers to the process of selling products and/or services based on their environmental benefits. Such a product or service may be environmentally friendly in it or produced and/or packaged in an environmentally friendly way. "Marketing products and services based on environmental factors or awareness. Companies involved in green marketing make decisions relating to the entire process of the company's products, such as methods of processing, packaging and distribution".

### **Evolution of Green Marketing**

The term Green Marketing came into prominence in the late 1980s and early 1990s.

- The green marketing has evolved over this period of time. The evolution of Green marketing had three phases. First phase was termed as "Ecological" green marketing, and during this period all marketing activities were concerned to help environment problems and provide remedies for environmental problems.
- Second phase was "Environmental" green marketing and the focus shifted on clean technology that involved designing of innovative new products, which take care of pollution and waste issues.
- Third phase was "Sustainable" green marketing. It came into prominence in the late 1990s and early 2000. This was the result of the term sustainable development which, is defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."

### **Why green Marketing?**

As resources are limited and human wants are unlimited, it is important for the marketers to utilize the resources efficiently without waste as well as to achieve the organization's objective. So green marketing is inevitable. There is growing interest among the consumers all over the world regarding protection of environment. Worldwide evidence indicates people are concerned about the environment and are changing their behavior. As a result of this, green marketing has emerged which speaks for growing market for sustainable and socially responsible products and services.

### **Eco-Friendly Products**

These products contribute to green living or practices that help conserve resources like water and energy. Some eco-friendly products are:-

- Cloth Napkins
- Reusable Water Bottles
- Cloth or Cotton Shopping Bags
- Recycled Fabric Clothes
- Rechargeable Batteries
- Solar Powered Devices

- Water Powered Clock
- Electric Vehicles
- Solar Cells
- Bamboo Plates and Cutlery
- Recycled Paper
- Eco-Friendly Kettle
- Reusable Straws
- Recycled Cutting Board
- Eco-friendly Umbrella
- Green Finger Rings
- Biodegradable Pots
- Organic Foods

### **Benefits of Green Marketing**

Companies that develop new and improved products and services with environment inputs in mind give themselves access to new markets, increase their profit sustainability, and enjoy a competitive advantage over the companies which are not concerned for the environment.

### **Adoption of Green Marketing**

- There are five basic reasons for which a marketer should adopt green marketing:
- Opportunities or competitive advantage
- Corporate social responsibilities (CSR)
- Government pressure
- Competitive pressure
- Cost or profit issues

### **Keys to successful green marketing**

Show potential consumers that you follow green business practices and you could reap more green on your bottom line. Green Marketing isn't just a catchphrase; it's a marketing

strategy that can help to get more consumers and make more money. But only if one does it right.

For green marketing to be effective, one have to do three things; be genuine, educate the consumers, and give them the opportunity to participate.

- Being genuine means that: to do what is being claimed in the green marketing campaign. The business policies are line with the environmental friendly aspirations laid by the businesses. These conditions are required to be met for the businesses to lay the foundation in order to establish environmental credential that they are trying to achieve through the green marketing campaign. To educate the customers it's not only about telling them what activities the businesses are doing but also to make them aware why is it important to be done. This is significant because there might be certain section in the market which has the tendency of thinking "so what" and thus the green marketing campaign might fail. By giving the consumers an opportunity participate means letting them know the means of personalizing the benefits of their environmentally friendly actions.

### **Green Marketing Mix**

Every company has its own favorite marketing mix. Some have 4 P's and some have 7 P's of marketing mix. The 4 P's of green marketing are that of a conventional marketing but the challenge before marketers is to use 4 P's in an innovative manner.

Product- The ecological objectives in planning products are to reduce resource consumption and pollution and to increase conservation of scarce resources (Keller man, 1978). Price- Price is a critical and important factor of green marketing mix. Most consumers will only be prepared to pay additional value if there is a perception of extra product value. This value may be improved performance, function, design, visual appeal, or taste. Green marketing should take all these facts into consideration while charging a premium price. Promotion-There are three types of green advertising: Ads that address a relationship between a product/service and the biophysical environment. Those that promote a green lifestyle by highlighting a product or service. Ads that present a corporate image of environmental responsibility. Place-The choice of where and when

to make a product available will have significant impact on the consumers. Very few consumers will go out of their way to buy green products.

### **Findings**

- Majority of the consumers know about the eco-friendly products.
- The most familiar eco-friendly products among respondents are organic vegetables and consumable items.
- The major reason that the consumers are not ready to pay more for eco-friendly products is the high cost of the product that they cannot afford and some consumers have the opinion that they cannot see the benefit of the product.
- Consumers say that information about green features of green marketing products is not available.
- Consumers have a positive perception towards environmentally friendly products. Most of them consider that it's important to them that the products they use do not harm the environment and they considered themselves as environment friendly attitude.
- Buyers are aware about the seriousness of various environmental problems. Industrial water pollution, industrial air pollution, pesticides on food, hazardous waste, drinking water contamination etc. are the major environmental concern on which the buyers express their seriousness.
- From the environmental point of view the marketing practices like manufacturing eco-friendly products, manufacturing products through eco-friendly process and educating consumer to use products in environmental friendly manner are more important.
- Consumer's commitment on environment friendly products is positive and hopeful. They are ready to prefer eco-friendly products over the non-eco-friendly products. But if the products are priced higher, the consumers shows a neutral attitude towards this.
- The major factors affecting purchase of green products are product price, availability of products and awareness about the products.

### **Conclusion**

From the analysis which carried out in this study, we can conclude that the people have awareness about the eco-friendly products and they show a positive attitude towards green marketing and green products. But we should try to increase the awareness level into another extent. The consumer's awareness should not be limited to organic vegetables and consumable items. Product price is the attribute that consumers reflect on when making a green purchasing decision. Consumers are less likely to purchase green products if they are more expensive. So efforts should make to reduce the price of eco-friendly products.

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**The impact of innovation marketing on strategic decisions of the food and beverage industry**

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**Abstract**

Innovation is instrumental in bringing about change which is creative and which brings about dynamism in the ever-evolving socio-economic environment. This change is transitional which brings change that caters to the ever changing demands in the market. To be operational and to be able to survive in the market, businesses need to adopt to innovation. It is critical to understand and adopt innovation to sustain in modern markets. For this businesses need to more inclusive and be ready for the customization. It's only then the innovation and marketing it accordingly can lead the organization towards the success.

This study aims at discussing the way in which innovation marketing influences the marketing strategies in food and beverage sector.

**KEYWORD:** Innovation marketing, Marketing Strategy, Food and Beverage, Customization, Consumer Behaviour.

**INTRODUCTION:**

In today's era consumers constantly changing demands for new technologies which leads to frequent advancement in Business Strategic development, these changes range from basic consideration such as improving Food safety, shelf life and reducing waste, to demand special. sophisticated nutritional value, palatability, and convenient. Although many of the challenges differ between the highly sophisticated systems and those of less sophisticated system it is notable that the need for innovation is common to all. The actual product development is determined by the interaction between consumer's expectations and demand, the technical capacity of the producer and emerging knowledge from food and beverage science research.

After encountering a tumultuous year consisting of uncertainty and ambiguity, the world of food and beverage industry woke up in 2021 to opportunities and a new way of conducting business which has never been explored before, this model of innovation is still in a nascent stage but both in-sector and beyond are undergoing a sizeable change to adapt this New Normal.

The Pre-Pandemic has drastically changed before the growth enhancing factor of food and beverage industries were on the go consumers with demand of quick service restaurants towering in comparison to other Food services but now consumer priorities have changed and with that there is change in the way food and beverage industry functions, with new safety guidelines and regulation imposed by the government and concerns of food safety and hygiene rising in consumers' mind. Various innovative steps have been added in the new business model which ensure safety and hygiene of the food and new ways to deliver quality food to the consumer have been discovered, after covid-19 scare standing still is not an option but evolving and embracing this change is the key to survive, integrating technology to spread awareness and reach to the consumers is embracing this new normal, in this study we aim to understand the innovative strategic decisions taken by major brands in food and beverage industry to overcome the challenges that are hovering over this industry since the beginning of 2020.

### **REVIEW OF LITERATURE:**

The term innovation was first used by Schumpeter, who discussed the concept in the "Theory of Economic Development" [1912]. Innovation marketing as a discipline encompasses marketing activities in the innovation process. This includes, for example, research into customer needs, concept and prototype tests with customers and the marketing of new products. These are all key tasks in innovation management and innovation marketing plays a very important role in securing and increasing the success of innovation (Angela Hengsberger, Lead innovation blog, 2019). Peter Drucker stated that Business has only two functions i.e. Innovation and Marketing, there are many overlaps between marketing and innovation management. For example, analyzing trends, researching customer needs and defining product policy in the marketing mix with product development and product design are also tasks that can be found in the function of innovation management. These overlaps and close interrelationships make it clear

that innovationmarketing exists and must exist. Innovation is subjective in nature Innovation can mean new product, new market, new marketing channel, new processes, or new marketing concept, innovation can mean a breakthrough or stream of incremental changes (Peter Doyle, Susan Bridgewater, Innovation in marketing). In this study we are focusing on innovation Marketing in a particular sector (Food and Beverage) taking account of the entire spectrum of Innovation. After the advent of Digital media, we have seen several incremental innovations undergoing within the food and beverage industry. Globalization, fast technological pace, rapid changes in customers' needs asked the companies to rethink their innovation processes as they became riskier and more unpredictable (Chesbrough, 2013). But in the recent events related to the COVID-19 situation placed an additional pressure on companies to look for different, more flexible and more collaborative perspective about innovation and business models (FAO, 2020a) which demanded a drastic step such as developing a suitable supply chain operations, safety, training, disaster management and responses, awareness, re-forming business models, digitalization and advancement of technology, and other unanticipated (Shafique UI RehamanMemon, Vijayata Ramesh Pawase, Tushar Ramesh Pawase and Maqsood Ahmed Soomro, 2020, MDPI) changes because if the industry couldn't keep up with the environment the circumstances might lead to its extinction. In this Research paper we aim to understand the importance and Impact of Innovation Marketing on Food and Beverage industries and how this marketing technique is aiding Food and Beverage industry to get back on its feet.

**RESEARCH GAP:**

Although previous studies have acknowledged the need of Innovation Marketing strategies in the food and beverage sector but a few of them specified what kind of innovation marketing techniques must be implemented to differentiate the market offering. In this study we aim to understand the Impact of innovation marketing on Strategic decision making at any enterprises inclusive of the risk and capital involved. Furthermore, we could imply that this research could be a start for many research to address themes involving strategic decision-making and innovation marketing.

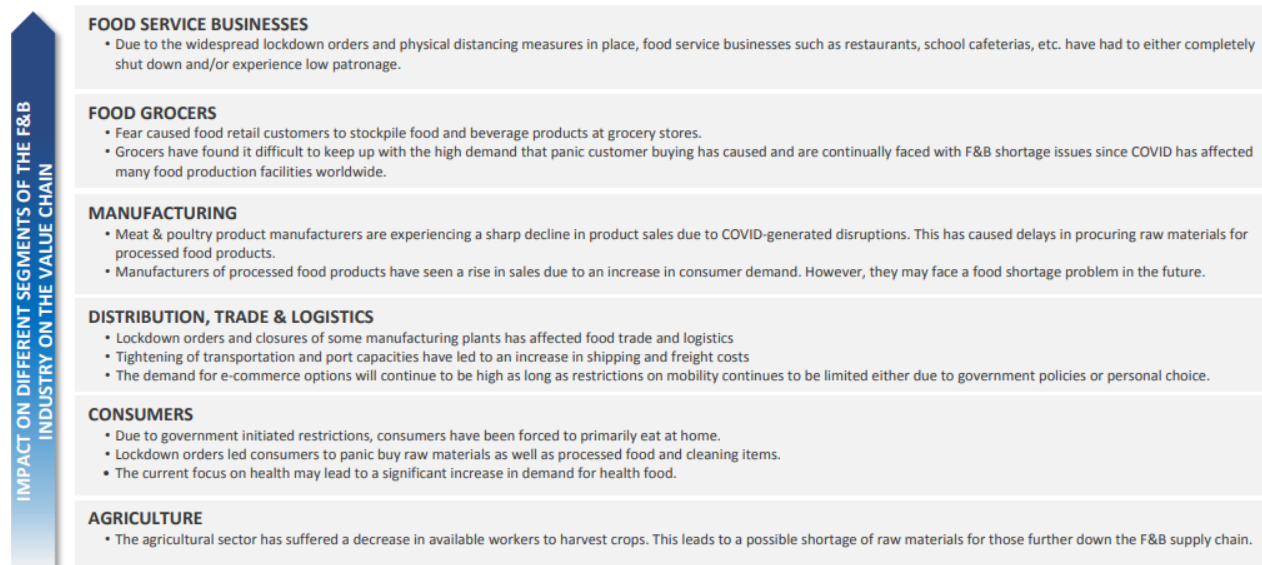
**METHODOLOGY:**

This research is the product of a systematic literature review with the purpose to identify the existing body of literature within a specific area and to analyze and interpret the collected data. The phenomenon of interest in this research is impact of innovation marketing on strategic decision making in food and beverage industry. To find the relevant articles, the keywords for the literature search were based on various literature streams revolving around the topic. we did Thorough examination of various case studies in volving strategic decision made while prioritizing innovation and innovation marketing in food and beverage industry, beside innovation marketing the term creativity marketing, impact of covid-19 on food and beverage industry, co-involvement, Innovation 2.0, co-creation, open innovation, sustainability, supply chain management, quick service restaurant, marketing innovation, food safety, consumer preferences 2020, Conscious consumption, Schumpeter's theory of innovation. Innovation in manufacturing process of food and beverage, and Business model of Restaurant, café industry 2021.

The search has been limited to journal articles, blogs and material considered validated knowledge. The abstracts and findings of 20 articles have been verified by examining and researching their authors, the articles that were related explicitly or implicitly to Innovation Marketing, Innovation in Food and Beverage industry, or strategic decisions at the helm of innovation marketing were analyzed. This study is based on 20 articles and 18 blogs with a specific focus on understanding the impact of innovation marketing Tactics on strategic decisions taken by food and beverage sector. An open coding content analysis technique was employed. Using this technique, notes and headings are written in the text based on their association with the research focus. While inductively reviewing the studies, we also acknowledged that each study could contribute to several different headings. Thereafter, all headings were collected on a coding sheet and categories were generated. Through this we were able to find similarities and build direct and indirect relationship within the data set concurrently leading us to our result.

### **Result and Findings:**

The Raison d'être of this Research is to understand the impact and importance of Innovation marketing in F&B Strategic decision. We acquired rich source of information from articles and Research pieces on how innovation became a necessity for F&B industries after the outbreak of Covid-19. A research By Gareth Armanious, Gloria Wada, Jorge L. Hurtado, 2020, PreScouter shows “How Covid-19 became a driver of innovation in Food and beverage industry”, and this particular research inspired us to closely examine the impact of innovation marketing on strategic decision making in the F&B industry. In the research they compiled the challenges faced by F&B industry segregating it into 6 sectors and then they concluded by showing how these sectors are innovating to overcome these obstacles.



(Fig.1) courtesy of PreScouter

But we also see different innovations in these industries which are ameliorating the some of the effects of covid-19 Such as:

- 1) Incorporating Innovative technologies in the business models, for forecasting trends and managing supply of products for example ERP systems and Supply AI, which helps in forecasting the demands and curtailing excessive supply.

- 2) Innovative strategy for Distribution, and trade is to repurpose the products to supply to Grocery retailers instead as people tend to stock up products that are necessary such as frozen food and meal that has a little longer shelf life.
- 3) Innovative strategy for beverage and non-essential industry is to start producing sanitizers and essential products that might help them stay less affected since they can stay open, although this strategy can work as a short-term plan and post-covid they can return to working in their usual order.

Now that we have seen the INNOVATION aspect in strategic decision making let us look at decision making process from a Marketing standpoint.

- **Emphasis on health and conscious consuming:** After Covid-19 Consumer's attitude towards food and beverage is changing, a report by TBWA India states that consumers are inclining towards **Conscious consumption** which means now the consumers are highly aware of the impact of their purchasing decisions on the environment and the consumers health and life in general.

Therefore, several companies are working on providing immunity boosters, health supplements and there has been an exponential increase in the organic food market.

WGSN identified immunity-supporting ingredients as a key theme for 2021. Product developers are learning from consumer demand in the past year. From elderberries and probiotics to turmeric and moringa, WGSN said the ingredients with immunity claims are among those poised for further growth.

- **New Methods of Brand Positioning and technology enabled transparency:** As the consumer are becoming more aware of what they are consuming, there is a sense of inquisitiveness in their minds of where their food is coming from, how is it produced and how does it reach to them, while the consumers are becoming more critical about their food, Companies are focusing on adding an extra layer of transparency to their marketing

agenda. F&B companies are focusing on bringing innovation in this picture by adding QR codes in their packaging which leads the customers to know everything about the product from the products origin to the ingredient it contains.

Major Brands are redefining their Brand image by positioning them as transparent and socially responsible enterprises. We observe brands building campaigns of healthcare and safety of workers. Prioritizing consumer safety and emphasizing on Hygiene and sanitization.

- F&B marketing adapting to new ways of ordering: With the emergence of food delivery applications like Zomato, Swiggy and UberEATS the F&B sector has sensed major competitive threats and opportunities.

Restaurants are implementing various strategies to increase their visibility in these platforms. Techniques like providing discounts and promo codes to loyal customers or first-time customers. Increasing their presence in social media platforms and working on differentiating themselves through pricing or product innovation.

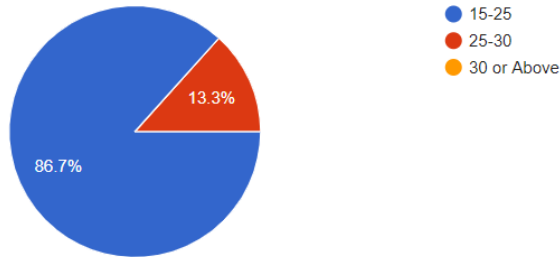
The above were some findings that we were able to collect with the help of systematic literature reviews and various secondary data based on the research of global market research companies.

## **DATA COLLECTION AND ANALYSIS**



Age

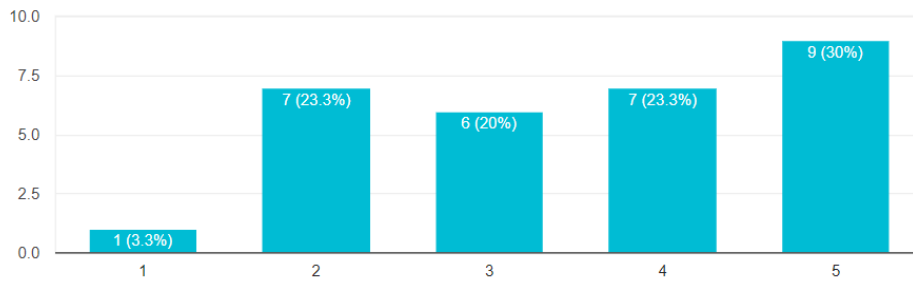
30 responses



On a scale of 1 to 5, where 1 is least likely and 5 is most likely Rate your answers

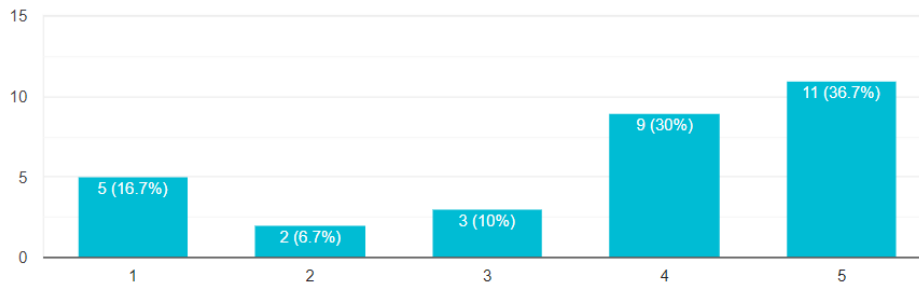
How often do you order food from online service ( zomato, swiggy, domino's)

30 responses



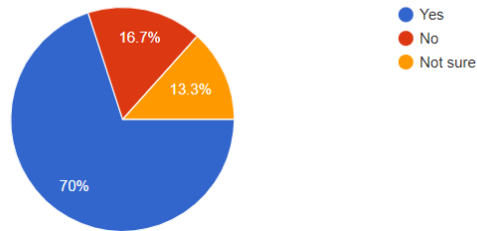
How convenient you feel in ordering food from Zomato or Swiggy

30 responses



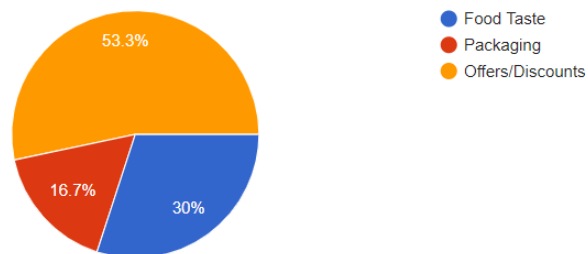
Have you heard of/used any online ordering services for delivery/ takeaway/dine-in

30 responses



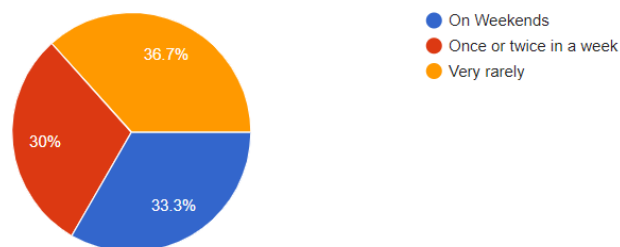
What finds you best to order online?

30 responses



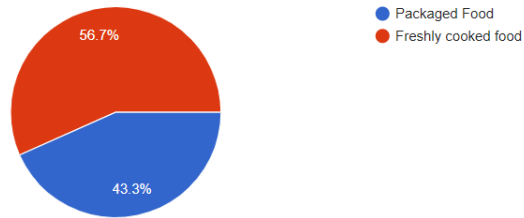
How many time in a week you order food?

30 responses



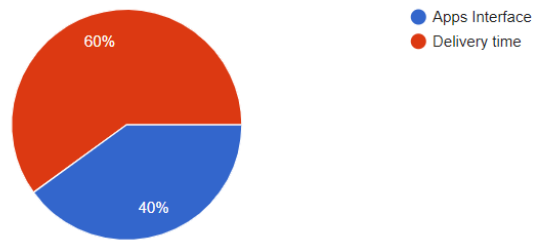
What would you prefer the most?

30 responses



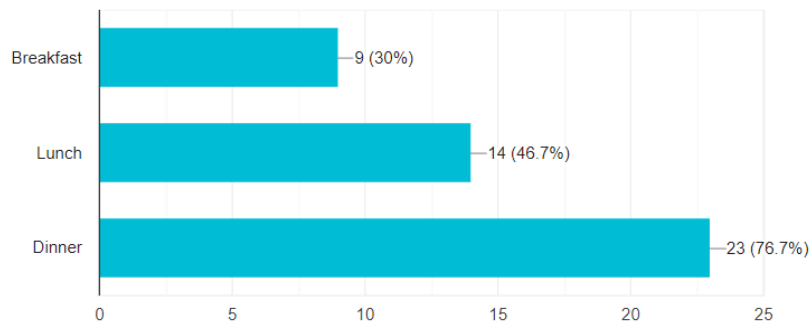
what would you like to see the possible change while ordering your food

30 responses



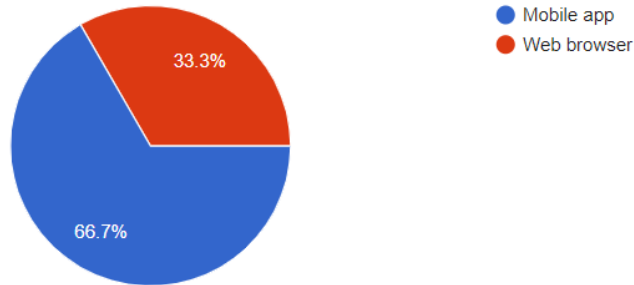
Which meal you prefer to order?

30 responses



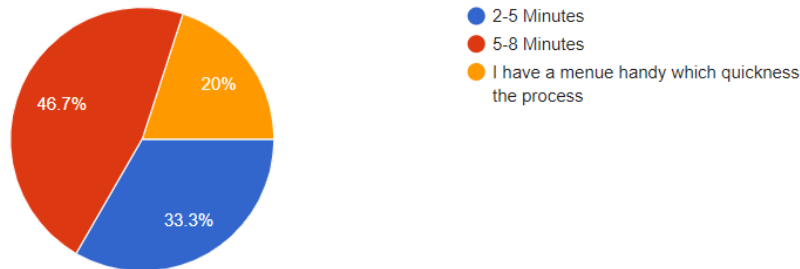
In general how do you prefer to order food?

30 responses



How long does it generally take you to place your order on the phone?

30 responses



## RESULT AND SUGGESTIONS

From the responses received we can see Gen Z are more inclined towards in ordering food from online platforms and shows 30% often order their food and they feel most convenient to order their meals. Gen Z are most aware about the food and beverage industry and about the offers.

Food industry are now more on offers and discounts but lacking in the taste and packaging quality that they use to offer earlier. From responses it can be interpreted 53.33% are attracted to offers and discounts and only 30% prefer the food taste. Offer are good strategy to attract and

target customers but some where they food quality could get compromised over discounts. 30% to 33.3% get the orders on weekdays and weekends, which suggests that food industry especially online platforms holdenough potential to generate revenue from this industry despite of ignoring the food quality and packaging. 60% of people wants to get the delivery process make quicker; delivery partners can make this process smooth by enhancing the user experience through mobile apps. As seen from data users prefer freshly cooked food and 76.7% order for dinner, food industry could take this advantage over online platforms to make best out of by providing freshly prepared meal and can also generate their revenue. Since Gen Z are born in this smart world and spend their maximum time on apps, food ordering apps can improve their process so it takes lesser time to order food from apps and improve user experience.

**LIMITATION:**

The limitations of this study are that the data was limited. First, in the study we used a secondary data by drawing on data collected Although all the necessary steps have been undertaken in the research design stage to improve the precision and reliability of the findings, nonetheless, the study lacks generalizability due to the nature of the research methodology we used is only collected from the India by the small and medium sized enterprises operating in food and beverage industry by exploring and identifying the marketing innovation strategies of firms in India during the COVID-19 crisis, some of the short-term impacts and medium-to-long-term impacts seem correlated. For example, lower sales and an increase in expired products certainly reduce the ROI. However, the study is silent on this issue, and the interrelationships among the factors examined are beyond the objectives of this study. this combines crisis management with marketing innovation theory of food and beverage industry to demonstrate that marketing innovations can help firms in the COVID-19 crisis survive and recover based on an in-depth case analysis. However, there is no empirical test of our conclusions. The present study does not attempt a ranking of the impacts and strategies. A future study investigating the relative importance of the strategies might be useful for the companies deciding where they should focus their efforts first, as they, along with the rest of the industry, seek to recover from the pandemic.

**FUTURE SCOPE:**

The food and beverages industry accounts for ~3% of India's GDP and is the single largest employer in the country, with more than 7.3 million workforces. The nationwide lockdown set this industry on a downward spiral with some predictions suggesting that nearly a quarter of all restaurants may shut down by the end of 2020. India's US\$50 billion restaurant industry is set to lose an according to the National Restaurant Association of India (NRAI).

To offset these challenges and regain profitability, the industry has been adapting and innovating since the lockdown was lifted. New service offerings and COVID hygiene protocols are emerging in the sector to gain customer confidence and lift revenues.

The pandemic has had a significant impact on the global supply chain, food service market, commodity prices, and demand for both essential and non-essential goods. Companies in India's food and beverage sector have begun to restart operations as the country recovers from the coronavirus outbreak that lasted months. However, the country's food and beverage market is still far from returning to normalcy; much has changed in the consumer's attitude toward the F&B sector since the crisis. The industry has been adjusting and innovating to resolve these obstacles and regain profitability. In order to gain customer trust and increase sales, the sector is introducing new service offerings and COVID hygiene protocols like hygiene Standards, Contactless Solutions, Cloud Kitchens, At Home Experiences, Vegan and Healthy Food Brands. The industry is headed for a transformation with digitization at its core. Services will grow to become more personalized and customer-centric, creative service offerings will be launched, health and safety will be standardized, operations will become less labour intensive and balance sheets will become leaner. All these changes will elevate customer experience and set new standards for the industry in the post-COVID era.

**CONCLUSION:**

For Strategic decisions in the context of Marketing and positioning role in this on-going covid era we can observe that Innovation Marketing plays a substantial role. The Food and beverage industries are looking for ways to innovate their process and product launches to find their place in this new normal. Innovation has become a crucial aspect to survive. As F&B was

already a volatile sector but after Coronavirus it has radically changed to transform into a more collaborative, more aware, and more innovative industry. We observe consumers looking for alternatives, and substitutes for healthy and conscious living simultaneously we observe how industries are adapting to consumer changing preferences and working on better positioning and offering quality products in an innovative manner.

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**IMPACT OF CONSUMER BUYING BEHAVIOUR FOR T-SHIRT  
BASED ON DEMOGRAPHIC CONDITIONS**

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**ABSTRACT**

The Research paper is about the effect of buyer purchasing conduct dependent on segment conditions for the item T-shirts in urban communities like Delhi and Mumbai. What sort of segment factors influence the customer purchasing conduct, for example, the climate conditions fluctuating in these two urban communities and the buying forces of the buyers that continues changing with time? As indicated by the exploration, every one of the elements are measurably noteworthy. Here a few thoughts are placed into coordinated effort about what variables influence the buyer purchasing conduct, when do the elements change, for what reason do these components influence when a purchaser needs to purchase T-shirts, which elements lead to the adjustments in the shopper purchasing conduct with regards to purchasing T-shirts and how or to what degree these elements legitimately suggest on the purchasing conduct.

**Introduction**

There is a chance to consider the relationship of buyer purchasing conduct, for our situation the item is T-shirts dependent on certain segment factors. The most significant criteria which a buyer searches for brand choice relies on the impacts, positive and negative viewpoints that encompass each brand. While deciding these impacts, important data should be verified in light of the fact that such data will uncover the particular impact on the valuing and closeout of shopper items. The investigation of a specific item's situation in the market is done based on section of individuals who purchase that item and further the impression of purchaser must be precisely known by the dealer and ought to likewise fulfill the needs of the purchaser.

In this research data with regards to the market, types, sorts, costs of merchandise wanted by a retailer's present and potential clients will be critical in applying the cost and advancement system. This examination enlightens us regarding the how factors like atmosphere conditions, salary and age directly affect the customer purchasing conduct in urban areas like Mumbai and Delhi as our exploration is relating to the review done in just these two urban communities.

### **Literature Review**

**Bhattacharya, C.B and Sen (2003)** this article state that Purchaser conduct imply to the psychological and passionate procedure and the recognizable conduct of shopper during searching, purchasing and post utilization a product administration. Buyer conduct include investigation of how individuals purchase, what they purchase, when they purchase and why they buy. It mixes the component the brain research, human science, sociopsychology, human sciences and financial aspect. It likewise attempts to evaluate the effect on the customer from gathering, for example, family companion, reference bunch society and general.

**Rajput, N., Kesharwani, S. and Khanna, A. (2012)** this article characterizes that the Modern time gives top notch materials and part of assortment in Indian piece of clothing business sector to fulfil the craving of clients. The clients are using the open door as well. The outcomes affirm that Indian individuals have become exceptionally brand cognizant by and by. Subsequently, brand picture is a not a critical factor in picking the item or brand to purchase. There are different perspectives like, quality, solace, desires and segment attributes are likewise impact to the acquiring choice that rule the buy choice of guys and females.

**JafarIqbalLaskar and Haidar Abbas (2014)** this examination means to think about the customer mindfulness about different attire brands (wellsprings of mindfulness just as the degree of mindfulness), their discernment about these brands and the elements that influence their recognition. Analyst has seen that commercial and rack nearness are the fundamental wellspring of brand mindfulness.

**Radha Krishna and shyajan in (2007)** proposed a calculated model and consider the impact of different promoting and segment factors on purchaser routine purchasing conduct towards marked clothing.

**(De Chernatony, L., et al.,2010).**Consumer purchasing conduct is a mainstream subject having critical measure of work done by scholastics just as researchers. The purchasing conduct plays an all the more dominant as far as client which is maintainable and profitable. Through the writing found out, it has been inferred that different segment factors do influence the purchasing conduct of buy.

### **Hypothesis**

The dependent variable here is consumer buying behavior. The independent variables used here are climatic conditions, income and age.

**H0: Weather condition have LOW impact on the consumers for buying various T-shirt.**

**H1: Weather condition have HIGH impact on the consumers for buying various T-shirt.**

**H0: Brands have LOW impact on buying behavior.**

**H1: Brands have HIGH impact on buying behavior.**

**H0: Consumer buying behavior have LOW impact for T-shirts via online or retail.**

**H1: Consumer buying behavior have HIGH impact for T-shirts via online/ retail.**

### **Research methodology**

#### **Research Design**

To examine the buying behavior of consumer's descriptive research design was used.

Primary data was gathered with the help of a questionnaire.

The current study is mainly based on primary data and examines the factors which influence the consumers regarding t-shirt purchase.

The area selected for this study is the Mumbai, Delhi.

The main focus of this study is primarily to understand the present buying behavior of consumers and find out the elements which impact the customers regarding the purchase of t-shirts.

Stratified random sampling is used for collection of data.

### **Questionnaire Design**

The present study is mainly based on the primary data structured questionnaire was used to gather data from the respondents which included three parts.

The first part of the questionnaire covers questions based on **demographic** aspects of the respondents and the second part of the questionnaire contained questions relating to t-shirt **buying behavior dimensions** viz., Consumer characteristics, Reference group, Promotion and Product attributes.

The third part of the questionnaire contained questions based on **Consumers purchase intention** toward buying t-shirts.

All these questions were measured with a 5-point **Likert Scale** that ranged from **5 very satisfied to 1 very dissatisfied**. The consumers were contacted through e-mail, social media and in person. They were given a brief information about the aim and importance of the study. Enough time was given to them to think over the answers for the questions to have the reliability of response. Details regarding demographic, and behavioral characteristics of the customer, consumer's awareness, buying behavior and preferences for buying apparel were taken as part of the survey.

### **Sample Design**

In order to measure the purchase intentions of t-shirt buyers, respondents containing male apparel were taken. The study was conducted in Mumbai, Delhi. The respondents were chosen randomly. The sample population was the consumers, at the age of 15 – 50. The sampling was adopted to cover a sample size of 247 males.

**Tools used for the study**

As the research is Conclusive, so the tool used for analyzing the data that can be collected from questionnaires, is Descriptive Analysis and other primary tools needed for questionnaire design and data collection. We use, **Anova** to check the impact of different factors of customers that lead to buying or switch the brand as when we do a comparative study **Anova** is the best test. Anova will help us in finding the significant relation between the retailer and the buyers.

**Identify the research test:**

Scale	Permissible Statistic	
Nominal	Percentages, Mode, chi-square, Contingency coefficient, Binomial test	Store type, Brand, Gender
Interval	Product moment, Correlation coefficient, ANOVA, T-test, Z-test, Regression analysis.	Opinion
Ratio	Geometric Means, Harmonic means and coefficient of variation	Age, Income, cost

**Reliability Test**

**Case Processing Summary**

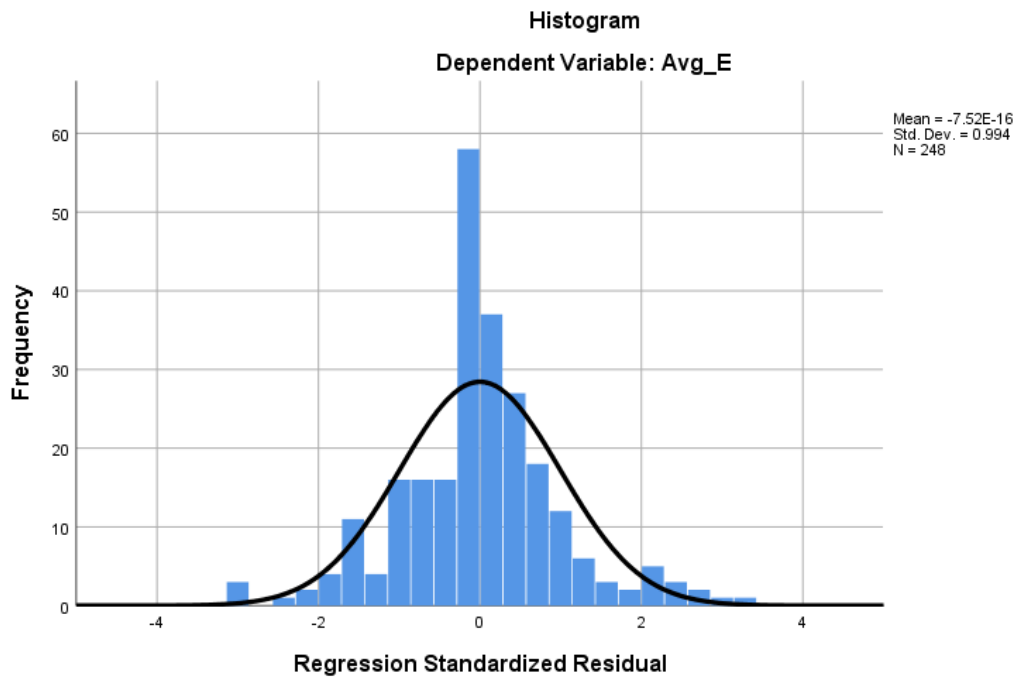
		N	%
Cases	Valid	242	97.6
	Excluded	6	2.4
	Total	248	100.0

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.878	.879	20

The Cronbach Alpha value =0.879 which means that the research that the data used in the research is reliable & valid.



**Data analysis & findings**

- H0: Weather condition have LOW impact on the consumers for buying various T-shirt.
- H1: Weather condition have HIGH impact on the consumers for buying various T-shirt.
- One-way anova test of weather condition & consumer buying behaviour for T-shirts

**ANOVA**

Avg\_B

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.103	4	3.526	10.610	.000
Within Groups	80.413	242	.332		
Total	94.516	246			

Here the significance level is 0.00 which is less than 0.005 which states that Weather conditions do have a HIGH impact on the consumer buying behavior. This states that our Null Hypothesis H0 is proved right & can be accepted.

H0: Weather condition have LOW impact on the consumers for buying various T-shirt.

And the Alternate Hypothesis H1 is thus rejected.

H1: Weather condition have DO NOT HAVE HIGH impact on the consumers for buying various T-shirt.

**Regression test of weather condition & consumer buying behaviour for T-shirts**

**City: - Delhi**

**Descriptive Statistics**

	Mean	Std. Deviation	N
AVG_B	3.216	.6629	122
AVG_E	3.53	1.006	122

**Correlations**

		AVG_B	AVG_E
Pearson Correlation	AVG_B	1.000	.384
	AVG_E	.384	1.000
Sig. (1-tailed)	AVG_B	.	.000
	AVG_E	.000	.
N	AVG_B	122	122
	AVG_E	122	122

**Coefficients**

Model	Unstandardized Coefficients		Standardized Coefficients		t	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta				Lower Bound	Upper Bound



1 (Constant)	2.323	.204		11.386	.000	1.919	2.727
AVG_E	.253	.056	.384	4.549	.000	.143	.363

a. Dependent Variable: AVG\_B

Regression test of weather condition & consumer buying behaviour for T-shirts

- City: -Mumbai

### Descriptive Statistics

	Mean	Std. Deviation	N
AVG_B	3.424	.5586	125
AVG_E	3.80	.842	125

### Correlations

		AVG_B	AVG_E
Pearson Correlation	AVG_B	1.000	.312
	AVG_E	.312	1.000
Sig. (1-tailed)	AVG_B	.	.000
	AVG_E	.000	.
N	AVG_B	125	125
	AVG_E	125	125

### Model Summary

Model	R	R square	Adjusted Square	R	Std error of the estimate	R Square Change	F Change	df1	df2
1	0.312 <sup>a</sup>	0.097	0.090	0.5329	0.097	0.097	13.257	1	123

a. Predictors: (Constant), AVG\_E

**Coefficients**

Model		Unstandardized Coefficients		Standardized Coefficients		95.0% Confidence Interval for B		
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1	(Constant)	2.638	.221		11.934	.000	2.201	3.076
	AVG_E	.207	.057	.312	3.641	.000	.094	.319

a. Dependent Variable: AVG\_B

**Descriptive test for the first hypothesis**

**Descriptive Statistics**

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
Avg_B	248	819.4	1.0	820.40	6.616	3.29	51.888
Avg_E	248	905	1	906	7.31	3.639	57.306
Valid (listwise)	N 248						

H0: Brands have LOW impact on consumer buying behavior.

H1: Brands have HIGH impact on consumer buying behavior.

**One-way anova test of branded t-shirts & consumer buying behaviour for t-shirts**

**ANOVA**

Avg\_B

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	26.986	4	6.746	24.176	.000
Within Groups	67.531	242	.279		
Total	94.516	246			

Here as we can see that the significance level = 0.000, it means that while purchasing T-SHIRTS, consumers prefer t-shirts that either are brands or not from a local market.

Consumers aren't specific about particular brands.

**Hence the null hypothesis here H0 is accepted.**

**H0: Brands have LOW impact on buying behavior.**

**And the alternate is rejected.**

**H1: Brands have HIGH impact on buying behavior.**

**Regression Test of Branded T-Shirts & Consumer Buying Behaviour**

**City: - Delhi**

**Model Summary<sup>b</sup>**

Mo	R	R	Adjuste	Std.	Change Statistics	Durbin-
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Model	R	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. Change	Durbin-Watson	
1	.377 <sup>a</sup>	.142	.135	.7772	.142	19.909	1	120	.000	1.812

a. Predictors: (Constant), Avg\_E

b. Dependent Variable: Avg\_D

As the significance level = 0.00, there exists a relationship between the I.V – branded t-shirts and the D.V- consumer buying behaviour.

### Regression Test of Branded T-Shirts & Consumer Buying Behaviour

City: - Mumbai

#### Model Summary

Model	R	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. Change	Durbin-Watson
1	.493 <sup>a</sup>	.243	.736	.243	39.495	1	123	.000	1.924

a. Predictors: (Constant), Avg\_D

b. Dependent Variable: Avg\_E

As the significance level = 0.00, there exists a relationship between the I.V – branded t-shirts and the D.V- consumer buying behaviour for both the cities Delhi & Mumbai.

#### Descriptive Test for the Second Hypothesis

**Descriptive Statistics**

	N	Range	Minimum	Maximum	Mean	Std. Error	Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Avg_E	248	905	1	906	7.31	3.639	57.306	3283.946
Avg_D	248	870.0	1.0	871.0	7.024	3.4982	55.0904	3034.953
Valid (listwise)	N 248							

**H0: Consumer buying behavior have IMPACT for buying T-shirts via retail.**

**H1: Consumer buying behavior have IMPACT for buying T-shirts via E-Commerce.**

**One-Way ANOVA Test of Consumer Buying Behaviour for T-Shirts via Retail Stores.**

**ANOVA**

TWF2

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	45.412	4	11.353	13.319	.000
Within Groups	206.288	242	.852		
Total	251.700	246			

Here the significance level is 0.00 which is less than 0.005 which states that consumers prefer to buy more from retail stores and less from e-commerce applications.


**This states that our Null Hypothesis H0 is proved right & can be accepted.**

H0: Consumer buying behavior have IMPACT for buying T-shirts via retail.

And the Alternate Hypothesis H1 is thus rejected.

H1: Consumer buying behavior have IMPACT for buying T-shirts via E-Commerce.

**Regression Test Of Consumer Buying Behaviour For T-Shirts Via Retail Stores Or Online Stores**

 **CITY: - DELHI**

**Model Summary<sup>b</sup>**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					
					R Square Change	F Change	df1	df2	Sig. Change	F Durbin-Watson
1	.450 <sup>a</sup>	.202	.195	.902	.202	30.388	1	120	.000	2.303

a. Predictors: (Constant), Avg\_F

b. Dependent Variable: Avg\_E

**Regression Test of Consumer Buying Behaviour for T-Shirts Via Retail Stores Or Online Stores**

**City: - Mumbai**

**Model Summary<sup>b</sup>**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				Sig. F Change	Durbin-Watson
					R Square Change	F Change	df1	df2		
1	.475 <sup>a</sup>	.226	.220	.744	.226	35.924	1	123	.000	2.063

a. Predictors: (Constant), Avg\_F

b. Dependent Variable: Avg\_E

**Descriptive Test for the Third Hypothesis**

**Descriptive Statistics**

	N	Range	Minimum	Maximum	Mean	Std. Error	Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic		Statistic	Statistic
Avg_F	248	865.5	1.0	866.5	6.988	3.4802	54.8067	3003.769
Avg_E	248	905	1	906	7.31	3.639	57.306	3283.946
Valid (listwise)	N 248							

**Findings**

1. The Cronbach Alpha value =0.879 which means that the research that the data used in the research is reliable & valid. Hence the data that is used is reliable and relevant enough to conduct the research in cities MUMBAI & DELHI.
2. Irrespective of the weather condition in cities like Mumbai & Delhi, consumers buying preferences in case of T-SHIRTS have LOW impact with respect to climatic conditions.

3. Brands have LOW impact on consumers while purchasing T-SHIRTS. Consumers prefer more local branded T-SHIRTS.
4. Consumer buying behavior have IMPACT for buying T-shirts from retail stores compared to online shopping in both the cities.

### **Conclusion**

Irrespective of the weather condition in cities like Mumbai & Delhi, consumers buying preferences in case of T-SHIRTS have LOW impact with respect to climatic conditions.

Brands have LOW impact on consumers while purchasing T-SHIRTS. Consumers prefer more local branded T-SHIRTS.

Consumer buying behavior have IMPACT for buying T-shirts from retail stores compared to online shopping in both the cities.

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**Display Marketing on Online Media Platform and its effects on Consumer Behavior.**

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**Abstract**

This paper summarizes how the display advertising affects customer behavior, also talks about what are they ways with which the agents should organize the content in the display advertising ecosystem. The study takes an interdisciplinary view and paves new research directions by drawing the relations between various streams such as marketing, economics, operations, digital systems etc. In the era of economically robust and fast pace market this study aims will be instrumental in bringing forward the potential research opportunities by integrating the view of the display advertising ecosystem.

**Keywords:** Display Advertising, Online Platform, Real-Time Data, digital display

**Introduction**

***Display Marketing***

According to the Interactive Advertising Bureau (IAB herein) report, display advertising (ad herein) totaled \$49.8 billion in the US in 2018, up from the \$39.4 billion reported in FY 2017. This double digit growth rate (26%) is fueled by the upswing in mobile browsing, social media activities, video ad formats, and the developments in targeting technology. Digital display ad spending has surpassed even search ad spending and will continue its rapid ascent in share and significance.

Given the substantial economic importance of the display ad market, the objective of this paper is to summarize the existing literature from the perspective of each player involved in the display ad ecosystem. In doing so, we take a diverse streams of theoretical research in information systems, marketing, economics, operations, and computer science.

Customers actively avoid looking at online banner ads (Dreze and Hussherr 2003). Response rates to banner ads have fallen dramatically over time (Hollis 2005). In reaction to this, online advertising on websites has developed along two strikingly distinct paths. On the one hand, the \$11.2 billion<sup>1</sup> online display advertising market has evolved beyond traditional banner ads to include many visual and audio features that make ads more obtrusive and harder to ignore. This paper explores how well these divergent strategies work for online advertising, and how consumer perceptions of intrusiveness and privacy influence their success or lack of it, both independently and in combination.

Focusing on the display ad market, existing survey papers either discuss issues facing advertisers (demand side), publishers (supply side), or intermediaries. On the advertiser side, Tucker (2012) and Goldfarb (2014) review the economic literature on targeting and privacy concerns, and highlight their trade-off in ad effectiveness. On the publisher side, Korula et al. (2016) cover a broad range of publishers' decisions in selling display ad, and review studies on allocating impressions and designing contracts/auctions. Our survey differs in that we provide a comprehensive view of the display ad ecosystem, including both guaranteed and non-guaranteed selling channels, and delineate the research progress gained from the eyes of all the players involved, including advertisers, publishers, and intermediaries. Furthermore, we take an interdisciplinary view and draw connections across disciplines. By providing an integrated view and bringing attention to the outstanding research opportunities, we hope to provide additional motivation for subsequent studies in this rapidly growing market.

## **Objectives**

One types involves building long-term brand equity. The other type is to generate short-term direct responses similar to coupons in print ads. As display ad objective is not directly observed by researchers in most datasets, integrated studies about what factors drive this two fold objective and the relative importance of goal types are scant.

There are a series of key performance indicators used by advertisers to evaluate their campaign performance and to set objectives functions for optimization algorithm. The most common amongst these include impressions, clicks, visits, and purchases. Consequences of the often incongruent two fold objective of increasing brand equity and enhancing direct response, the question arises of metrics should be evaluated and optimized.

### **Literature Review**

Advancement in technology during the last century have enabled the creation of the 3 big media channels- TV, Radio, Print. These were the backbone on which marketing had been functioning for the better part of the last century, and to a large extend, it still does now. Today these are known as traditional media channels and we refer to the model of marketing communication applied over them as traditional marketing communications. Embracing digital marketing is not a novelty but a necessity in order to cope with changes in media and communication landscape (Ivan Temovski, 2015).

Customers actively avoid looking at banners ads (Dreze and Hussherr, 2003). Response rate to banner ads have fallen dramatically over time (Hollis 2005). In reaction to this, online advertising on websites has developed along two strikingly distinct paths.

Google has developed a highly profitable non-search display advertising division (called AdSense) that generates an estimated \$6 billion in revenues by displaying plain content-targeted text ads: 76% of US internet users are estimated to have been exposed to AdSense ads. This paper explores how well these divergent strategies work for online advertising, and how consumer perceptions of intrusiveness and privacy influence their success or lack of it, both independently and in combination.

The advertisers in our data used two core improvements on standard banner ad campaigns to attract their audience. (1) Some web campaigns matched the product they advertised to the Website content, for example when auto manufacturers placed their ads on auto websites. (2) Some web campaigns deliberately tried to make their ad stand out from the content by using Video, creating a pop-up, or having the ad take over the webpage. The results suggest that matching an ad's content to the website content increased stated purchase intent among exposed consumers. Also consistent with prior literature (e.g. Cole, Spalding, and Fayer 2009), the results suggest that increasing the obtrusiveness of the ad increased purchase intent.

The literature on consumer response to persuasion attempts provides an alternative explanation: Obtrusive ads may lead consumers to infer that the advertiser is trying to manipulate them, reducing purchase intentions (Campbell 1995). Increased processing attention may lead the consumer to think about why a particular advertising tactic was used (Campbell 1995; Friestad and Wright 1994).

### Methods

We have used the primary data collection methods in collecting the responses of the audience regarding the impression about **display marketing in the online media platform** and representing the real time data using primary data collection.

#### Q1. Do you see ads on online platform?

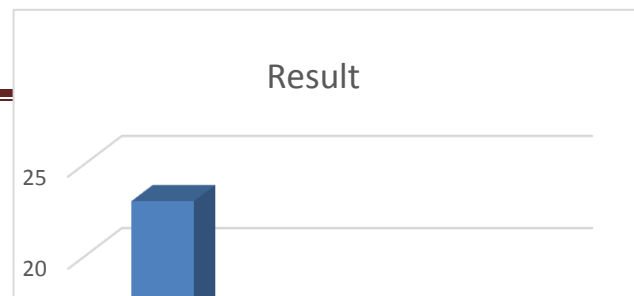
Name	Yes	No	Sometimes
Vishal	✓		
Mayank Piriya			✓
Rahul Gosavi	✓		
Soni	✓		
Priya	✓		
Trisha	✓		
Ritesh			✓
Ritesh Jha			✓

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[VICMR-2022]

Ashish Prajapat	✓
Vaishali Maloo	✓
Harsh Dugar	✓
Lokesh Jain	✓
Mukesh Verma	✓
Amol Rawat	✓
Akshat Joshi	✓
Divyansh Shrivastava	✓
Shashank Ranade	✓
Awadhesh Sharma	✓
Rajat Bagheshwar	✓
Abhishek Damke	✓
Himanshu Samad	✓
Aman Gupta	✓
Rohit Jain	✓
SachinChouhan	✓
Adarsh Vyas	✓
Tilak Patidar	✓
Suraj Vaishnav	✓
Aditi Vyas	✓
Mansi Shrivastava	✓
Srishti Pawar	✓
Payal Kale	✓
VaidehiKelapure	✓
Palak Kusumakar	✓
Kuntal Gupta	✓
Neha Verma	✓

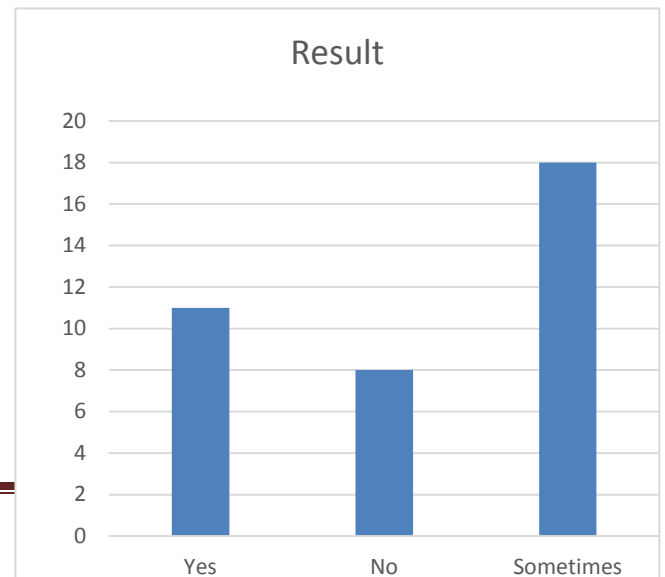
ISBN: 978-93-94198-04-3



Shubham Khode	✓
Uttkarsh Patel	✓
Sourabh Chaturvedi	✓

**Q2. Do you click on ads that you see on website?**

Name	Yes	No	Sometimes
Vishal	✓		
Mayank Piriya	✓		
Rahul Gosavi			✓
Soni Dubey			✓
Priya Agarwal			✓
Trisha Agarwal		✓	
Ritesh Jha	✓		
Ashish Prajapat			✓
Vaishali Maloo		✓	
Harsh Dugar			✓
Lokesh Jain	✓		
Mukesh Verma			✓
Amol Rawat	✓		
Akshat Joshi			✓
Divyansh Shrivastava		✓	
Shashank Ranade			✓
Awadhesh Sharma	✓		
Rajat Bagheshwar			✓



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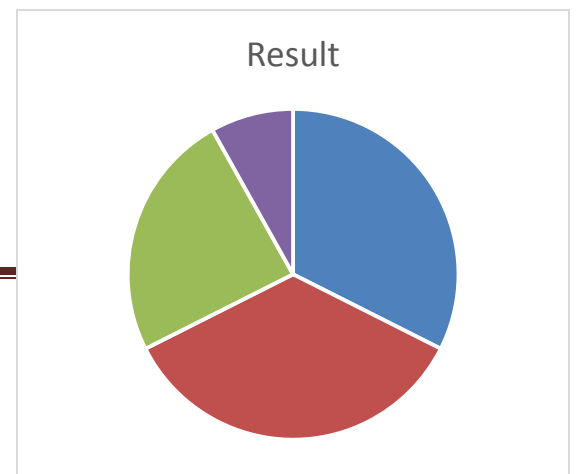
[VICMR-2022]

Abhishek Damke		✓
Himanshu Samad	✓	
Aman Gupta	✓	
Rohit Jain	✓	
Sachin Chouhan	✓	
Adarsh Vyas		✓
Tilak Patidar		✓
Suraj Vaishnav		✓
Aditi Vyas		✓
Mansi Shrivastava		✓
Srishti Pawar	✓	
Payal Kale		✓
VaidehiKelapure		✓
Palak Kusumakar		✓
Kuntal Gupta		✓
Neha Verma		✓
Shubham Khode		✓
Uttkarsh Patel		✓
Sourabh Chaturvedi		✓

### Q3. What kinds of ads attract you the most?

Name	Photos	Videos	GIFs	Others
Vishal	✓			
Mayank Piriya	✓			
Rahul Gosavi		✓		
Soni Dubey			✓	
Priya Agarwal	✓			

ISBN: 978-93-94198-04-3





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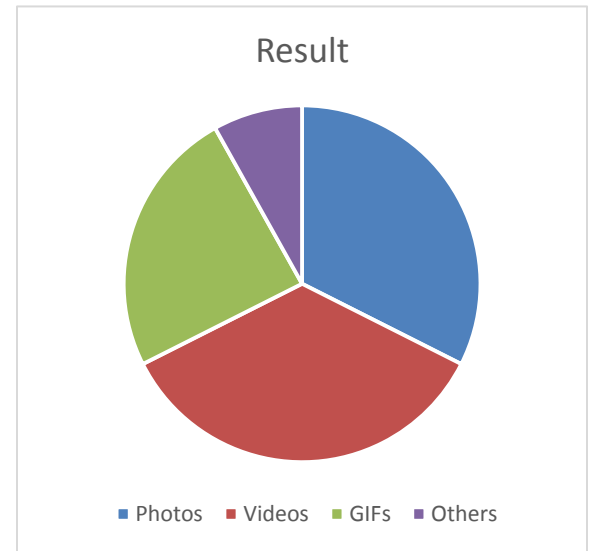
[VICMR-2022]

Trisha Agarwal	✓	
Ritesh Jha		✓
Ashish Prajapat	✓	
Vaishali Maloo		✓
Harsh Dugar	✓	
Lokesh Jain		✓
Mukesh Verma		✓
Amol Rawat	✓	
Akshat Joshi		✓
Divyansh Shrivastava	✓	
Shashank Ranade		✓
Awadhesh Sharma	✓	
Rajat Bagheshwar	✓	
Abhishek Damke	✓	
Himanshu Samad		✓
Aman Gupta		✓
Rohit Jain		✓
Sachin Chouhan	✓	
Adarsh Vyas		✓
Tilak Patidar		✓
Suraj Vaishnav		✓
Aditi Vyas	✓	
Mansi Shrivastava		✓
Srishti Pawar		✓
Payal Kale	✓	
VaidehiKelapure		✓
Palak Kusumakar		✓

Kuntal Gupta	✓
Neha Verma	✓
Shubham Khode	✓
Uttkarsh Patel	✓
Sourabh Chaturvedi	✓

**Q4. On what type of ads do you click the most?**

Name	Photos	Videos	GIFs	Others
Vishal	✓			
Mayank Piriya	✓			
Rahul Gosavi		✓		
Soni Dubey			✓	
Priya Agarwal	✓			
Trisha Agarwal		✓		
Ritesh Jha			✓	
Ashish Prajapat	✓			
Vaishali Maloo			✓	
Harsh Dugar	✓			
Lokesh Jain		✓		
Mukesh Verma			✓	
Amol Rawat	✓			
Akshat Joshi			✓	
Divyansh	✓			



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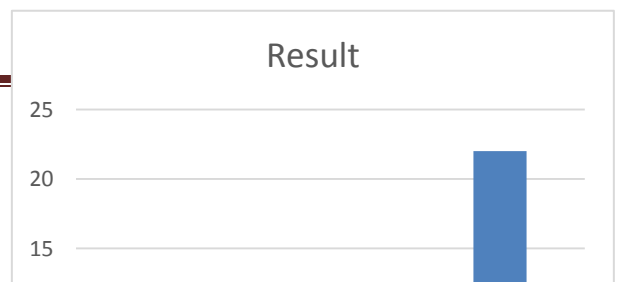
[VICMR-2022]

Shrivastava		
Shashank Ranade	✓	
Awadhesh Sharma	✓	
Rajat Bagheshwar	✓	
Abhishek Damke	✓	
Himanshu Samad	✓	
Aman Gupta	✓	
Rohit Jain	✓	
Sachin Chouhan	✓	
Adarsh Vyas	✓	
Tilak Patidar	✓	
Suraj Vaishnav		✓
Aditi Vyas	✓	
Mansi Shrivastava		✓
Srishti Pawar		✓
Payal Kale	✓	
VaidehiKelapure		✓
Palak Kusumakar		✓
Kuntal Gupta	✓	
Neha Verma		✓
Shubham Khode	✓	
Uttkarsh Patel		✓
Sourabh Chaturvedi	✓	

**Q5. Does the color combination of ads affect your rate of clicking on the ads?**

Name	Yes	No	Maybe
Vishal			✓

**ISBN: 978-93-94198-04-3**



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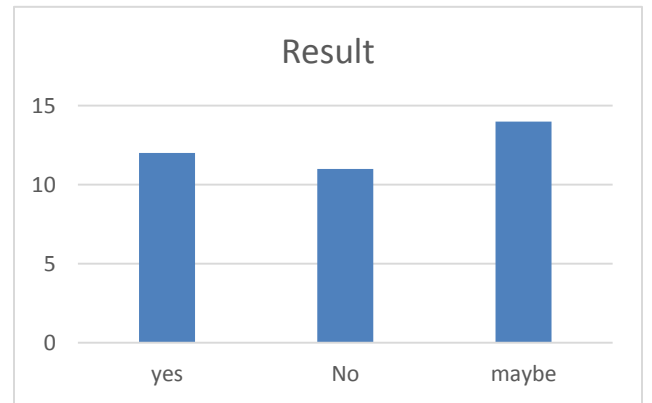
[VICMR-2022]

Mayank Piriya	✓
Rahul Gosavi	✓
Soni	✓
Priya	✓
Trisha	✓
Ritesh	✓
Ritesh Jha	✓
Ashish Prajapat	✓
Vaishali Maloo	✓
Harsh Dugar	✓
Lokesh Jain	✓
Mukesh Verma	✓
Amol Rawat	✓
Akshat Joshi	✓
DivyanshShrivastava	✓
Shashank Ranade	✓
Awadhesh Sharma	✓
Rajat Bagheshwar	✓
Abhishek Damke	✓
Himanshu Samad	✓
Aman Gupta	✓
Rohit Jain	✓
Sachin Chouhan	✓
Adarsh Vyas	✓
Tilak Patidar	✓
Suraj Vaishnav	✓
Aditi Vyas	✓
Mansi Shrivastava	✓

Srishti Pawar	✓
Payal Kale	✓
VaidehiKelapure	✓
Palak Kusumakar	✓
Kuntal Gupta	✓
Neha Verma	✓
Shubham Khode	✓
Uttkarsh Patel	✓

**Q6. Does picture quality of ads affect the number of time you click on the ads?**

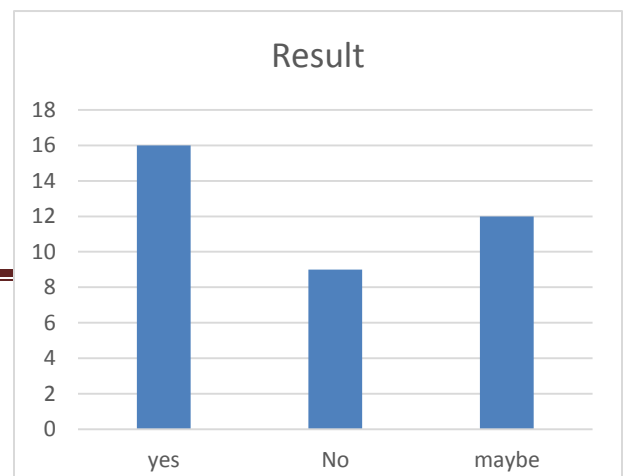
Name	Yes	No	Maybe
Vishal			✓
Mayank Piriya		✓	
Rahul Gosavi	✓		
Soni	✓		
Priya		✓	
Trisha			✓
Ritesh	✓		
Ritesh Jha			✓
Ashish Prajapat		✓	
Vaishali Maloo			✓
Harsh Dugar	✓		
Lokesh Jain			✓
Mukesh Verma			✓
Amol Rawat		✓	
Akshat Joshi	✓		
Divyansh		✓	



Shrivastava		
Shashank Ranade	✓	
Awadhesh Sharma		✓
Rajat Bagheshwar	✓	
Abhishek Damke		✓
Himanshu Samad	✓	
Aman Gupta	✓	
Rohit Jain		✓
Sachin Chouhan	✓	
Adarsh Vyas	✓	
Tilak Patidar		✓
Suraj Vaishnav		✓
Aditi Vyas		✓
Mansi Shrivastava		✓
Srishti Pawar		✓
Payal Kale		✓
VaidehiKelapure	✓	
Palak Kusumakar		✓
Kuntal Gupta		✓
Neha Verma		✓
Shubham Khode		✓
Uttkarsh Patel		✓

**Q7. Does the size of the image affect the number of times you click on ads?**

Name	Yes	No	Maybe
Vishal		✓	
Mayank Piriya	✓		
Rahul Gosavi		✓	

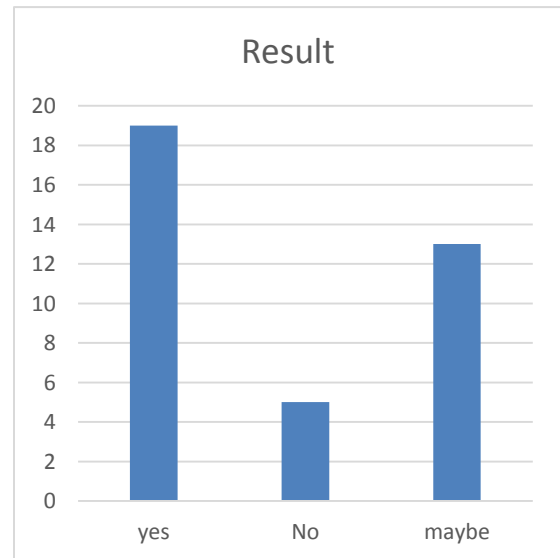


Soni	✓	
Priya		✓
Trisha	✓	
Ritesh		✓
Ritesh Jha		✓
Ashish Prajapat		✓
Vaishali Maloo	✓	
Harsh Dugar		✓
Lokesh Jain		✓
Mukesh Verma		✓
Amol Rawat		✓
Akshat Joshi	✓	
Divyansh Shrivastava		✓
Shashank Ranade		✓
Awadhesh Sharma	✓	
Rajat Bagheshwar		✓
Abhishek Damke		✓
Himanshu Samad	✓	
Aman Gupta		✓
Rohit Jain	✓	
Sachin Chouhan	✓	
Adarsh Vyas	✓	
Tilak Patidar		✓
Suraj Vaishnav	✓	
Aditi Vyas		✓
Mansi Shrivastava	✓	
Srishti Pawar		✓

Payal Kale	✓
VaidehiKelapure	✓
Palak Kusumakar	✓
Kuntal Gupta	✓
Neha Verma	✓
Shubham Khode	✓
Uttkarsh Patel	✓

**Q8. Does the length of video affect the number of times you click on the ads?**

Name	Yes	No	Maybe
Vishal			✓
Mayank Piriya	✓		
Rahul Gosavi		✓	
Soni			✓
Priya	✓		
Trisha		✓	
Ritesh	✓		
Ritesh Jha	✓		
Ashish Prajapat		✓	
Vaishali Maloo			✓
Harsh Dugar	✓		
Lokesh Jain			✓
Mukesh Verma	✓		
Amol Rawat		✓	
Akshat Joshi	✓		
Divyansh			
Shrivastava	✓		
Shashank Ranade			✓

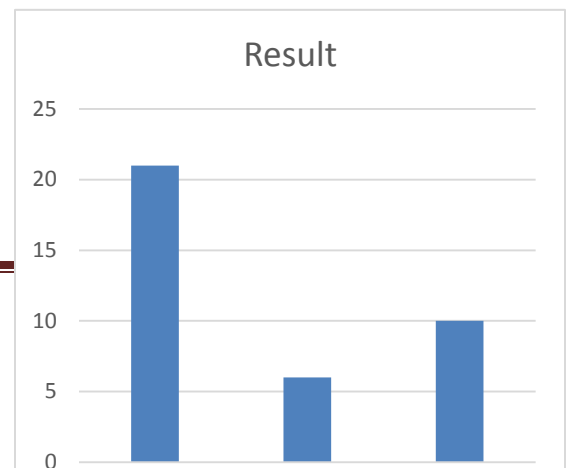




Awadhesh Sharma	✓	
Rajat Bagheshwar		✓
Abhishek Damke	✓	
Himanshu Samad		✓
Aman Gupta	✓	
Rohit Jain		✓
Sachin Chouhan		✓
Adarsh Vyas	✓	
Tilak Patidar		✓
Suraj Vaishnav	✓	
Aditi Vyas		✓
Mansi Shrivastava	✓	
Srishti Pawar	✓	
Payal Kale		✓
VaidehiKelapure	✓	
Palak Kusumakar		✓
Kuntal Gupta	✓	
Neha Verma	✓	
Shubham Khode		✓
Uttkarsh Patel	✓	

**Q9. Does the ad content affect the number of times you click on the ad?**

Name	Yes	No	Maybe
Vishal	✓		
Mayank Piriya			✓
Rahul Gosavi	✓		
Soni			✓
Priya	✓		



Trisha	✓
Ritesh	✓
Ritesh Jha	✓
Ashish Prajapat	✓
Vaishali Maloo	✓
Harsh Dugar	✓
Lokesh Jain	✓
Mukesh Verma	✓
Amol Rawat	✓
Akshat Joshi	✓
Divyansh Shrivastava	✓
Shashank Ranade	✓
Awadhesh Sharma	✓
Rajat Bagheshwar	✓
Abhishek Damke	✓
Himanshu Samad	✓
Aman Gupta	✓
Rohit Jain	✓
Sachin Chouhan	✓
Adarsh Vyas	✓
Tilak Patidar	✓
Suraj Vaishnav	✓
Aditi Vyas	✓
Mansi Shrivastava	✓
Srishti Pawar	✓
Payal Kale	✓
VaidehiKelapure	✓

Palak Kusumakar	✓
Kuntal Gupta	✓
Neha Verma	✓
Shubham Khode	✓
Uttkarsh Patel	✓

**Q10. How likely are you to buy the products or services after viewing the ads?**

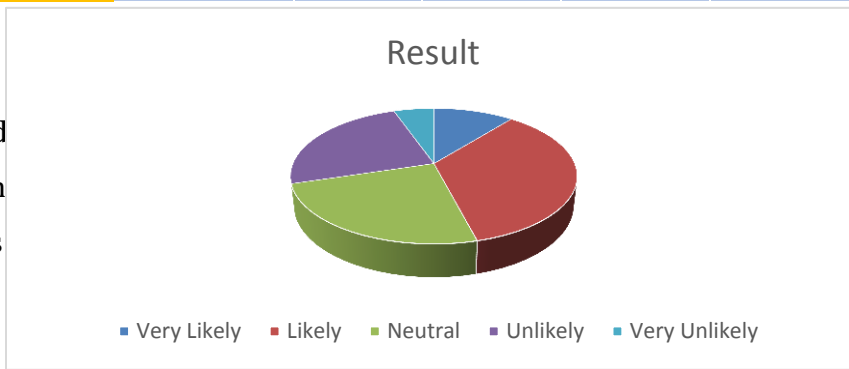
Name	Very Likely	Likely	Neutral	Unlikely	Very Unlikely
Vishal			✓		
Mayank Piriya		✓			
Rahul Gosavi			✓		
Soni Dubey			✓		
Priya Agarwal			✓		
Trisha Agarwal	✓				
Ritesh Jha		✓			
Ashish Prajapat	✓				
Vaishali Maloo		✓			
Harsh Dugar		✓			
Lokesh Jain		✓			
Mukesh Verma		✓			
Amol Rawat			✓		
Akshat Joshi			✓		
Divyansh Shrivastava		✓			
Shashank Ranade				✓	
Awadhesh Sharma		✓			
Rajat Bagheshwar	✓				

Abhishek Damke				✓	
Himanshu Samad				✓	
Aman Gupta			✓		
Rohit Jain		✓			
Sachin Chouhan		✓			
Adarsh Vyas	✓				
Tilak Patidar			✓		
Suraj Vaishnav				✓	
Aditi Vyas		✓			
Mansi Shrivastava		✓			
Srishti Pawar		✓			
Payal Kale			✓		
VaidehiKelapure					✓
Palak Kusumakar				✓	
Kuntal Gupta				✓	
Neha Verma				✓	
Shubham Khode				✓	
Uttkarsh Patel				✓	
Sourabh Chaturvedi					✓

**Results and**

In the size of this circulated:

At Q1, the



this is the sample es that have been

and some of them

preferred sometimes and there are no people who want to view on online platform.

At Q2, the major of the people sometimes click on ads that they see on websites. Some of them preferred to click on ads and very few of them don't want to click the ads.

At Q3, 12 people prefer the photos ads that attracts them the most; 13 people prefer the video ads; 9 people prefer the GIF ads; 3 people prefer other ads.

At Q4, 12 people prefer the photo ads to click on them; 13 people prefer the video ads to click on them; 9 people prefer the GIF ads to click on them; 3 people prefer the other ads to click on them.

At Q5, the number of people that gets affected by the color combination of ads are 9; 22 people might be affected and 6 people doesn't get affected.

At Q6, 12 people get affected by the picture quality of the ad; 14 people might get affected; and 11 people doesn't get affected.

At Q7, 16 people get affected by the size of the image; 12 people might not get affected and 9 people doesn't get affected by the size of the image of the ad.

At Q8, the number of people that get affected by the length of the video are 19; 13 people might get affected and 5 people doesn't get affected.

At Q9, 21 people get affected by the content of the ads; 10 people might get affected and 6 people doesn't get affected.

## **Conclusion**

As we can say that most of the people in this research are more inclined to buy the products and services after viewing the display ads on the digital media and the sales are increasing tremendously due to these ads, so we can conclude that display ads are effective in increasing the sales of a business since the technology is developing and growing on a daily basis and are reachable to more customers, so we can expect increased sales in future using display marketing on online platform.

## **Reference**

**ON QUASI NEUTROSOPHIC BETA OMEGA OPEN MAPPINGS IN NEUTROSOPHIC  
TOPOLOGICAL SPACES**

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Abstract

In this paper, the concept “Quasi neutrosophic beta omega open mappings” and “Quasi neutrosophic beta omega closed mappings” are newly defined. We have analyzed their properties and some interesting theorems are introduced.

Keywords — Quasi- $N\beta\omega$ -open mapping, Quasi- $N\beta\omega$ -closed mapping.

**Introduction**

In the past several decades, Fuzzy set theory has played an important role in the research of mathematics. The research on the theory of fuzzy sets has been witnessing an exponential growth in mathematics. Zadeh established the fuzzy set as an extension of a classical notion of crisp set in 1965 [14]. K. Atanassov, extended the intuitionistic fuzzy set as a generalization of fuzzy set in 1983 [3]. Then Florentin Smarandache generalized the concept intuitionistic fuzzy sets as Neutrosophic sets in 1999 [5]. Later A. Salama and S. A. Alblowi studied the concept of neutrosophic topological spaces [10]. Wadei Al-Omeri and Saeid Jafari discovered the generalized closed sets and generalized pre-closed sets in neutrosophic topological space which belong to the important class of neutrosophic sets [13]. Nandhini [7] introduced Quasi  $N_{\alpha\beta\psi}$ -open and Quasi  $N_{\alpha\beta\psi}$ -closed Functions in neutrosophic topological spaces in 2019.

## Preliminaries

**Definition 2.1.** [10] Let  $X$  be a non-empty fixed set. A neutrosophic set (NS)  $G$  is an object having the form  $G = \{ \langle x, \mu_G(x), \sigma_G(x), \upsilon_G(x) \rangle : x \in X \}$  where  $\mu_G(x)$ ,  $\sigma_G(x)$  and  $\upsilon_G(x)$  represent the degree of membership, degree of indeterminacy and the degree of nonmembership respectively of each element  $x \in X$  to the set  $G$ . A neutrosophic set  $G = \{ \langle x, \mu_G(x), \sigma_G(x), \upsilon_G(x) \rangle : x \in X \}$  can be identified as an ordered triple  $\langle \mu_{G_N}, \sigma_{G_N}, \upsilon_{G_N} \rangle$  in  $]0, 1^+[$  on  $X$ .

But in real life application, using neutrosophic set with values from real standard or non-standard subset of  $]0, 1^+[$  is very difficult. So that we used the Neutrosophic set which takes values from the subsets of  $[0, 1]$ . Here, the neutrosophic topological space is denoted by  $(X, \tau_N)$ . Also the neutrosophic interior, neutrosophic closure of a neutrosophic set  $G$  are denoted by  $int_N(G)$  and  $cl_N(G)$ . The complement of a neutrosophic set  $G$  is denoted by  $\bar{G}$  and the empty and whole sets are denoted by  $0_N$  and  $I_N$  respectively.

**Definition 2.2.** [1] We have used the following definitions throughout this paper.

1.  $G \subseteq H$  if  $\mu_G(x) \leq \mu_H(x)$ ,  $\sigma_G(x) \leq \sigma_H(x)$  and  $\upsilon_G(x) \geq \upsilon_H(x)$  where  $x \in X$
2.  $G \cap H = \langle x, \mu_G(x) \wedge \mu_H(x), \sigma_G(x) \wedge \sigma_H(x), \upsilon_G(x) \vee \upsilon_H(x) \rangle$   $x \in X$
3.  $G \cup H = \langle x, \mu_G(x) \vee \mu_H(x), \sigma_G(x) \vee \sigma_H(x), \upsilon_G(x) \wedge \upsilon_H(x) \rangle$   $x \in X$

4.  $G_N^C = \{ \langle x, v_G(x), 1-\sigma_G(x), \mu_G(x) \rangle : x \in X \}$
5.  $0_N = \{ \langle x, 0, 0, 1 \rangle : x \in X \}$
6.  $1_N = \{ \langle x, 1, 1, 0 \rangle : x \in X \}$ .

**Definition 2.3. [10]** A neutrosophic topology (NT) on a non-empty set  $X$  is a family  $\tau$  of neutrosophic subsets in  $X$  satisfies the following axioms:

$$(NT_1) 0_N, 1_N \in \tau$$

$$(NT_2) G_1 \cap G_2 \in \tau \text{ for any } G_1, G_2 \in \tau_N$$

$$(NT_3) \cup G_i \in \tau \{ G_i : i \in J \} \subseteq \tau_N$$

In this case the pair  $(X, \tau)$  is a neutrosophic topological space (NTS) and any neutrosophic set in  $\tau$  is known as a neutrosophic open set (NO set) in  $X$ . A neutrosophic set  $A$  is a neutrosophic closed set (NC set) if and only if its complement  $C(A)$  is a neutrosophic open set in  $X$ .

**Definition 2.4. [9]** A neutrosophic set  $G$  of a neutrosophic topological space  $(X, \tau)$  is called *neutrosophic  $N\beta\omega$  closed* ( $N\beta\omega$ -Closed) if  $\beta cl_N(G) \subseteq U$  whenever  $G \subseteq U$  and  $U$  is  $N\omega$ -Open in  $(X, \tau)$ .

### Quasi Neutrosophic Beta Omega Open Mappings

**Definition 3.1.** A neutrosophic mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  is said to be quasi neutrosophic beta omega open (briefly, quasi- $N\beta\omega$ -open), if the image of every  $N\beta\omega$ -open set in  $(X, \tau)$  is  $N$ -open in  $(Y, \sigma)$ . It is evident that, the concepts of quasi- $N\beta\omega$ -openness and  $N\beta\omega$ -continuity coincide if the mapping is a bijection.



**Example 3.1.** Let  $X = \{a, b, c\}$ ,  $Y = \{u, v, w\}$ ,  $\tau = \{0_N, G, 1_N\}$ ,  $\sigma = \{0_N, H, I, 1_N\}$ ,  $(X, \tau) = \{0_N, G, G^c, U, 1_N\}$  and  $(Y, \sigma) = [0,1] \times [0,1] \times [0,1]$  where  $G = \langle x, \left(\frac{a}{0.3}, \frac{b}{0.2}, \frac{c}{0.2}\right), \left(\frac{a}{0.2}, \frac{b}{0.2}, \frac{c}{0.3}\right), \left(\frac{a}{0.7}, \frac{b}{0.7}, \frac{c}{0.8}\right) \rangle$ ,  $U = \langle x, \left(\frac{a}{0.8}, \frac{b}{0.5}, \frac{c}{0.9}\right), \left(\frac{a}{0.8}, \frac{b}{0.7}, \frac{c}{0.9}\right), \left(\frac{a}{0.8}, \frac{b}{0.8}, \frac{c}{0.9}\right) \rangle$ ,  $H = \langle x, \left(\frac{u}{0.3}, \frac{v}{0.2}, \frac{w}{0.2}\right), \left(\frac{u}{0.2}, \frac{v}{0.2}, \frac{w}{0.3}\right), \left(\frac{u}{0.7}, \frac{v}{0.7}, \frac{w}{0.8}\right) \rangle$  and  $I = \langle x, \left(\frac{u}{0.8}, \frac{v}{0.5}, \frac{w}{0.9}\right), \left(\frac{u}{0.8}, \frac{v}{0.7}, \frac{w}{0.9}\right), \left(\frac{u}{0.8}, \frac{v}{0.8}, \frac{w}{0.9}\right) \rangle$ . Then  $\tau$  and  $\sigma$  are NTs. Define a mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  by  $f(a) = u$ ,  $f(b) = v$  and  $f(c) = w$ . Then  $f$  is quasi- $N\beta\omega$ -open mapping.

**Theorem 3.1.** A neutrosophic mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  is quasi- $N\beta\omega$ -open if and only if for every subset  $G$  of  $(X, \tau)$ ,  $f(\beta\omega\text{int}_N(G)) \subset \text{int}_N(f(G))$ .

**Proof:** Let  $f$  be a quasi- $N\beta\omega$ -open mapping. As we have  $\beta\omega\text{int}_N(G)$  is  $N\beta\omega$ -open,  $f(\beta\omega\text{int}_N(G))$  is  $N$ -open in  $(Y, \sigma)$ . Therefore, we have  $f(\beta\omega\text{int}_N(G)) \subset \text{int}_N(f(G))$ . Conversely, assume that  $G$  is a  $N\beta\omega$ -open set in  $(X, \tau)$  and then,  $f(G) = f(\beta\omega\text{int}_N(G)) \subset \text{int}_N(f(G))$  but  $\text{int}_N(f(G)) \subset f(G)$ . Consequently,  $f(G) = \text{int}_N(f(G))$  and hence  $f$  is quasi- $N\beta\omega$ -open.

**Theorem 3.2.** If a neutrosophic mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  is quasi- $N\beta\omega$ -open, then  $\beta\omega\text{int}_N(f^{-1}(G)) \subset f^{-1}(\text{int}_N(G))$  for every subset  $G$  of  $(Y, \sigma)$ .

**Proof:** Let  $G$  be any arbitrary subset of  $(Y, \sigma)$ . Then,  $\beta\omega\text{int}_N(f^{-1}(G))$  is a  $N\beta\omega$ -open set in  $(X, \tau)$  and  $f$  is quasi- $N\beta\omega$ -open, then  $f(\beta\omega\text{int}_N(f^{-1}(G))) \subset \text{int}_N(G)$ . Thus,  $\beta\omega\text{int}_N(f^{-1}(G)) \subset f^{-1}(\text{int}_N(G))$ .

**Theorem 3.3.** For a neutrosophic mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$ , the following are equivalent

(i)  $f$  is quasi- $N\beta\omega$ -open;

(ii) for each subset  $G$  of  $(X, \tau)$ ,  $f(\beta\omega\text{int}_N(G)) \subset \text{int}_N(f(G))$  ;

(iii) for each  $x$  in  $(X, \tau)$  and each  $N\beta\omega$ -neighbourhood  $G$  of  $x$  in  $(X, \tau)$ , there exists a neighbourhood  $H$  of  $f(x)$  in  $(Y, \sigma)$  such that  $H \subset f(G)$ .

**Proof:** (i)  $\Rightarrow$  (ii) It follows from theorem 3.2.

(ii)  $\Rightarrow$  (iii) Let  $x$  in  $(X, \tau)$  and  $G$  be an arbitrary  $N\beta\omega$ -neighbourhood of  $x$  in  $(X, \tau)$ . Then, there exists a  $N\beta\omega$ -open set  $H$  in  $(X, \tau)$  such that  $x \in H \subset G$ . Then by (ii), we have  $f(H) = f(\beta\omega\text{int}_N(H)) \subset \text{int}_N(f(H))$  and hence  $f(H)$  is open in  $(Y, \sigma)$  such that  $f(x) \in f(H) \subset f(G)$ .

(iii)  $\Rightarrow$  (i) Let  $G$  be an arbitrary  $N\beta\omega$ -open set in  $(X, \tau)$ . Then for each  $y$  in  $f(G)$ , by (iii) there exists a neighbourhood  $H$  of  $y$  in  $(Y, \sigma)$  such that  $H \subset f(G)$ . As  $H$  is a neighbourhood of  $y$ , there exists a  $N$ -open set  $W$  in  $(Y, \sigma)$  such that  $y \in W \subset H$ . Thus  $f(G) = W$  which is a  $N$ -open set in  $(Y, \sigma)$ . This implies that  $f$  is quasi- $N\beta\omega$ -open mapping.

**Theorem 3.4.** A neutrosophic function  $f : (X, \tau) \rightarrow (Y, \sigma)$  is quasi- $N\beta\omega$ -open if and only if for any subset  $G$  of  $(Y, \sigma)$  and for any  $N\beta\omega$ -closed set  $F$  of  $(X, \tau)$  containing  $f^{-1}(G)$ , there exists a  $N$ -closed set  $P$  of  $(Y, \sigma)$  containing  $G$  such that  $f^{-1}(P) \subset F$ .

**Proof:** Suppose  $f$  is quasi- $N\beta\omega$ -open. Let  $G \subset (Y, \sigma)$  and  $F$  be a  $N\beta\omega$ -closed set of  $(X, \tau)$  containing  $f^{-1}(G)$ . Now, put  $G = (Y, \sigma) - f((X, \tau) - F)$ . It is clear that  $f^{-1}(G) \subset F \Rightarrow G \subset f(F) = P$ . Since  $f$  is quasi- $N\beta\omega$ -open, we obtain  $G$  as a  $N$ -closed set of  $(Y, \sigma)$ . Moreover, we have  $f^{-1}(P) \subset F$ . Conversely, let  $G$  be a  $N\beta\omega$ -open set of  $(X, \tau)$  and put  $P = (Y, \sigma) - f(G)$ . Then  $(X, \tau) - G$  is a  $N\beta\omega$ -closed set in  $(X, \tau)$  containing  $f^{-1}(P)$ . By hypothesis, there exists a  $N$ -closed set  $F$  of  $(Y, \sigma)$  such that  $P \subset F$  and  $f^{-1}(F) \subset (X, \tau) - G$ . Hence, we obtain  $f(G) \subset (Y, \sigma) - F$ . On the other hand, it follows that  $P = (f(G))^c \subset f(G^c)$  which implies that  $f^{-1}(P) \subseteq G^c$ . Thus we obtain  $f(G) = (Y, \sigma) - F$  which is  $N$ -open and hence  $f$  is a quasi- $N\beta\omega$ -open mapping.

**Theorem 3.5.** A neutrosophic mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  is quasi- $N\beta\omega$ -open if and only if  $f^{-1}(\text{cl}_N(G)) \subset \beta\omega\text{cl}_N(f^{-1}(G))$  for every subset  $G$  of  $(Y, \sigma)$ .

**Proof:** Suppose that  $f$  is quasi- $N\beta\omega$ -open. For any subset  $G$  of  $(Y, \sigma)$ ,  $f^{-1}(G) \subset \beta\omega\text{cl}_N(f^{-1}(G))$ . Therefore, by theorem 3.4., there exists a  $N$ -closed set  $P$  in  $(Y, \sigma)$  such that  $G \subset P$  and  $(f^{-1}(P)) \subset \beta\omega\text{cl}_N(f^{-1}(G))$ . Therefore, we obtain  $f^{-1}(\text{cl}_N(G)) \subset (f^{-1}(P)) \subset \beta\omega\text{cl}_N(f^{-1}(G))$ . Conversely, let  $G \subset (Y, \sigma)$  and  $F$  be a  $N\beta\omega$ -closed set of  $(X, \tau)$  containing  $f^{-1}(G)$ . Put  $W = \text{cl}_N((Y, \sigma)-(G))$ , then we have  $G \subset W$  and  $W$  is  $N$ -closed and  $f^{-1}(W) \subset \beta\omega\text{cl}_N(f^{-1}(G)) \subset F$ . Then by theorem 3.4.,  $f$  is quasi- $N\beta\omega$ -open.

**Theorem 3.6.** Two neutrosophic mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  and  $g : (Y, \sigma) \rightarrow (Z, \phi)$  and  $g \circ f : (X, \tau) \rightarrow (Z, \phi)$  is quasi- $N\beta\omega$ -open. If  $g$  is continuous injective mapping, then  $f$  is quasi- $N\beta\omega$ -open.

**Proof:** Let  $G$  be a  $N\beta\omega$ -open set in  $(X, \tau)$ , then  $(g \circ f)(G)$  is  $N$ -open in  $(Z, \phi)$ , since  $g \circ f$  is quasi- $N\beta\omega$ -open. Again  $g$  is an injective continuous mapping,  $f(G) = g^{-1}(g \circ f(G))$  is  $N$ -open in  $(Y, \sigma)$ . This shows that  $f$  is quasi- $N\beta\omega$ -open

### Quasi Neutrosophic Beta Omega Closed mappings

**Definition 4.1.** A neutrosophic mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  is said to be neutrosophic quasi beta omega closed (briefly, quasi- $N\beta\omega$ -closed), if the image of every  $N\beta\omega$ -closed set in  $(X, \tau)$  is  $N$ -closed in  $(Y, \sigma)$ .

**Example 4.1.** Let  $X = \{a, b, c\}$ ,  $Y = \{u, v, w\}$ ,  $\tau = \{0_N, G, 1_N\}$ ,  $\sigma = \{0_N, H, I, 1_N\}$ ,  $(X, \tau) = \{0_N, G, G^c, U, 1_N\}$  and  $(Y, \sigma) = [0,1] \times [0,1] \times [0,1]$  where

$$G = \langle x, \left(\frac{a}{0.2}, \frac{b}{0.2}, \frac{c}{0.1}\right), \left(\frac{a}{0.1}, \frac{b}{0.2}, \frac{c}{0.2}\right), \left(\frac{a}{0.7}, \frac{b}{0.7}, \frac{c}{0.8}\right) \rangle.$$

$$U = \langle x, \left(\frac{a}{0.7}, \frac{b}{0.5}, \frac{c}{0.8}\right), \left(\frac{a}{0.7}, \frac{b}{0.7}, \frac{c}{0.8}\right), \left(\frac{a}{0.8}, \frac{b}{0.8}, \frac{c}{0.9}\right) \rangle,$$

$$H = \langle x, \left(\frac{u}{0.7}, \frac{v}{0.5}, \frac{w}{0.8}\right), \left(\frac{u}{0.7}, \frac{v}{0.7}, \frac{w}{0.8}\right), \left(\frac{u}{0.8}, \frac{v}{0.8}, \frac{w}{0.9}\right) \rangle \quad \text{and}$$

$I = \langle x, \left(\frac{u}{0.2}, \frac{v}{0.2}, \frac{w}{0.1}\right), \left(\frac{u}{0.1}, \frac{v}{0.2}, \frac{w}{0.2}\right), \left(\frac{u}{0.7}, \frac{v}{0.7}, \frac{w}{0.8}\right) \rangle$ . Then  $\tau$  and  $\sigma$  are NTs. Define a mapping  $f: (X, \tau) \rightarrow (Y, \sigma)$  by  $f(a) = u$ ,  $f(b) = v$  and  $f(c) = w$ . Then  $f$  is quasi- $N\beta\omega$ -closed mapping.

**Theorem 4.1.** Every quasi- $N\beta\omega$ -closed mapping is  $N$ -closed as well as  $N\beta\omega$ -closed.

**Proof:** It is obvious.

**Remark 4.1.** The converse of the above theorem need not be true by the following example.

**Example 4.2.** Let  $X = \{a, b, c\}$ ,  $Y = \{u, v, w\}$ ,  $\tau = \{0_N, G, 1_N\}$ ,  $\sigma = \{0_N, H, 1_N\}$  where

$$G = \langle x, \left(\frac{a}{0.2}, \frac{b}{0.2}, \frac{c}{0.1}\right), \left(\frac{a}{0.1}, \frac{b}{0.2}, \frac{c}{0.2}\right), \left(\frac{a}{0.7}, \frac{b}{0.7}, \frac{c}{0.8}\right) \rangle \quad \text{and} \quad H = \langle x, \left(\frac{u}{0.2}, \frac{v}{0.2}, \frac{w}{0.1}\right), \left(\frac{u}{0.1}, \frac{v}{0.2}, \frac{w}{0.2}\right), \left(\frac{u}{0.7}, \frac{v}{0.7}, \frac{w}{0.8}\right) \rangle.$$

Then  $\tau$  and  $\sigma$  are NTs. Define a mapping  $f: (X, \tau) \rightarrow (Y, \sigma)$  by  $f(a) = u$ ,  $f(b) = v$  and  $f(c) = w$ . Then  $f$  is  $N$ -closed mapping but not quasi- $N\beta\omega$ -closed.

**Example 4.3.** Let  $X = \{a, b, c\}$ ,  $Y = \{u, v, w\}$ ,  $\tau = \{0_N, G, 1_N\}$ ,  $\sigma = \{0_N, H, 1_N\}$  where

$$G = \langle x, \left(\frac{a}{0.7}, \frac{b}{0.5}, \frac{c}{0.8}\right), \left(\frac{a}{0.7}, \frac{b}{0.7}, \frac{c}{0.8}\right), \left(\frac{a}{0.8}, \frac{b}{0.8}, \frac{c}{0.9}\right) \rangle \quad \text{and}$$

$$H = \langle x, \left(\frac{u}{0.2}, \frac{v}{0.2}, \frac{w}{0.1}\right), \left(\frac{u}{0.1}, \frac{v}{0.2}, \frac{w}{0.2}\right), \left(\frac{u}{0.7}, \frac{v}{0.7}, \frac{w}{0.8}\right) \rangle.$$

Then  $\tau$  and  $\sigma$  are NTs. Define a mapping  $f:(X, \tau) \rightarrow (Y, \sigma)$  by  $f(a)= u$ ,  $f(b)= v$  and  $f(c)= w$ . Then  $f$  is  $N\beta\omega$ -closed mapping but not quasi- $N\beta\omega$ -closed.

**Lemma 4.1.** If a neutrosophic mapping is quasi- $N\beta\omega$ -closed, then for every subset  $G$  of  $(Y, \sigma)$ ,  $f^{-1}(cl_N(G)) \subset \beta\omega cl_N(f^{-1}(G))$ .

**Proof:** Let  $G$  any arbitrary subset of  $(Y, \sigma)$ . Then,  $\beta\omega cl_N(f^{-1}(G))$  is a  $N\beta\omega$ -closed set in  $(X, \tau)$  and  $f$  is quasi- $N\beta\omega$ -closed, so that we get  $f(\beta\omega cl_N(f^{-1}(G))) \subset cl_N(f(f^{-1}(G))) \subset cl_N(G)$ . Thus,  $f(\beta\omega cl_N(f^{-1}(G))) \subset f^{-1}(cl_N(G))$ .

**Theorem 4.2.** A neutrosophic mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  is quasi- $N\beta\omega$ -closed if and only if for any subset  $G$  of  $(Y, \sigma)$  and for any  $N\beta\omega$ -open set  $U$  of  $(X, \tau)$  containing  $f^{-1}(G)$ , there exists a  $N$ -open set  $V$  of  $(Y, \sigma)$  containing  $G$  such that  $f^{-1}(V) \subset U$ .

**Proof:** This proof is similar to that of theorem 3.3.

**Theorem 4.3.** If  $f : (X, \tau) \rightarrow (Y, \sigma)$  and  $g : (Y, \sigma) \rightarrow (Z, \phi)$  be any quasi- $N\beta\omega$ -closed mappings, then  $g \circ f : (X, \tau) \rightarrow (Z, \phi)$  is a quasi- $N\beta\omega$ -closed mapping.

**Proof:** It is obvious.

**Theorem 4.4.** Let  $f : (X, \tau) \rightarrow (Y, \sigma)$  and  $g : (Y, \sigma) \rightarrow (Z, \phi)$  be any two neutrosophic mappings, then

- (i) If  $f$  is  $N\beta\omega$ -closed and  $g$  is quasi- $N\beta\omega$ -closed, then  $g \circ f$  is  $N$ -closed;
- (ii) If  $f$  is quasi- $N\beta\omega$ -closed and  $g$  is quasi- $N\beta\omega$ -closed, then  $g \circ f$  is strongly- $\beta\omega$ -closed;

**Proof:** It is obvious.

**Theorem 4.5.** Let  $(X, \tau)$  and  $(Y, \sigma)$  be neutrosophic topological spaces. Then the mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  is a quasi- $N\beta\omega$ -closed if and only if  $f((X, \tau))$  is  $N$ -closed in  $(Y, \sigma)$  and  $f(H)-f((X, \tau)-H)$  is  $N$ -open in  $f((X, \tau))$  whenever  $H$  is  $N\beta\omega$ -open in  $(X, \tau)$ .

**Proof:** Necessity: Suppose  $f : (X, \tau) \rightarrow (Y, \sigma)$  is a quasi- $N\beta\omega$ -closed mapping. Since  $(X, \tau)$  is  $N\beta\omega$ -closed,  $f((X, \tau))$  is  $N$ -closed in  $(Y, \sigma)$  and  $f(H)-f((X, \tau)-H) = f(H) \cap f((X, \tau)-f((X, \tau)-H))$  is  $N$ -open in  $f((X, \tau))$  when  $H$  is  $N\beta\omega$ -open in  $(X, \tau)$ .

Sufficiency: Suppose  $f((X, \tau))$  is  $N$ -closed in  $(Y, \sigma)$ ,  $f(H)-f((X, \tau)-H)$  is  $N$ -open in  $f((X, \tau))$  when  $H$  is  $N\beta\omega$ -open in  $(X, \tau)$  and let  $I$  be  $N\beta\omega$ -closed in  $(X, \tau)$ . Then  $f(I) = f((X, \tau))-f(I-(X, \tau))-f(I)$  is  $N$ -closed in  $f((X, \tau))$  and hence  $N$ -closed in  $(Y, \sigma)$ .

**Corollary 4.1.** Let  $(X, \tau)$  and  $(Y, \sigma)$  be two neutrosophic topological spaces. Then a surjective mapping  $f : (X, \tau) \rightarrow (Y, \sigma)$  is quasi- $N\beta\omega$ -closed if and only if  $f(H)-f((X, \tau)-H)$  is  $N$ -open in  $(Y, \sigma)$  whenever  $G$  is  $N\beta\omega$ -open in  $(X, \tau)$ .

**Proof:** It is obvious.

**Theorem 4.6.** Let  $(X, \tau)$  and  $(Y, \sigma)$  be neutrosophic topological spaces and let  $f : (X, \tau) \rightarrow (Y, \sigma)$  be  $N\beta\omega$ -continuous and quasi- $N\beta\omega$ -closed surjective mapping. Then the neutrosophic topology on  $(Y, \sigma)$  is  $\{f(H)-f((X, \tau)-H) : H \text{ is } N\beta\omega\text{-open in } (X, \tau)\}$ .

**Proof:** Let  $W$  be  $N$ -open in  $(Y, \sigma)$ . Let  $f^{-1}(W)$  is  $N\beta\omega$ -open in  $(X, \tau)$ , and  $f(f^{-1}(W))-f((X, \tau)-f^{-1}(W)) = W$ . Hence all  $N$ -open sets a  $(Y, \sigma)$  are of the form  $f(H)-f((X, \tau)-H)$ ,  $H$  is  $N\beta\omega$ -open in  $(X, \tau)$ . On the other hand, all sets of the form  $f(H)-f((X, \tau)-H)$ .  $H$  is  $N\beta\omega$ -open in  $(X, \tau)$ , are  $N$ -open in  $(Y, \sigma)$  from corollary 4.1.

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**THE SURVEY OF DATA MINING APPLICATIONS AND FEATURE SCOPE**

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## **Abstract**

In this paper we have focused a variety of techniques, approaches and different areas of the research which are helpful and marked as the important field of data mining Technologies. As we are aware that many MNC's and large organizations are operated in different places of the different countries. Each place of operation may generate large volumes of data. Corporate decision makers require access from all such sources and take strategic decisions. The data warehouse is used in the significant business value by improving the effectiveness of managerial decision-making. In an uncertain and highly competitive business environment, the value of strategic information systems such as these are easily recognized however in today's business environment, efficiency or speed is not the only key for competitiveness. This type of huge amount of data's are available in the form of tera- to peta-bytes which has drastically changed in the areas of science and engineering. To analyze, manage and make a decision of such type of huge amount of data we need techniques called the data mining which will transforming in many fields. This paper imparts more number of applications of the data mining and also focuses scope of the data mining which will be helpful in the further research.

## **Keywords**

Data mining task, Data mining life cycle, Visualization of the data mining model, Data mining Methods, Data mining applications,

## INTRODUCTION

In the 21<sup>st</sup> century the human beings are used in the different technologies to adequate in the society . Each and every day the human beings are using the vast data and these data are in the different fields .It may be in the form of documents, may be graphical formats ,may be the video, may be records (varying array ) .As the data are available in the different formats so that the proper action to be taken. Not only to analyze these data but also take a good decision and maintain the data .As and when the customer will required the data should be retrieved from the database and make the better decision .This technique is actually we called as a data mining or Knowledge Hub or simply KDD(Knowledge Discovery Process).The important reason that attracted a great deal of attention in information technology the discovery of useful information from large collections of data industry towards field of “Data mining” is due to the perception of “*we are data rich but information poor*”. There is huge volume of data but we hardly able to turn them in to useful information and knowledge for managerial decision making in business. To generate information it requires massive collection of data. It may be different formats like audio/video, numbers, text, figures, Hypertext formats . To take complete advantage of data; the data retrieval is simply not enough, it requires a tool for automatic summarization of data, extraction of the essence of information stored, and the discovery of patterns in raw data. With the enormous amount of data stored in files, databases, and other repositories, it is increasingly important, to develop powerful tool for analysis and interpretation of such data and for the extraction of interesting knowledge that could help in decision-making. The only answer to all above is ‘Data Mining’. Data mining is the extraction of hidden predictive information from large databases; it is a powerful technology with great potential to help organizations focus on the most important information in their data warehouses [1,2,3,4]. Data mining tools predict future trends and behaviors, helps organizations to make proactive knowledge-driven decisions [2]. The automated, prospective analyses offered by data mining move beyond the analyses of past events provided by prospective tools typical of decision support systems. Data mining tools can answer

the questions that traditionally were too time consuming to resolve. They prepare databases for finding hidden patterns, finding predictive information that experts may miss because it lies outside their expectations. Data mining, popularly known as Knowledge Discovery in Databases (KDD), it is the nontrivial extraction of implicit, previously unknown and potentially useful information from data in databases [3, 5]. It is actually the process of finding the hidden information/pattern of the repositories .[1,3,5].

This paper describes 7 sections .Section 1 is completely introduction where you will get huge information about the data mining concept. Section 2 describes the data mining task which describes that how the data will be store, how to retrieve, how to analyze the data. .Section 3 focuses the data mining classification tasks .section 4 provides the data mining life cycles. Section 5 describes visualization of the data model and it involves extracting the hidden information as we as we have proposed the new way to define KDD Process. Section 6 describes shortly, some of the popular data mining methods. The chapter 7 is the heart of the paper, we have reviewed applications and we propose feature directions some of data mining applications. We have added the scope of the data mining applications so that the researcher can pin pointed the following areas.

### **The Data Mining Task**

The data mining tasks are of *different* types depending on the use of data mining result the data mining tasks are classified as[1,2]:

#### **Exploratory Data Analysis:**

In the repositories vast amount of information's are available .This data mining task will serve the two purposes

- (i).With out the knowledge for what the customer is searching, then
- (ii) It analyze the data

These techniques are interactive and visual to the customer.

**Descriptive Modeling:**

It describe all the data, it includes models for overall probability distribution of the data, partitioning of the p-dimensional space into groups and models describing the relationships between the variables.

**Predictive Modeling:**

This model permits the value of one variable to be predicted from the known values of other variables.

**Discovering Patterns and Rules:**

This task is primarily used to find the hidden pattern as well as to discover the pattern in the cluster. In a cluster a number of patterns of different size and clusters are available .The aim of this task is “how best we will detect the patterns” .This can be accomplished by using rule induction and many more techniques in the data mining algorithm like(K-Means/K-Medoids) .These are called the clustering algorithm.

**Retrieval by Content:**

The primary objective of this task is to find the data sets of frequently used in the for audio/video as well as images It is finding pattern similar to the pattern of interest in the data set

**Types of Data Mining System:**

Data mining systems can be categorized according to various criteria the classification is as follows[3]:

**Classification of data mining systems according to the type of data source mined:**

In an organization a huge amount of data's are available where we need to classify these data but these are available most of times in a similar fashion. we need to classify these data according to its type(maybe audio/video ,text format etc)

**Classification of data mining systems according to the data model:**

There are so many number of data mining models ( Relational data model, Object Model, Object Oriented data Model, Hierarchical data Model/W data model )are available and each and every model we are using the different data .According to these data model the data mining system classify the data in the model.

**Classification of data mining systems according to the kind of knowledge discovered:**

This classification based on the kind of knowledge discovered or data mining functionalities, such as characterization, discrimination, association, classification, clustering, etc. Some systems tend to be comprehensive systems offering several data mining functionalities together.

**Classification of data mining systems according to mining techniques used:**

This classification is according to the data analysis approach used such as machine learning, neural networks, genetic algorithms, statistics, visualization, database oriented or data warehouse-oriented, etc.

The classification can also take into account the degree of user interaction involved in the data mining process such as query-driven systems, interactive exploratory systems, or autonomous systems. A comprehensive system would provide a wide variety of data mining techniques to fit different situations and options, and offer different degrees of user

interaction.

### **Data Mining Life Cycle:**

The life cycle of a data mining project consists of six phases[2,4]. The sequence of the phases is not rigid. Moving back and forth between different phases is always required. It depends on the outcome of each phase. The main phases are:

#### **Business Understanding:**

This phase focuses on understanding the project objectives and requirements from a business perspective, then converting this knowledge into a data mining problem definition and a preliminary plan designed to achieve the objectives.

#### **Data Understanding:**

It starts with an initial data collection, to get familiar with the data, to identify data quality problems, to discover first insights into the data or to detect interesting subsets to form hypotheses for hidden information.

#### **Data Preparation:**

In this stage , it collects all the different data sets and construct the varieties of the activities basing on the initial raw data

#### **Modeling:**

In this phase, various modeling techniques are selected and applied and their parameters are calibrated to optimal values.

**Evaluation:**

In this stage the model is thoroughly evaluated and reviewed. The steps executed to construct the model to be certain it properly achieves the business objectives. At the end of this phase, a decision on the use of the data mining results should be reached.

**Deployment:**

The purpose of the model is to increase knowledge of the data, the knowledge gained will need to be organized and presented in a way that the customer can use it. The deployment phase can be as simple as generating a report or as complex as implementing a repeatable data mining process across the enterprise.

**Visualizing Data Mining Model**

The main objective of data visualization is the overall idea about the data mining model .In data mining most of the times we are retrieving the data from the repositories which are in the hidden form. This is the difficult task for a user. So this visualization of the data mining model helps us to provide utmost levels of understanding and trust. Because the user does not know beforehand what the data mining process has discovered, it is a much bigger leap to take the output of the system and translate it into an actionable solution to a business problem. The data mining models are of two types [1,2,6,45]: Predictive and Descriptive.

The predictive model makes prediction about unknown data values by using the known values. Ex. Classification, Regression, Time series analysis, Prediction etc. The descriptive model identifies the patterns or relationships in data and explores the properties of the data examined. Ex. Clustering, Summarization, Association rule, Sequence discovery etc.

Many of the data mining applications are aimed to predict the future state of the data. Prediction is the process of analyzing the current and past states of the attribute and prediction of its future state. Classification is a technique of mapping the target data to the predefined groups or classes, this is a supervised learning because the classes are predefined before the examination of the target data. The regression involves the learning of function that map data item to real valued prediction variable. In the time series analysis the value of an attribute is examined as it varies over time. In time series analysis is used for many statistical techniques which will analyze the time-series data such as auto regression methods etc. It is sometimes used in the two types of modeling (I) ARIMA (II) Long-memory time-series modeling .

The term clustering means analyzes the different data objects without consulting a known class levels. It is also referred to as unsupervised learning or segmentation. It is the partitioning or segmentation of the data into groups or clusters. The clusters are defined by studying the behavior of the data by the domain experts. The term segmentation is used in very specific context; it is a process of partitioning of database into disjoint grouping of similar tuples. Summarization is the technique of presenting the summarized information from the data.

**New way to define the KDD Process:**

We have found the broader meaning of the followings Data, patterns, Process, Valid, Novel, and Useful Understandable. Of KDD. The Knowledge discovery in databases is the non-trivial process of identifying valid, novel, potentially useful, and ultimately understandable patterns in data.

**Table 1.1 to describe the new form the word**

<b>ta</b>	set of facts, $F$ .
<b>tern</b>	expression $E$ in a language $L$ describing facts in a subset of



<b>rocess</b>	means different operations associated with the KDD .T erations involving preparation of the data ,searching ferentpatterns , Judging the knowledge and evaluation e
<b>lid</b>	ose patterns which are discovered that are completely w oneand which can be used feature
<b>vel</b>	rive the hidden patterns
<b>eful</b>	wly discovered patterns should be used for different actio

**Data Mining Methods:**

**Some of the popular data mining methods are as follows:**

1. Decision Trees and Rules
2. Nonlinear Regression and Classification Methods
3. Example-based Methods
4. Probabilistic Graphical Dependency Models
5. Relational Learning Models

We found these are some famous data mining methods are broadly classified as: On-Line Analytical Processing ,(OLAP), Classification, Clustering, Association Rule Mining, Temporal Data Mining, Time Series Analysis, Spatial Mining, Web Mining etc. These methods use different types of algorithms and data. The data source can be data warehouse, database, flat file or text file. The algorithms may be Statistical Algorithms, Decision Tree based, Nearest Neighbor, Neural Network based, Genetic Algorithms based, Ruled based, Support Vector Machine etc. Generally the data mining algorithms are fully dependent of the two factors these are

- which type of data sets are using
- what type of requirements of the user

Basing upon the above two factors the data mining algorithms are used. A knowledge discovery (KD) process involves preprocessing data, choosing a data-mining algorithm, and post processing the mining results. The Intelligent Discovery Assistants [7] (IDA), helps users in applying valid knowledge discovery processes. The IDA can provide users with three benefits:

- A systematic enumeration of valid knowledge discovery processes;
- Effective rankings of valid processes by different criteria, which help to choose between the options;
- An infrastructure for sharing knowledge, which leads to network externalities.

Several other attempts have been made to automate this process and design of a generalized data mining tool that posse's intelligence to select the data and data mining algorithms and up to some extent the knowledge discovery.

## **1. Data Mining Applications:**

In this section, we have focused some of the applications of data mining and its techniques are analyzed respectively Order.

### **1.1 Data Mining Applications in Healthcare**

**Data mining applications in health can have tremendous potential and usefulness [60,61]. However, the success of healthcare data mining hinges on the availability of clean healthcare data. In this respect, it is critical that the healthcare industry look into how data can be better captured, stored, prepared and mined. Possible directions include the standardization of clinical vocabulary and the sharing of data across organizations to enhance the benefits of healthcare data mining applications**

#### **1.1.1 Future Directions of Health care system through Data Mining Tools**

As healthcare data are not limited to just quantitative data (e.g., doctor's notes or clinical records), it is necessary to also explore the use of text mining to expand the scope and nature of what healthcare data mining can currently do. This is specially used to mixed all the data and then mining the text. It is also useful to look into how images (e.g., MRI scans) can be brought into healthcare data mining applications. It is noted that progress has been made in these areas

### **Data mining is used for market basket analysis**

Data mining technique is used in MBA(Market Basket Analysis).When the customer want to buying some products then this technique helps us finding the associations between different items that the customer put in their shopping buckets. Here the discovery of such associations that promotes the business technique .In this way the retailers uses the data mining technique so that they can identify that which customers intension (buying the different pattern).In this way this technique is used for profits of the business and also helps to purchase the related items.

### **The data mining is used an emerging trends in the education system [57, 58] inthe whole world**

In Indian culture most of the parents are uneducated .The main aim of in Indian government is thequality education not for quantity. But the day by day the education systems are changed and in the 21<sup>st</sup> century a huge number of universalities are established by the order of UGC. As the numbers of universities are established side by side, each and every day a millennium of students are enrolls across the country. With huge number of higher education aspirants, we believe that data mining technology can help bridging knowledge gap in higher educational systems. The hidden patterns, associations, and anomalies that are discovered by data mining techniques from educational data can improve decision making processes in higher educational systems. This improvement can bring advantages such as maximizing educational

system efficiency, decreasing student's drop-out rate, and increasing student's promotion rate, increasing student's retention rate in, increasing student's transition rate, increasing educational improvement ratio, increasing student's success, increasing student's learning outcome, and reducing the cost of system processes. In this current era we are using the KDD and the data mining tools for extracting the knowledge this knowledge can be used for improving the quality of education .The decisions treeclassification is used in this type of applications.

### **Data mining is now used in many different areas in manufacturing engineering[59]**

When we retrieve the data from manufacturing system then the customer is to use these data for different purposes like to find the errors in the data ,to enhance the design methodology ,to make the good quality of the data ,how best the data can be supported for making the decision . But most of time the data can be first analyzed then after find the hidden patterns which will be control the manufacturing process which will further enhance the quality of the products .Since the importance of data mining in manufacturing has clearly increased over the last 20 years, it is now appropriate to critically review its history and Application

### **Future Directions in the manufacturing Engineering through the Data mining Tools**

It is very tedious task to mine the manufacturing data .Generally when we mine the data in the manufacturing, we dose not give more important to the quality of the rules .After mining those knowledge which has generated is very difficult because relationship identification is too complex to understand. That's why we need the further to enhance the research methodology to know the proper knowledge. The new methodology was proposed i.e CRISP-DM which will provides the high level detail steps of instructions for using the data mining in the engineering field. Further research is needed to develop generic guidelines for a variety of different data and types of problems, which are commonly faced by manufacturing engineering industry

**Data Mining Applications can be generic or domain specific.**

Data mining system can be applied for generic or domain specific . Some generic data mining applications cannot take its own these decisions but guide users for selection of data, selection of data mining method and for the interpretation of the results. The multi agent based data mining application [8, 10] has capability of automatic selection of data mining technique to be applied. The Multi Agent System used at different levels [8]: First, at the level of concept hierarchy definition then at the result level to present the best adapted decision to the user. This decision is stored in knowledge Base to use in a later decision-making. Multi Agent System Tool used for generic data mining system development [10] uses different agents to perform different tasks.

**A multi-tier data mining system is proposed to enhance the performance of the data mining process [9].**

It has basic components like user interface, data mining services, data access services and the data. There are three different architectures presented for the data mining system namely one-tire, Two-tire and Three-tire architecture. Generic system required to integrate as many learning algorithms as possible and decides the most appropriate algorithm to use. CORBA (Common Object Request Broker Architecture) has features like: Integration of different applications coded in any programming language considerably easy. It allows reusability in a feasible way and finally it makes possible to build large and scalable system. The data mining system architecture based on CORBA is given by Object Management Group [10] has all characteristics to accomplish a distributed and object oriented computation. A data-centric focus and automated methodologies makes data mining accessible to no experts [11]. The use of high-level interfaces can implement the automated methodologies that hide the data mining concepts away from the users. A data-centric design hides away all the details of mining methodology and exposes them through high-level tasks that are goal-oriented. These goal-oriented tasks are implemented using data-centric APIs. This design makes data mining task like other types of queries that users perform on the data. In data mining better results could be obtained if large data

is available. It leads to the merging and linking of local databases. A new data-mining architecture based on Internet technology addressed this problem. [12] The context factor plays vital role in the success of data mining. The importance and meaning of same data in the different context is different. A data in one context is very important may not be much important in other context. A context-aware data-mining framework filters useful and interesting context factors, and can produce accurate and precise prediction using those factors[46].

### **Application of Data Mining techniques in CRM**

Data mining technique is used in CRM .Now a days it is one of the hot topic to research in the industry because CRM have attracted both the practitioners and academics. It aims to give a research summary on the application of data mining in the CRM domain and techniques which are most often used. Although this review cannot claim to be exhaustive, it does provide reasonable insights and shows the incidence of research on this subject. The results presented in this paper have several important implications: Research on the application of data mining in CRM will increase significantly in the future based on past publication rates and the increasing interest in the area. The majority of the reviewed articles relate to customer retention [49]

### **The Domain Specific Applications**

**The domain specific applications are focused to use the domain specific data and data mining algorithm that targeted for specific objective. The applications studied in this context are aimed to generate the specific knowledge. In the different domains the data generating sources generate different type of data. Data can be from a simple text, numbers to more complex audio-video data. To mine the patterns and thus knowledge from this data, different types of data mining algorithms are used. The collection and selection of context specific data and applying the data mining algorithm to generate the context specific knowledge is thus a skillful job. In many domains specific data mining applications the domain experts plays vital role to mine useful knowledge.**

In the identification of foreign-accented French the audio files were used and the best 20 data mining algorithms were applied[13] the Logistic Regression model found the most robust algorithm than other algorithm.

**In language research and language** engineering much time extra linguistic information is needed about a text. A linguistic profile that contains large number of linguistic features can be generated from text file automatically using data mining [14]. This technique found quite effective for authorship verification and recognition. A profiling system using combination of lexical and syntactic features shows 97% accuracy in selecting correct author for the text. The linguistic profiling of text effectively used to control the quality of language and for the automatic language verification.[15] This method verifies automatically the text is of native quality. The results show that language verification is indeed possible.

### **In Medical Science**

In medical science there is large scope for application of data mining. Diagnosis of disease, health care, patient profiling and history generation etc. are the few examples. Mammography is the method used in breast cancer detection. Radiologists face lot of difficulties in detection of tumors that's why CAM(Computer Aided Methods) could help to the medical staff . So that they can produce the good quality of the result detection [16]. The neural networks with back-propagation and association rule mining used for tumor classification in mammograms. The data mining effectively used in the diagnosis of lung abnormality that may be cancerous or benign [17]. The data mining algorithms significantly reduce patient's risks and diagnosis costs. Using the prediction algorithms the observed prediction accuracy was 100% for 91.3% cases. The use of data mining in health care is the widely used application of data mining. The medical data is complex and difficult to analyze. A REMIND (Reliable Extraction and Meaningful Inference from Non-structured Data) system [21] integrates the structured and unstructured clinical data in patient records to automatically create high quality structured clinical data. To adopt the high quality technique, we can mine the existing patient records to support guidelines and give

compliance to improve patient care. [21]

### **Data Mining methods are used in the Web Education**

Data mining methods are used in the web Education which is used to improve courseware. The relationships are discovered among the usage data picked up during students' sessions. This knowledge is very useful for the teacher or the author of the course, who could decide what modifications will be the most appropriate to improve the effectiveness of the course. [42]. In the 21<sup>st</sup> century the beginners are using the data mining techniques which is one of the best learning method in this era[41]. This makes it possible to increase the awareness of learners. Web Education which will rapidly growth in the **application** of data mining methods to educational chats which is both feasible and can be improvement in learning environments in the 21<sup>st</sup> century.

### **Credit Scoring**

Credit scoring has become very important issue due to the recent growth of the credit industry, so the credit department of the bank faces the huge numbers of consumers' credit data to process, but it is impossible analyzing this huge amount of data both in economic and manpower terms. In this study we reviewed the papers which have applied data mining methods in credit risk evaluation problem. Ten data mining technique which were most used method in the credit risk evaluation context were extracted, and then we searched almost all papers which had focused on these ten methods form 2000 to 2011. It is concluded that the support vector machine has been widely applied in recent years and which is one of the best technique.. Since to improve the performance of this model, it is necessary a method for reduction the feature subset, many hybrid SVM based model are proposed. Moreover the hybrid models have been attended in the last decade because of its enjoying from advantages of two or more models. Many of these proposed models can only classify customers into two classes "good" or "bad" ones. Several single and hybrid data mining methods are applied for credit scoring problem [50], [51], [53], [54], [55]. The most used applied methods for doing credit scoring task are derived from classification technique. Generally classification is used when we predict some thing which is possible by using the previous available information. It is one type of methods which can be defined as classification where the



members of a given set of instances into some groups where the different types of characteristics are to be made. Classification task is very suited to data mining methods and techniques

### **The Intrusion Detection in the Network**

The intrusion detection in the Network is very difficult and needs a very close watch on the data traffic. The intrusion detection plays an essential role in computer security. The classification method of data mining is used to classify the network traffic normal traffic or abnormal traffic.[26]. If any TCP header does not belong to any of the existing TCP header clusters, then it can be considered as anomaly.

### **A malicious Executable is Threat**

A malicious executable is threat to system's security, it damage a system or obtaining sensitive information without the user's permission. The data mining methods used to accurately detect malicious executables before they run[25]. Classification algorithms RIPPER, Naive Bayes, and a Multi-Classifer system are used to detect new malicious executables. This classifier had shown detection rate 97.76%.

### **Sports data Mining :**

The data mining and its technique is used for an application of Sports center. Data mining is not only use in the business purposes but also it used in the sports .In the world, a huge number of games are available where each and every day the national and international games are to be scheduled, where a huge number of data's are to be maintained .The data mining tools are applied to give the information as and when we required. The open source data mining tools like WEKA and RAPID MINER frequently used for sport. This means that users can run their data through one of the built-in algorithms, see what results come out, and then run it through a different algorithm to see if anything different stands out. As these programs' are available in the form of

open source in nature, that's why the users are frequently to modify the source code, so that other can get the updated information [56] . In the sports world the vast amounts of statistics are collected for each player, team, game, and season. In the game sports the data's are available in the form of statistical form where data mining can be used and discover the patterns, these patterns are often used to predict the future forecast . Data mining can be used for scouting, prediction of performance, selection of players, coaching and training and for the strategy planning [34]. The data mining techniques are used to determine the best or the most optimal squad to represent a team in a team sport in a season, tour or game.[44] The 'Cy Young Award'[30] has been presented annually to the best pitcher in the major league of baseball. The award is based largely on statistics compiled over the course of the baseball season. A Bayesian classifier is developed to predict Cy Young Award winners in American major league baseball.

### **The Intelligence Agencies**

The Intelligence Agencies collect and analyze information to investigate terrorist activities. One challenge to law enforcement and intelligent agencies is the difficulty of analyzing large volume of data involve in criminal and terrorist activities. Now a days the intelligence agency are using the sophisticated data mining algorithms which makes it easy, to handle the very large data bases databases for organizations. The different data mining techniques are used in crime data mining. [33],[37] .Though the organization's have used large data bases but data mining helps us to generate the different types of information in the organization like personal details of the persons along with, vehicle details .In data mining the Clustering techniques is used (Association rule mining) for the different objects(like persons, organizations, vehicles etc.) in crime records. Not only data mining detects but also analyzes the crime data. The classification technique is also used to detect email spamming and also find person who has given the mail. String comparator is used to detect deceptive information in criminal record.

### **The data mining system implemented at the Internal Revenue Service**

The data mining system implemented at the Internal Revenue Service to identify high-income individuals engaged in abusive tax shelters [23] show significantly good results. The major lines of investigation included visualization of the relationships and data mining to identify and rank possibly abusive tax avoidance transactions. To enhance the quality of product data mining techniques can be used effectively. The data mining technology SAS/EM is used to discover the rules those are unknown before and it can improve the quality of products and decrease the cost. A regression model and the neural network model when applied for this purpose given accuracy above 80%. [31] The neural network model found better than the regression model.

### **E-commerce is also the most prospective**

E-commerce is also the most prospective domain for data mining [39]. It is ideal because many of the ingredients required for successful data mining are easily available: data records are plentiful, electronic collection provides reliable data, insight can easily be turned into action, and return on investment can be measured. The integration of e-commerce and data mining significantly improve the results and guide the users in generating knowledge and making correct business decisions. This integration effectively solves several major problems associated with horizontal data mining tools including the enormous effort required in pre-processing of the data before it can be used for mining, and making the results of mining actionable.

### **The Digital Library Retrieves**

The data mining application can be used in the field of the Digital Library where the user will find or collect, store and preserve the data which are in the form of digital mode. The advent of electronic resources and their increased use in libraries has brought about significant changes in Library [40]. The data and information are available in the different formats. These formats include Text, Images, Video, Audio, Picture, Maps, etc. therefore digital library is a suitable domain for application of data mining.

### **The prediction in engineering applications**

The prediction in engineering applications was treated effectively by a data mining approach[17]. The prediction problems like the cost estimation problem in engineering, the problem of engineering design that involves decisions where parameters, actions, components, and so on are selected. data mining technique is used for the variety of the parameters in the field of engineering applications like prior data .Once we gather the data then we can generate the different models ,algorithms which will predict to different characteristic. The data mining algorithm applied on the test file with nine features has produced 100% correct predictions. Several other applications studied in this context.

### **The Scope of Data Mining**

Data mining derives its name from the similarities between searching for valuable business information in a large database for example, finding linked products in gigabytes of store scanner data and mining a mountain for a vein of valuable ore. Both processes require either sifting through an immense amount of material, or intelligently probing it to find exactly where the value resides. Given databases of sufficient size and quality, data mining technology can generate new business opportunities by providing these capabilities:

#### **Automated prediction of trends and behaviors.**

Data mining automates the process of finding predictive information in large databases. Questions that traditionally required extensive hands-on analysis can now be answered directly from the data quickly. A typical example of a predictive problem is targeted marketing. Data mining uses data on past promotional mailings to identify the targets most likely to maximize return on investment in future mailings. Other predictive problems include forecasting bankruptcy and other forms of default, and identifying segments of a population likely to respond similarly to given events.

- **Artificial neural networks:**

Non-linear predictive models that learn through training and resemble biological neural networks in structure.

- **Decision trees:**

Tree-shaped structures that represent sets of decisions. These decisions generate rules for the classification of a dataset. Specific decision tree methods include Classification and Regression Trees (CART) and Chi Square Automatic Interaction Detection (CHAID) .

- **Genetic algorithms: Optimization techniques that use process such as genetic combination, mutation, and natural selection in a design based on the concepts of evolution.**

- **Nearest neighbor method:**

A technique that classifies each record in a dataset based on a combination of the classes of the k record(s) most similar to it in a historical dataset (where  $k \geq 1$ ). Sometimes called the k-nearest neighbor technique.

- **Rule induction:**

The extraction of useful if-then rules from data based on statistical significance. Many of these technologies have been in use for more than a decade in specialized analysis tools that work with relatively small volumes of data. These capabilities are now evolving to integrate directly with industry-standard data warehouse and OLAP platforms.

**Conclusion:**

In this paper we briefly reviewed the various data mining applications. This review would be helpful to researchers to focus on the various issues of data mining. In future course, we will review the various classification algorithms and significance of evolutionary computing (genetic programming) approach in designing of efficient classification algorithms for data

mining. Most of the previous studies on data mining applications in various fields use the variety of data types range from text to images and stores in variety of databases and data structures. The different methods of data mining are used to extract the patterns and thus the knowledge from this variety databases. Selection of data and methods for data mining is an important task in this process and needs the knowledge of the domain. Several attempts have been made to design and develop the generic data mining system but no system found completely generic. Thus, for every domain the domain expert's assistant is mandatory. The domain experts shall be guided by the system to effectively apply their knowledge for the use of data mining systems to generate required knowledge. The domain experts are required to determine the variety of data that should be collected in the specific problem domain, selection of specific data for data mining, cleaning and transformation of data, extracting patterns for knowledge generation and finally interpretation of the patterns and knowledge generation. Most of the domain specific data mining applications show accuracy above 90%. The generic data mining applications are having the limitations. From the study of various data mining applications it is observed that, no application called generic application is 100 % generic. The intelligent interfaces and intelligent agents up to some extent make the application generic but have limitations. The domain experts play important role in the different stages of data mining. The decisions at different stages are influenced by the factors like domain and data details, aim of the data mining, and the context parameters. The domain specific applications are aimed to extract specific knowledge. The domain experts by considering the user's requirements and other context parameters guide the system. The results yield from the domain specific applications are more accurate and useful. Therefore it is conclude that the domain specific applications are more specific for data mining. From above study it seems very difficult to design and develop a data mining system, which can work dynamically for any domain.

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**HUMAN RESOURCE MANAGEMENT: CAREER DEVELOPMENT**

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**ABSTRACT**

This paper mainly emphasizes on career development which is gaining much importance in recent times in order to retain skilled, competent and result oriented people in the organization. This paper invites special attention in this area of organizations. People are the sources of all productive effort in organizations. Organizational effectiveness depends on the performance of people working in organizations. Better people achieve better results. As a part of human resource management, every organization should acquire and retain skilled, competent, and motivated employees, because the full potential of human resources needs to be achieved for the growth of the organization. For the purpose of retaining skilled employees, management should assist individuals to plan their careers with realistic information about career opportunities that exist within a particular organization. Career planning is a recently developed phenomenon and organizations are nowadays looking HRD in this new angle.

Keywords: human resource management, skilled employees competent, and motivated employees.

## **Introduction**

The tremendous growth of organizations in recent times due to technological improvements and tough competition in global market necessitates the organizations not only to select the right type of staffs, but also to retain them in the organizations. The dynamic and growth oriented employees should be allowed to grow through career development programs because the high turnover of such potential staff leads to great loss in terms of cost, quality and productivity. Douglas T. Hall Says career as

The individually perceived sequence of attitudes and behavior associated with the work related experiences and activities over the span of the person's life.' Thus, a career refers to both attitude and behavior and it is work related. Each person's career is unique. It has an upward mobility i.e. making more money, having more responsibility, acquiring more status and power.

## **Career Performance**

Handsome monetary as well as fringe benefits and elevation in job are the main indicators of career performance. The modern organizations are basically interested in career performancesince it has a direct relationship with goal attainment. The two aspects -the extent of organization's performance appraisal, and the pessimistic attitude of the individual to realize the career effectiveness-should be well understood by the management for better career development. So, career performance is the integrated effort of both management and theemployees.[1]

## **Motivation and Career Development**

Motivation is defined as 'all those of inner striving conditions described as needs, drives, desires, motives and so forth. It is the inner state that activates or moves.' An individualis motivated if he puts forth his best efforts, always working at performing the job and directinghis efforts towards accomplishment of goals.

Managers are concerned about employees accomplishing significant work goals-output, quality and cost consciousness. Assisting the employees in career development ensures the organization to attain these goals. In this connection, it is essential to mention about Abraham Maslow's need hierarchy theory of motivation. Maslow says the need of highest level-self actualization need is achieved by a person only after satisfying the lower order needs such as physiological, safety, social and esteem needs. It is necessary on the part ofthe managers to satisfy all the basic needs of an employee and also

the self-actualization need. Self actualization like self-fulfillment, personal growth, assignment of challenging job, creativity, risk taking, maximum skill potential etc, are possible through better career development programs.[2,3]

### **Career Planning and Pathing**

Career planning involves matching an individual's career aspirations with the opportunities available in an organization. Career pathing is a sequential pattern of the specific jobs associated with those opportunities. The two processes are intertwined. Career planning involves identifying the means of accomplishing desired results, and in this regard of career plans, career paths are the means of achieving aspirations. Although, career planning is still a new practice, most of the organizations are turning to it as a way to protect rather than react to the problems associated with the career.

The individual most identify his career aspirations and abilities and then recognize what training and development are required to follow a particular career path, whereas the organization must identify the needs and opportunities.[4,5]

### **Career Development Programs**

The organizations have to develop right type of career development programs so as to make the people grow to their full potential and to retain skilled, competent and talented employees in the organization. Some organizations use career development programs to identify the pool of talent available for promotion and posting, some organizations often restrict career development programs to managerial and professional staff, while some other provide it for both managerial and non-managerial staffs.

The relationship between career development and human resource planning is obvious. Career developments ensure a supply of abilities and talents, whereas human resource planning projects demand for talents and abilities. The supportive and integrated effort of top-level management of the organization as well as system analyst for effective career development and human resource planning are needed for maximizations of both demand and supply of talents and abilities.

Organization structure also often causes failure in the integration of efforts of career development. The failure on the part of the personnel department to coordinate other departments of the organization to place right people in the right jobs through proper planning often causes as a barrier for the people to develop their careers.[6,7]

## **Conclusions**

In Nepal, the increasing demand for right people in organization is tremendous due to changing economic scenario. Nowadays, the organizations are becoming international in their operations. To withstand the international competition, organization should develop and retain skilled, talented and motivated employees so as to develop quality, cost consciousness and productivity but it is no doubt that human resource planning and career development are the two vital pillars on which the organizations stand strongly.

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**A REVIEW ON INTERNET OF THINGS FOR HEALTH CARE**

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**Abstract**

New conventional technology known as the Internet of Things (IoT) is transforming the way we live into smart living. IoT may be used in a variety of settings, including manufacturing, energy conservation, transportation, urban planning, and even the household. Smart systems,

intelligent gadgets, and sensors abound in the Internet of Things (IoT). The Internet of Things (IoT) is a powerful tool for improving healthcare systems. IoT healthcare systems are designed to provide a real-time remote monitoring system for patients' health status and to improve their quality of life. Internet-enabled health care services focus on improving user experience and enhancing quality of life while keeping costs down. Using the Internet of Things in healthcare, medical systems may be remotely connected to the network to cure ailments. The Internet of Things (IoT) makes it possible to create medical systems with advanced sensor, network, and server functions. IoT in healthcare is examined in this article, with a focus on how to utilise IoT effectively, as well as a few healthcare applications that are changing the landscape.

**Keywords:** Internet of things, Healthcare, Sensors, Remote monitoring.

## **I. INTRODUCTION**

The idea of health is critical to the development and well-being of individuals, as well as to the advancement of technology. Keeping tabs on patients' well-being is a top priority. The Internet of Things (IoT)-enabled health monitoring system is one option for improving health monitoring. IoT is often seen as a way to alleviate the demand in the healthcare sector. A substantial portion of this research focuses on the ability to monitor patients from a distance. Healthcare monitoring system, which is utilised to keep an eye on the patient's heartbeat at all times Patients may be closely monitored and observed at all times when they are being treated remotely, which aids in the delivery of superior care. Similarly, a wide range of IoT technologies are used in the healthcare industry. It is possible to construct an IoT environment to monitor a patient's fundamental health, as well as the condition of their room, through the use of smart healthcare technologies. Data from the hospital's environment is gathered via a CO sensor, an air temperature sensor, and a carbon dioxide sensor, all of which are used to improve healthcare. The Internet of Things (IoT) is helping individuals in rural regions who generally ignore any type of health difficulties, such as body temperature, heartbeat, and so on. In order to avoid this, it would be more cost effective if patients were given smart sensors to monitor them from their customary place of stay, which is generally located afar. It's also possible to utilise a medication

tracking system, which keeps tabs on the prescriptions patients are taking remotely and notifies them when it's time to take their meds. In healthcare, chronic illness management is one of the most common uses. Chronically ill people can keep a better eye on their health with the help of remote monitoring. Overall, IoT in healthcare has the potential to streamline patient care processes while also enhancing their well-being. They all assist to collect data from patients and deliver it to health experts via an app as well as to notify the patient via SMS. IoT in healthcare is transforming healthcare applications, and this article examines numerous studies and architecture to illustrate how IoT works in the healthcare area.

## **II. LITERATURE SURVEY**

Recently, a number of Internet-of-things (IoT) health monitoring systems have been modelled. A protocol has been devised by Nazir et al. [1,11] for the monitoring of IoT healthcare systems using mobile applications. For example, m-health provides compactness, an IP connection, low battery usage, and security.

Health care IoT solutions and advancements in IoT-based technology are discussed by Islam et al. [2, 12-14]. They provide current network topologies, applications, and industry trends. In addition, health care is a consideration. Security criteria, attack taxonomies and threat models were explored as part of the research. ECG, EMG, muscular activity, temperature, sweating, respiration rate, and blood glucose levels may all be measured health monitoring system [3, 10,11]. All patient records are securely transferred and converted from any location to the health facility using this technology. Sensors in an Internet of Things system may be controlled remotely through a smartphone as the concentrator. A considerable impact of the Internet of Things (IoT) may be seen in the sector of health care, according to Rashmika. In order to improve the quality of healthcare applications, the Internet of Things (IoT) helps by allowing patient administration and medical record management, medical emergency management, treatment management, and other services. Patients' health data and medical information may be tracked and recorded using sensors and web- or mobile-based apps, according to a method developed by Shubham et al. [5, 8, 9] and implemented by Shubham et al. By utilising MySQL db module and web interface, one can connect Raspberry Pi to database. The other can connect Raspberry Pi to GSM module and use web interface. Damain et al.

introduced IoT-based solutions for indoor and outdoor information systems [6]. Thresholding, PDR, and decision trees were employed in the development of the new methodology. Design Methodology (DM) is needed to examine the design aim from the perspective of contracting authorities, stakeholders, and potential users. A body sensor network was proposed by Ashlesha et al. as part of an IoT-based health care monitoring system [7]. The body sensor network (BSN) is one of the core technologies of IoT breakthroughs in healthcare and may be used to monitor patients using a collection of small powered and lightweight wireless sensor nodes. Wireless Body Area Sensor Network and a Raspberry Pi microcontroller are used in the proposed system. Various sensors such as temperature, blood pressure and heartbeat are used in this experiment. Using long-range wireless technology, sensors are placed on the human body to help monitor health problems without interfering with the patients' daily routines, and these health-related data are then uploaded to a physician's server.

Table 1 represents summary of IoT enabled applications and findings in medical field. Studies

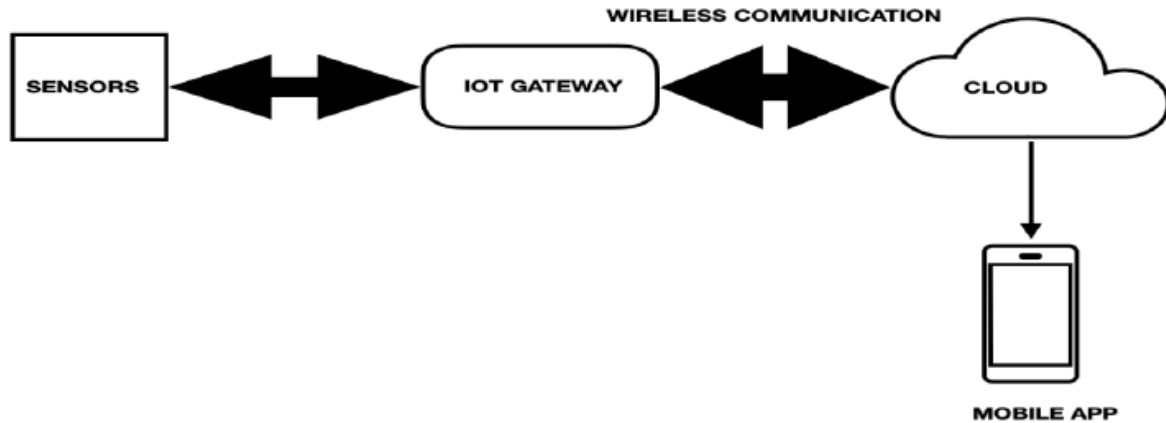
**Table 1: Summary of Applications and Findings**

AUTHOR / YEAR OF PUBLICATION	METHODOLOGY/ TECHNOLOGY	APPLICATIONS	FINDINGS
Shah Nazir, Yasir Ali 2019	SLR Protocol methodology, GSM.	Smart hospital	Result analysis of m-health using mobile computing provides various applications for management of health.
S.M.Riazul Islam 2015	Wireless Sensor Network (6LoWPAN), IoTnet, GSM.	Smart hospital	Technological solutions have been provided to enhance healthcare and make the system more efficient.
M.Sathya, S.Madhan, K.Jayanthi 2018	Wireless Sensor Network, Cloudlet Processing.	Remote Monitoring System	Usage of compact sensors with IoT in remote health monitoring made huge impact on patients making their life easier.
Rashmika Madushan 2020	RFID, Wireless Sensor Network.	Remote Monitoring System, Medication Management	Current technology helps in resolving the challenges in healthcare and provides better solutions for development of healthcare.
Shubham Banka 2018	Raspberry Pi, data mining techniques.	Remote Monitoring System	System monitors the health condition using sensors and Raspberry Pi uses a data aggregator to collect data from patients.
Damian Dziak, Bartosz Jachimczyk 2017	Pedestrian dead reckoning and decision tree algorithm.	Remote health monitoring system	End result of the developed design is built on IMU, with an integral accelerometer to propose a home care monitoring system.
Ashlesha.Patil, Dr.S.R.Suralkar 2017	BSN based Using Raspberry Pi.	Remote Monitoring System	Using web based concepts in healthcare resolves issues and improves security in systems.
Sudha.V, Shaziya Banu A 2018	Arduino, Body sensors.	Remote health monitoring system	A well-equipped model with features is developed where doctors can examine patients remotely.

Prajoona Valsalan 2020	Arduino, WI-FI module, Room humidity Sensor.	Room and patient monitoring system	Information collected from patients is stored and processed in the cloud this reduces hospital visits for the documents and patients can be monitored by a doctor being stayed remotely.
Md. Milon Islam, Ashikur Rahman 2020	ESP32, Sensors, Web Server	Hospital Management	Smart health care system monitors the basic essential parameters of patients like body temperature, heart rate, and calculates the hospital room condition like the level of CO2, CO gases and room humidity.
Jie Wang, Ning Cao 2018	WISE Cloud, BASN technology	Wearables	A wearable helps the patient to monitor their health condition and also WISE cloud helps to store and access the information from the cloud.
K.Hari Kishore, D.Pavan Kumar 2019	Arduinio, Smart cloud, GSM.	Remote health monitoring system	System can be implemented in general wards of hospitals to assist patients, understand its utilization and performance. The system can minimize the adverse emergency of a patient with heart disease.
R. Alekya, Neelima Devi Boddeti 2020	Wireless sensor network, Coap, 6LoWPAN, REST	Cluster Condition health application	Helps better to provide people with healthcare at any time in any region by eliminating geography, time and other barriers while increasing their coverage and efficiency at the same time. IoT health revolution is a reality and thus fair, affordable care provides high-quality care to people.
Stephanie B Baker, Wei Xiang 2017	Secure cloud, WBAN, Photoplethysmographic pulse sensor, RF array module.	Review on all applications	Various healthcare systems are proposed using IoT which can be applied in general conditions. Wearables are one of the most significant technologies. Technology like data storage, cloud are the best means of storing the information in healthcare.
J.V.Alamelu, A.Mythili 2017	Wireless sensor network, cloud with sensor network.	Remote Monitoring System	System acquires pulse rate signals using a cloud platform. Results demonstrated the evaluation for its performance in the context of energy.

### III. DISCUSSION

#### A. IOT-Internet of Things Architecture



**Fig 1: IoT Architecture**

Figure 1 illustrates architecture of IoT and its working components.

#### 1. Sensors:

One or more sensors comprise the Internet of Things (IoT). Sensors pick up information from the air. Sensors will be able to gather a wide range of data, including information on a machine's current state, the surrounding environment, the current location, and even the human body itself. Temperature sensors, for example, gather information about the ambient temperature. The sensor sends the data it collects to the gateway, a device that connects the sensor to the Internet.

#### 2. IoT Gateway:

The Internet of Entities (IoT) gateway allows us to communicate with devices and things that we need to engage with. Gateways are the points of contact between the server and the various devices. A gateway collects data from the sensors and transmits it to the infrastructure, which is generally a cloud server, for further processing.

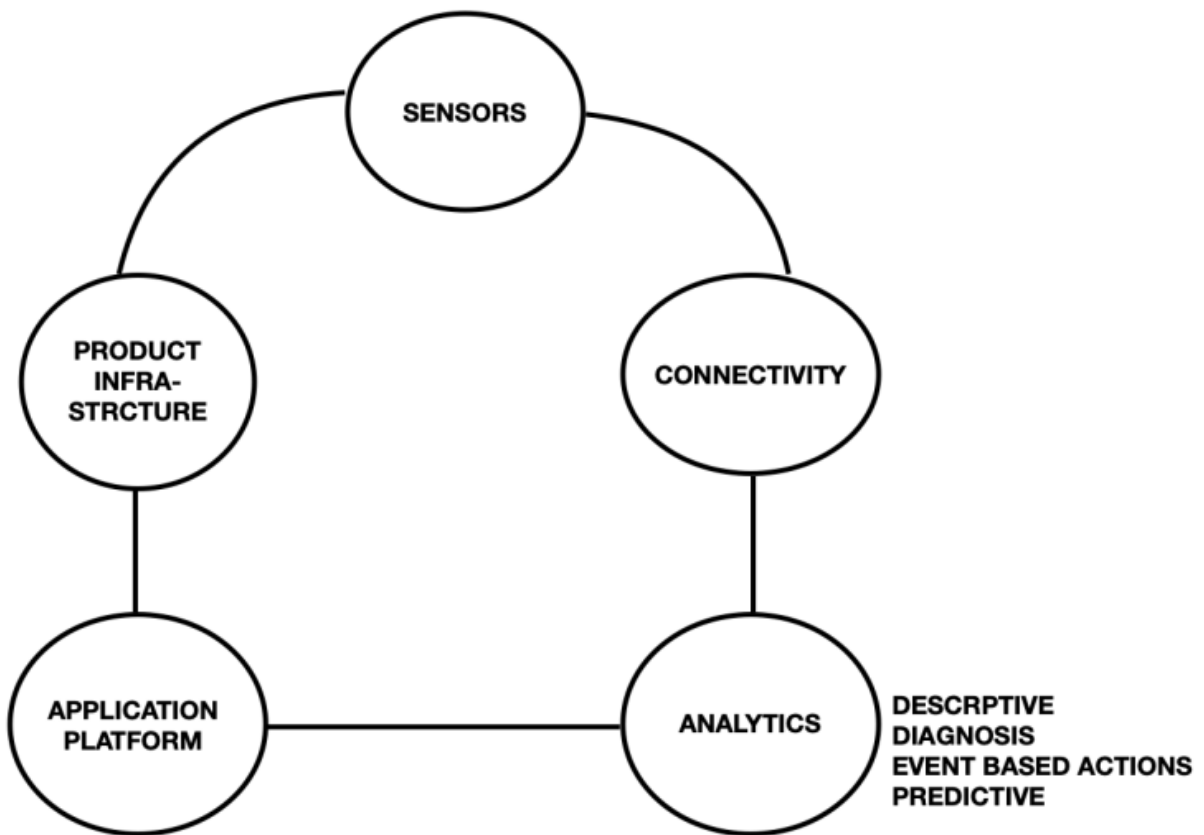
#### 3. Cloud server:

Storage and processing of information takes place at a data centre (cloud server). Using processed data, we are able to make all of our gadgets smarter. The cloud server does all diagnosis and decision making before transmitting the results to the user's mobile device.

**4. Mobile applications:**

End-users can monitor and operate medical devices via mobile apps. These apps access the cloud server to retrieve the processed data and display it on mobile devices such as smartphones and tablets. These apps will provide information to the user's mobile devices in the form of bars, graphs, and a pi-diagram that is easy to understand. Sensors, such as those in an air conditioner, may be given orders to adjust their values via mobile applications.

**B. IoT in Health Care Architecture**



**Fig 2: System Architecture of Health Care**

Figure 2 illustrates the architecture of Health Care systems IoT Architecture with respect to healthcare changes according to the design, Figure 2 demonstrates a usual working of IoT in the healthcare domain.



**Product Infrastructure:** It is the software or hardware component that reads the sensor signals and displays them to a specific device in the IoT product architecture. Pulse rate monitoring devices or an IoT software are examples of this type of technology.

**Sensors:** The Internet of Things in healthcare includes a wide range of sensors, including fluid level sensors, electrocardiograms, thermometers, pulse-oximeters, and sphygmomanometers (blood pressure) (data).

**Connectivity:** The Internet of Things (IoT) system makes it easier to read data from devices and sensors by connecting them more easily (through Bluetooth, WiFi, etc.).

**Analytics:** Data from sensors and associates in the healthcare system is examined by the system to determine the health parameters of the patient, and the patient's health is then improved as a result of this data analysis. The four stages of analytics are descriptive, diagnostic, event-based intervention, and forecasting.

Platform for mobile applications: These applications allow patients' electronic health records to be sent to healthcare providers, and the other way around.

#### IV. APPLICATIONS OF HEALTH CARE

##### A. Remote Monitoring System

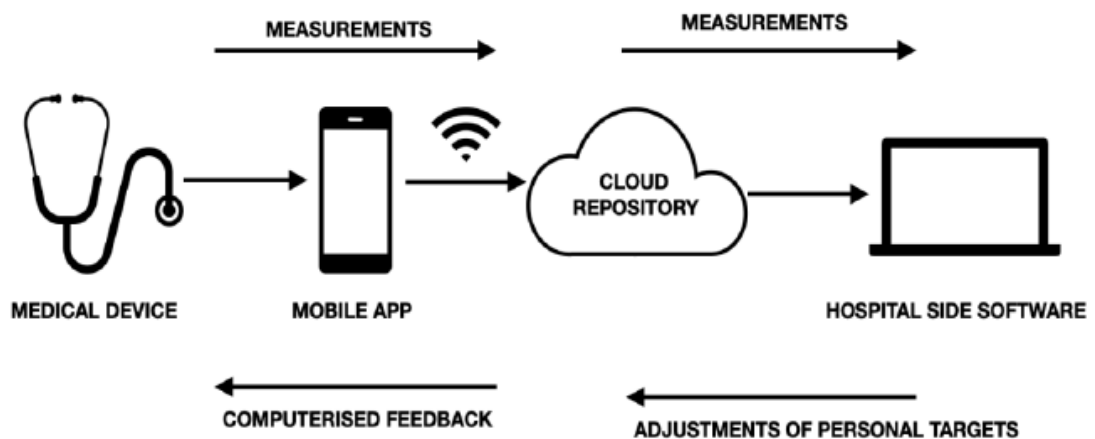


Fig 3: Remote Monitoring System

Figure 3 shows a system for remote monitoring. Remote monitoring is a healthcare application that helps to treat the patient from a remote location, where there is no need for the patient to run to the hospital or any emergency treatment. To gain access, patients need to make use of Internet

of Things (IoT) devices. These include, but are not limited to, oximeters, blood pressure monitors, and other Internet of Things (IoT) devices. The patient uses these gadgets to monitor their health, and the data is transferred to a cloud server via a mobile application on their phone. As a result, the cloud-based data is analysed and provided to medical staff. Personal or telephone conversations are used to exchange information.

### B. Devices of Remote Monitoring System

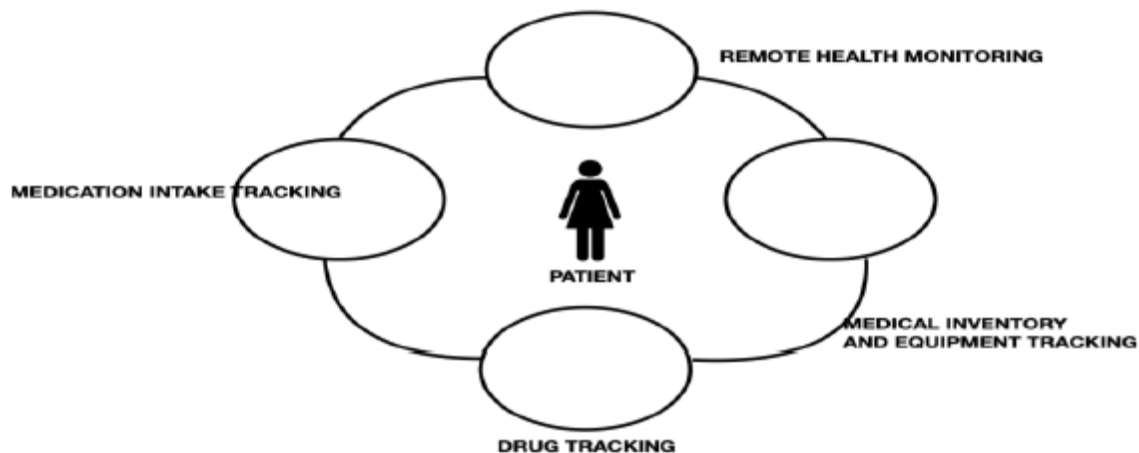
**CGM:** CGM devices are implanted in the arms of diabetic patients to track their blood glucose levels.

An IoT-enabled gadget maintains track of time, quantity, and kind of insulin administered in Smart Insulin Pens (SIPs). Patients with diabetes can also monitor their insulin dosage and determine how much of that dosage affects their blood sugar levels.

Psychiatric sensors that may be ingested are known as ingestion sensors. The wearable patch activates these sensors. Using a patch, users may monitor the patient's activity level, ingested data, and emotional state.

### C. Medical Management

There are a few patients who neglect to take prescribed medicine because they do not have direct access to their doctor or are being watched in a distant location. With IoT-enabled systems, patients may be monitored from afar and reminded to take their prescription according to their doctor's orders, which can be sent through text message or email.



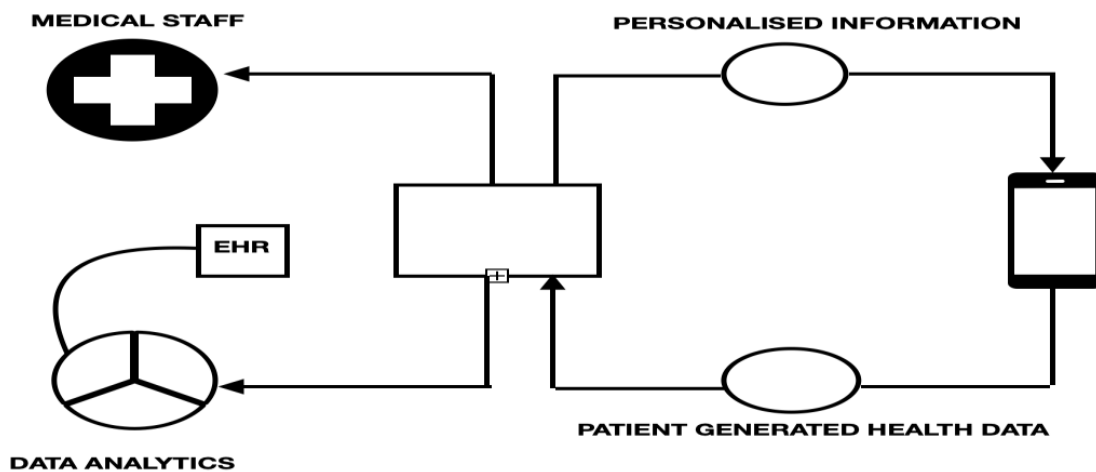
**Fig 4: Medical Management System**

Medications may now be taken from the comfort of one's own home. Patients can use their equipment remotely and it will be monitored by health professionals using the medical management systems shown in Figure 4. These systems give many monitoring options, such as medical inventory and equipment tracking. Patients can use a drug monitoring system to keep track of the medicines they are taking and their doses. Patients benefit from medication monitoring because they are able to keep track of their dosages, and the system also reminds them to take their prescription on time if they forget to.

**IoT Devices for Medical Management**

- As part of a patient's prescription regimen, a Smart Pill container is provided. Tracks patient medication consistency and alerts patients when they miss doses through text message.
- Connected Platform: Doctors may connect with patients via an IoT-enabled plug-and-play platform to ensure they are following their dose instructions. A sensor-embedded platform allows patients to be monitored remotely and, in some situations, reduces treatment costs. This allows for a more accurate evaluation of the patient's condition.

**D. Chronic Disease Management**



**Fig 5: Chronic Disease Management System**

Data from wearables and network-enabled medical equipment are sent immediately to the patient's health repository. It's easier to use, and it's less expensive. It is now possible to deploy Internet of Things (IoT) devices to continually monitor the vital statistics of chronically unwell patients. Figure 5 depicts a method for chronically sick people to keep track of their health. To monitor their health, the patient is provided with an Internet-of-Things (IoT) gadget. The technology sends the studied data to the health professional's device.

#### **Chronic Diseases Can Be Managed with the Help of IoT Devices**

- **Connected Inhalers:** Respiratory diseases can be addressed using this device. People are affected by illnesses like chronic bronchitis. This sensor will be linked to an inhaler that monitors the pace at which patients get rescue medicine. Data from this sensor will be sent to mobile data, where it will be evaluated and sent to the doctor or the user, who will then be notified of the possible causes of their problems.
- **Automated Device for Asthma Monitoring and Management:** ADAMM is an IoT-enabled wearable that predicts an asthma attack and alerts the wearer and their authorised career. Preventative measures can be taken before things get out of control. Patients may use an IoT application to record their speech and track their actions and emotions using the gadget, which also detects and records inhaler use. In addition, the user may use this gadget to keep track of their prescription regimen and create reminders.

#### **V. CHALLENGES IN IOT FOR HEALTHCARE**

- **Data Security and Privacy:**

Privacy and security are two of the biggest issues that IoT in healthcare faces. Data protocols are lacking in IoT-permitted devices, which contain real-time data. Since IoT-enabled devices are prone to data theft and sensitive to hackers, the health information will be kept there. As a result, criminals are able to utilise these devices to manufacture phoney IDs for illegal drug sales and purchases.

- **Data Overload and Accuracy:**

It is challenging to acquire data because of the inconsistencies in data and communication technologies. Because IoT devices collect data in large quantities for analysis, it is necessary to break the data into manageable chunks so that it can be processed more accurately.

● **Cost:**

When attempting to design an IoT system for health management, one of the most significant obstacles is the associated cost. Even if it only saves one life, the cost is well worth it. As a result, the cost of developing an IoT application is substantial.

**VI. CONCLUSION**

The Internet of Things (IoT) may be used in a wide range of industries. In the sphere of health monitoring systems, IoT has the ability to give feasible solutions for any remote tracking system. IoT-enabled products are being developed to make people's lives easier and more productive. IoT can be used to improve healthcare, according to our research. It is possible that the Internet of Things (IoT) may help enhance the healthcare system. The growth of healthcare is being modelled and new technologies are being discovered. The advantages of IoT in healthcare might be the subject of further research and development. There is always a method to overcome the downsides of IoT in healthcare, despite the various problems it faces.

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**CHANGE IN PHYSICOCHEMICAL PROPERTIES OF EDIBLE OIL  
DURING FRYING: A REVIEW**

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**Abstract**

Cooking, salad dressings, and bread dips all require a variety of edible oils, whether they come from plants, animals, or synthetic sources. In contrast to petroleum-based oils, plant-derived edible oils include carboxylic acids with long hydrocarbon chains. A process known as beta-oxidation occurs when human enzymes attack and break down the chain of carboxyl groups, making the oils edible. A broad range of cooking oils are available from plant sources, including olive oil, palm oil, soy sauce (rapeseed oil), canola oil (rapeseed oil), maize oil, and peanut oil. The physicochemical attributes and compositional features of several frying oils are compared in this work. Additionally, the article discusses the long-term prospects of edible oils and their health advantages.

**Keywords:** Edible oils, carboxyl group, physicochemical properties, health benefits.

**Introduction**

Oils and fats include a wide variety of lipids and triacylglycerols by nature. Saturated and unsaturated fatty acids and glycerides make up their chemical composition. Essential fatty acids, energy, and fat-soluble vitamins are all provided by edible oils in our daily diet (Erum Zahir et al., 2014) [26]. At room temperature, most cooking oils are liquid, but some saturated fat oils, such as coconut oil, palm oil, and palm kernel oil, are solid at this temperature. One of the most traditional and widely used methods of cooking food is to brown it in fat before frying it in oil.

Because of their appealing flavour, colour, and crispy texture, deep-fat fried dishes are extremely popular with customers. Fry is a high-temperature cooking method that involves submerging food in hot oil and allowing oil, air, and food to come into direct contact. Fatty meals have a distinct flavour and texture thanks to the fat frying process, which involves transferring heat and mass from the oil, food, and air all at the same time. Heat transfer medium and flavour enhancer: Frying oil serves both functions in fried food (Hassan A. Mudawi et al., 2014 [15]). Fryers employ a variety of plant and animal-based oils, depending on where they are located. In Southeast Asia, coconut and groundnut oils are popular, as are olive oils in India and the Mediterranean.

The Western food industry has become more reliant on the frying method to provide a wide range of snack items during the past five decades. There has been a rise in popularity of fried meals including potato chips, french fries, and fried fish and poultry across the world (Farkas B.E. et al., 1996) [10]. Physicochemical parameters such as density, viscosity, boiling point, peroxide, iodine and saponification values were used to determine the quality of Corn and Mustard oils, according to Erum Zahir. Table 1 shows the results. Consumers find reduced viscosity and density oils to be quite appealing. These characteristics are critical inputs for the creation of a cutting-edge technological process. Since palm kernel oil's saponification value (280.5–56.1 mg KOH/g) is higher than coconut oil (257.5–6.5 mg KOH/g) and groundnut oil (191.5–3.5 mg KOH/g), it may be concluded that palm kernel oil contains more unsaturated fatty acids than coconut and groundnut oils. Palm kernel oil has a lower molecular weight than groundnut and coconut oils, according to this study (Theodore, 1983) [23]. For palm kernel oil, the iodine value is likewise greater than those reported for coconut and groundnut oils (8.5–1.5 mgKOH/g and 9.4–1.2 mgKOH/g), indicating an increased level of unsaturation (Pearson, 1976). As a result, palm kernel oil has a larger peroxide value than coconut and groundnut oils, which have a negligible peroxide value. A sign of rancidity in palm kernel oil, which is likely more susceptible than coconut or groundnut oils to oxidation. It's not a surprise that this is happening because of the heightened amount of unsaturation. As soon as the peroxide value rises to more than 10 mEq/kg (Pearson, 1976), rancidity becomes apparent. There is a direct correlation between the molecular weight of an oil and its unsaturation, according to Furniss (1978) [11].



In comparison to coconut and groundnut oils, palm kernel oil has a specific gravity of 0.904, which indicates that the molecular weight of palm kernel oil is smaller than that of these oils. In terms of acidity, palm kernel oil had a lower acid value than coconut and groundnut oils (i.e., 2.70.3 mg KOH/g and 5.50.5 mg KOH/g, respectively) suggesting that the glycerides in the oil had been dissolved by lipase activity. [18] Due to the lower levels of acidity in palm kernel oil as compared to coconut and groundnut oils, it's safe to eat this oil. Sunflower Oil has a high iodine value, which indicates that it is rich in unsaturated fatty acids, which means that it has a limited oxidative storage stability, according to Perkins (1992) [21]. The oil's Free Fatty Acid readings were lower than the FAO/WHO recommended value, which may be due to variations in variety and environmental circumstances shown in the iodine value. Because oil has a low FFA level, it may have a lower saponification value than usual. The FAO/WHO standard for edible vegetable oils said that the acid and peroxide readings were acceptable. Oil has a lower specific gravity than water, which indicates that it is less dense.

Table 1: Physicochemical characteristics of edible oils

Physicochemical properties	Palm Kernel Oil	Coconut Oil	Groundnut Oil	Corn Oil	Mustard Oil	Sunflower Oil	Peanut Oil
Saponification value (mg KOH/g)	280.5±56.1	257.5±6.5	191.5±3.5	153.8	125.6	182.233	–
Acid value (mg KOH/g)	2.7±0.3	5.5±0.5	9.0±0.5	–	–	0.953	–
Free fatty (FFA) (mg KOH/g)	1.35±0.15	2.75±4.5	4.5±0.25	0.125(%)	–	0.042(%)	0.150
Peroxide value (mEq/kg)	14.3±0.8	–	–	0.162	0.83	6.322	2.000
Iodine value (mgKOH/g)	15.86±4.02	8.5±1.5	9.4±1.2	15.96	8.10	119.921	–
Specific Gravity value (S.G)	0.904	0.91±0.003	0.9155±0.0055	–	–	0.915	0.9146
Refractive index	1.412°	1.449±0.001	1.47±0.001	1.4750	–	–	1.471
Viscosity	–	–	–	112 (millipoise)	117.27 (millipoise)	28.3(at30°C)	41.00 (centipoise)
Odour	Burnt Smell	Pleasant	Pleasant	–	–	–	–
Colour	Burnt Brown	Pale yellow	Very pale brown	25(R) 0.9(Y)	–	25(R) 0.4(Y)	1.3(R) 10(Y)
Stability	Soluble in non-polar solvent	Soluble in non polar solvent	Soluble in non polar solvent	–	–	–	–
Ester Value(mg KOH/g)	277.8±56.4	252±6.5	182.5±3.0	–	–	182.138	–
Source	Amira, P. Olaniyi <i>et al.</i> , 2014 [2]	Amira, P. Olaniyi <i>et al.</i> , 2014 [2]	Amira, P. Olaniyi <i>et al.</i> , 2014 [2]	Erum Zahir <i>et al.</i> , 2014 [26]	Erum Zahir <i>et al.</i> , 2014 [26]	Hassan A. Mudawi, 2014 [15]	Muna Abass Fadlseed and Ahlam Ahmed Hussain, 2016

### Necessity of checking the quality of frying oil

Cooking food by deep frying is one of the most prevalent techniques of doing it. Repeated deep-frying alters the oil's physicochemical, nutritional, and sensory qualities as a result of oxidative and heat processes (Che Man and Jasvir, 2000) [8]. In the course of frying, the composition of oil changes owing to hydrolysis, oxidation and polymerization processes, which alters the flavour and stability of its constituents (Gloria and Aguilera, 1998) [13]. During deep frying, several reactions are influenced by elements such as the replenishment of fresh oil, the frying conditions, the initial quality of the frying oil, and the decline in their oxidative stability, among others (Choe and Min, 2007) [9]. Oxygen interacts immediately with lipids and other organic molecules in the oil to produce structural deterioration, which results in a decrease in the quality of food and is damaging to the health of humans (Bhattacharya et al., 2008) [6]. In order to prevent the health risks associated with eating food cooked in deteriorated oil, preserve the quality of fried meals, and decrease production expenses associated with early disposal of the frying medium, it is critical to keep an eye on the quality of the oil used in their preparation.

### **1.2 Physicochemical changes occurring in oil during frying**

Oil is a good medium for cooking since it allows for high rates of heat transmission into the meal. The frying procedure, on the other hand, alters the oil chemically and physically. The sensory and nutritional properties of food are also affected by these modifications (Farkas B.E. et al., 1996) [10], in addition to the heating characteristics.

#### **Physicochemical changes in the oil are due to three factors:**

- Oil quality, especially in the case of frying, is heavily dependent on the oil's oxidative stability, which is why frying oil must be highly oxidative stable throughout usage (Tabee, et al., 2008).
- Water vapour from frying causes hydrolytic alterations in the product (Gertz and Klostermann, 2002) [12]
- Changes in temperature owing to the oil being kept at a high temperature.

The organoleptic quality of food is influenced by volatile chemicals created during the frying process. It is critical that oil have non-volatile chemicals, which are able to travel into the food as it is being fried and thereafter be consumed. A number of analytical techniques have

been devised to assess changes in oil after frying (Farkas et al., 1996 [10]) based on these nonvolatile chemicals.

Fresh oil replenishment, frying settings, oil quality, food, and kind of fryer are all aspects that affect deep-fat fry responses. Antioxidants and oxygen concentration are also important. Oil's oxidative stability and flavour quality are weakened by high frying temperatures, the number of fryings, the concentration of free fatty acids, polyvalent metals, and unsaturated fatty acids. However, antioxidants' efficiency diminishes at higher temperatures of frying (H. A. Mudawi et al., 2014) [15].

### **Physicochemical changes occurring in food during frying**

When it comes to how much oil is absorbed into the meal, factors such as frying duration, food surface area, moisture content, breading or battering style, and frying oil may all play a role. At the right temperature and at the right time, food that has been fried to perfection is golden brown in colour, perfectly cooked, crispy, and absorbs the maximum amount of oil possible [7]. At the other end of the spectrum is food that has been under-fried, which has white or slightly brown edges and partially cooked starch in the centre. A lack of deep-fat frying flavour, excellent colour, and crispy texture can be found in under-fried dishes. When meals are over-fried, the extra oil absorbs into the food, causing blackened and harder surfaces and a greasy texture (Hassan A.Mudawi et al., 2014)[15].

### **Edible oil used in frying foods**

A look at some of the most regularly used oils in commercial food frying is given. Some more oils, such as those stated, are utilised in frying that meet the requirements for process, cost, and quality features.

### **Tests performed and their importance**

Oils are tested for their physical and chemical qualities in order to assess their quality, purity, and uniqueness. A characteristic property is a feature of the oil that is unique to that particular oil. Regardless of where or how the oil was sourced, these characteristics are used to

describe it (Amira et al., 2014) [2]. Because the iodine value is based on unsaturation or double bonds among the fatty acids contained in the oil, it cannot tell you the exact fatty acid composition of any given oil. The iodine value or number can be used to check for oil adulteration as well as to monitor the production process for oil. The level of deterioration is determined by the peroxide value. Edible oils that have not been subjected to rancidity must have a standard peroxide value substantially below 10 meq/kg (Pearson,1976) [19]. To get a basic idea of how well oils are doing, the free fatty acid value is commonly employed (Pearson, 1976) [19]. The molecular weight of fat or oil can be approximated using the saponification value. Molecular weight increases as saponification value decreases. The amount of alkali needed to preserve a specific amount of fat or oil into soap is also shown. Checking for fat and oil adulteration is one of its primary applications (Theodore, 1983) [23]. Difference between free fatty acid and saponification values is known as esterification value. A beam of light's refractive index is the amount of refraction that happens as it travels through a clear material. At a temperature of 20°C, a refractometer may be used to calculate an oil's refractive index in degrees. For each oil, a unique value may be determined, and this can be used to verify the oil's authenticity and purity. An oil's or fat's specific gravity is estimated and computed at 20°C, by multiplying its mass in air by its mass at 20°C (Theodore, 1983) [23]. Besides determining the degree of adulteration, it may also be used to determine the appropriate size of pumps and pipelines for plant installations and to accept oils as raw materials. Nearly all oils have a relative density of between 0.8 and 0.9 at 20°C [23] (Theodore, 1983).

Solubility, freezing point, colour, odour, and boiling point are some of the other qualities of oil that can vary. In order to keep oil from spoiling, Furniss (1978) recommends that it be kept airtight, antioxidants added, chelation agents added, and hydrogenated.

### **Conclusion**

Physicochemical features of all oils may be seen in the data, and it is noticed that the five sequential frying operations have a significant effect on them. While potatoes were used in this research, many other foods exist and might yield different findings, especially when it comes to physical qualities. As a result, more research including other foods is encouraged. Rice Bran Oil

and its combination with other oils, in particular, is a high-antioxidant oil that should be studied further in this field.

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**IN SILICO DRUG DESIGN TOOL FOR OVERCOMING THE DISCREPANCY IN THE  
DRUG DISCOVERY PROCESS**

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**ABSTRACT**

In recent years, drug development prices have risen while the quantity of novel chemical entities has decreased. There are a lot of possible explanations for this outcome. Many people believe that progress in the applied sciences have lagged behind those in the fundamental sciences. As a result, the employment of alternative technologies is required in order to provide answers on efficacy and safety more quickly, with more assurance, and at a lower cost. In silico drug design, or computer-aided drug design, is one example of an alternate tool (CADD). There are several ways that in silico drug design can help with medication development, from early preclinical research to late-stage clinical testing and beyond. In drug development, it may be used to ensure that only powerful lead molecules are selected so that late-stage clinical failures can be avoided, resulting in considerable cost savings. In this article, the possibilities, drivers, and limits of in silico drug design are explored, as well as the existing situation and its prospects for the future.

**Keywords:** In silico drug design, Computer aided drug design, Virtual screening

**INTRODUCTION**

A candidate molecule's failure might be caused by a variety of factors, such as poor pharmacokinetics, ineffectiveness, adverse effects, and commercial considerations. Drug discovery and development is a complicated and time-consuming process. Medication discovery usually begins with altering the chemical structure of already existing medications, followed by



screening large compound libraries or the creation of new therapeutic proteins. The structures of more and more protein targets are becoming available as genomics, proteomics, bioinformatics, and technologies like crystallography and NMR continue to advance in the field. Because of this, there is a need for computational tools that can find and assess active areas as well as recommend possible drugs. Molecules capable of attaching to these receptors. This research gap is filled by in silico models. In silico investigations include everything from molecular docking and dynamics to quantum mechanics and QSAR to ADMET prediction and dissolution. Technology advancements and a large library of pharmaceuticals from drug banks and protein data banks have fueled the adoption of in silico models. Before diving into the specifics of in silico drug design, let's take a look at the conventional drug discovery process and the problems it has, as well as the need for an alternative tool to cut down on R&D time and costs, and how in silico drug design fits into that picture. Later, the focus is on a list of various globally available in silico models emphasising their potential intervention at various stages of drug design, drivers and restraints in implementing these models, current status of in silico drug design and future prospects. These models will be discussed in more detail.

### **Drug discovery process**

It's known as the "pipeline" or the "development chain" and consists of a number of separate phases that are all linked together. Preclinical and Clinical can be categorised as two distinct phases. Preclinical research necessitates a two-step procedure. Identifying the biological target in the body is the first stage (the protein). Next, a lead chemical (molecule) having drug-like characteristics must be found in relation to this protein preliminary testing on animals will be performed after that. After then, the medication undergoes several clinical trials in people. The medication is tested on human volunteers in the clinical phase to determine:

- When a substance enters your system and exits through your urine or faces.
- The body's response to the medication
- Effectiveness in treating the ailment it is intended to treat
- The drug's side effects.

### **Cost and the time involved in the drug discovery process**

Pharmaceutical research and manufactures of America (PhRMA) projected in 2001 that the cost of a new drug's development would be US\$802 million over an 11-year period<sup>4</sup>. In 2003, DiMasi at the Tufts Center for the Study of Drug Development (CSDD) calculated the average cost at US\$802 million distributed over 12 years, while the Boston Consulting Group estimated the cost as \$880 million over 15 years<sup>6</sup>. The drug discovery process now costs between \$800 million and \$1.8 billion<sup>7</sup>. Depending on the ailment being addressed, the treatment being produced, and the nature and breadth of the clinical trials necessary to get regulatory clearance, these figures are averages, and there will be substantial variance in both time and expense. Drug research and development costs are summarised in Table 1, which provides an overview of the process.

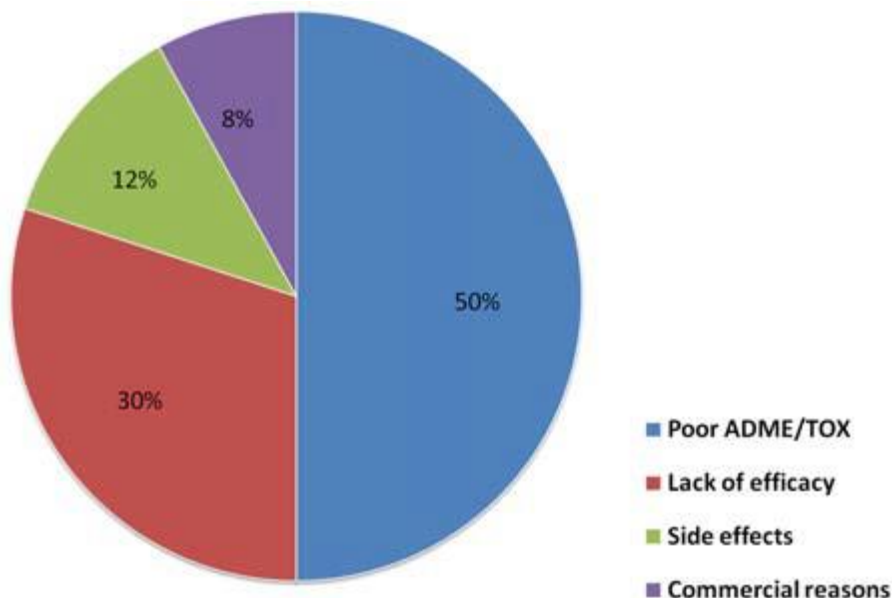
**Table 1: Shows the cost incurred and time involved in the drug discovery process**

	Cost US \$ Million	Cost %	Time in years
<b>Biology</b>			
Target identification	165	18.8	1.0
Target validation	205	23.3	2.0
<b>Chemistry</b>			
Screening	40	4.5	4.5
Optimization	120	13.6	2.7
<b>Development</b>			
Pre-clinical	90	10.2	1.6
Clinical	260	29.5	7.0
<b>Total</b>	<b>880</b>	<b>100.0</b>	<b>14.7</b>

### **Pitfall in current drug discovery process the productivity gap**

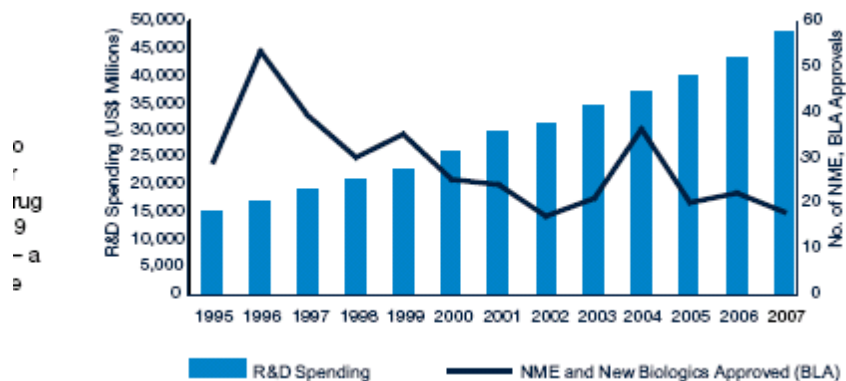
- The GAO recently released a report<sup>8</sup> that found that the number of NDAs submitted to the FDA increased only 38% over the period from 1993 to 2004, while the number of NME NDAs increased only 7%. This is despite the fact that the overall number of NDAs submitted to the FDA increased by 147 percent between 1993 and 2004.
- Attrition is a problem that must be addressed. For every 12 new medications that enter clinical trials, only one will be approved by the FDA. In the pharmaceutical sector, attrition rates during drug development remain high, despite the deployment of many R&D methodologies. High attrition rates have been linked to several reasons, but one that has drawn particular attention is the prevalence of active ingredients having subpar pharmacological characteristics. It is necessary to withdraw certain active compounds

from development because of their poor bioavailability, pharmacokinetics, or harmful effects. Approximately half of all drug development failures are attributed to these sorts of mishaps. The causes for the candidate molecule's failure are shown in Figure 1.



**Fig. 1: It shows the potential reasons for failure of a candidate molecule**

A new era in illness prevention and treatment was anticipated when the human genome was sequenced in 2000, but it has failed to materialise despite the continued funding of biomedical research. As a result, new drug and biologic submissions to regulatory authorities, as well as NME approvals from regulatory agencies worldwide, began to slow down around 2000. Recently, there has been a decrease in the number of new medical device applications submitted. Over the past decade, (Figure 2 provides an overview of R&D investment and NME approvals). Patients might expect an overall reduction in the number of FDA-approved new products. There seems to be a widening distance between the bench and the bedside, as fundamental biomedical knowledge grows at an ever-accelerating rate. Because the easy illness targets have all been treated, and those that remain are more difficult to handle from a classical chemistry standpoint, or their function in disease is not well known, this decreased productivity is partially owing to this.



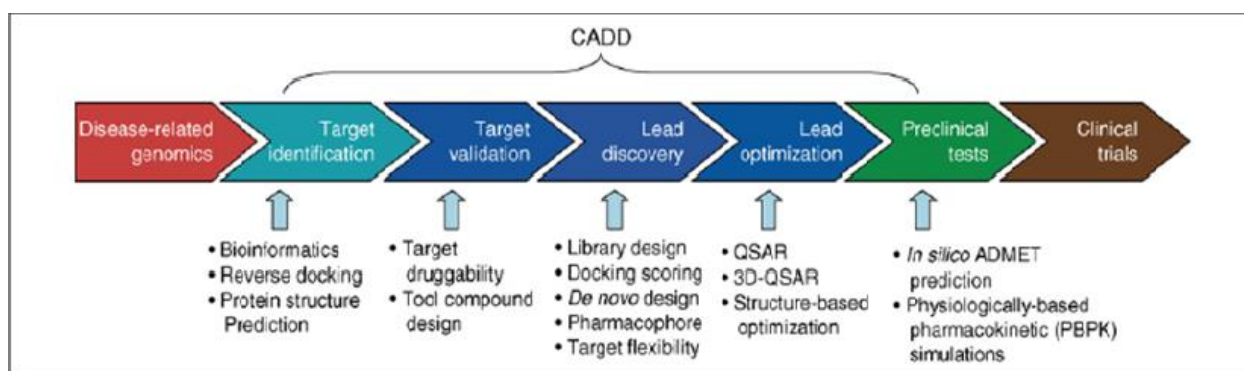
**Fig 2: It gives an insight to R&D spending and NME approved over the decade Need for an alternative tool**

These facts and numbers show that there is a pressing need to find a new method of speeding up the R&D process while also reducing the ever-increasing costs. For some, it appears that applied sciences have not kept up with the progress of basic sciences. Innovation and Stability: Challenge and Opportunity on the Critical Path to New Medical Products was produced by the FDA in 2005. 9 It's possible that models and simulations might help close the gap in terms of innovation.

Despite a significant rise in biomedical research funding, the number of novel molecular entities submitted has remained unchanged. Additionally, the analysis noted that a medicine that entered phase I trials in 2000 had the same commercial potential as a drug that entered phase I trials 15 years earlier, according to the paper. According to the paper, "often, developers are obliged to rely on the tools of the past century to evaluate this century's advancements." However, the agency feels that the sector can take certain actions. "There is optimism that increased predictive power may be acquired via *in silico* (computer modelling) assessments, such as predictive modelling," the paper notes. "Extensive usage of *in silico* technology might cut the overall cost of medication development by as much as 50%," according to a paper cited in the report.

### Impact of technology

Drug discovery is currently being done on the computer rather than the lab. These two terms are nearly interchangeable. CADD's spectrum of applications has significantly expanded in the post-genomic era, including nearly all phases of the drug development pipeline, from target identification to lead discovery and optimization, all the way through to preclinical and clinical trials<sup>12</sup>. A look at Figure 3 reveals how CADD may be used to the various stages of drug development, as shown.



**Fig. 3: It shows the Applications of CADD to the various stages of drug development**

### *In silico* drug discovery process comprises of 3 stages<sup>13</sup>

A therapeutic target must be identified, and then a heterogeneous small molecule library must be constructed and evaluated against it. In the next step, a virtual screening methodology is developed using either docking of small molecules from the library or constructing these structures in the active site using De novo design techniques. To this stage, the chosen hits are docked at binding sites of additional known drug targets to verify their specificity. Leads are compounds that have undergone extensive *in silico* ADMET profiling experiments and have come out of these tests unscathed.

### Target identification and validation *in silico*

The first step in the drug discovery process is the identification and confirmation of the target. Even though there are hundreds of potential macromolecules for druggable targets, finding the right ones is still a difficult task<sup>14</sup>. Recently, a slew of new technologies for attacking

the targets have been created. Genomic and proteomic techniques are the primary means of identifying a target. A proteomic method, for example, compares the protein expression patterns of a specific cell or tissue in the presence or absence of the given drug in order to identify binding proteins for that molecule. Because this strategy is time-consuming and labor-intensive, it hasn't shown to be very effective in discovering new targets. A range of computational (in silico) technologies have also been created to aid in the identification of target molecules. Sequence-based techniques and structure-based approaches are two classifications for them. Sequence-based approaches provide functional information about target candidates and location information to biological networks to aid in target identification procedures. By comparing functional genomics from people and pathogens for illnesses caused by external pathogens like bacteria and viruses, unique targets may be uncovered in the pathogens. Subtractive Genomic Analysis (SGA) has been applied to *Helicobacter pylori* (*H. pylori*) to identify a collection of genes that appear to be necessary to the infection but are lacking in humans.<sup>15</sup>

#### **In silico ADMET (absorption, distribution, metabolism, excretion, toxicity) prediction<sup>16</sup>**

In recent years, research has shown that late-stage drug failures are almost always due to inadequate pharmacokinetics and toxicity, therefore it's become common knowledge that these factors should be taken into account as early as feasible throughout the drug discovery process. The number of chemicals for which preliminary data on absorption, distribution, metabolism, excretion (ADME), and toxicity (T) are required has expanded dramatically as a result of combinatorial chemistry and high-throughput screening. Drug development can be speeded up by employing in silico methods to mimic the most important aspects of pharmacokinetic, Metabolic and toxicological outcomes. With an in-silico technique, only a powerful lead molecule may be selected for further medication development and testing. There are programmes like DD plus and Gastro plus that provide the pharmacokinetic profile of the medicine once the drug's structure is provided.

#### **In silico prediction of drug safety<sup>17</sup>**

Drug research and development rely heavily on computer models for predicting safety. In late-stage clinical trials or after a medicine is on the market, significant toxicological side effects

can lead to huge financial losses and put patients at risk. Drug development can be discontinued early when these compounds are discovered. Medicinal chemists may also benefit from early insights about the toxicity potential of a scaffold or a series of structures in the drug development process. A computational toxicity model might be used to evaluate preclinical toxicity data and choose relevant experimental endpoints for additional investigations during clinical candidate selection and early clinical research. Toxicities like this can be predicted with the use of technologies.

- (1) Genotoxicity,
- (2) Liver toxicity,
- (3) CYP450 inhibition and
- (4) Cardiotoxicity

### **In silico prediction of drugdrug interactions 18**

MDDIs have recently been the subject of various high-profile drug development issues, resulting in restricted usage, withdrawal or denial of authorisation by regulatory bodies. Methods for evaluating MDDI's potential have become commonplace in the drug development process. Although their meaning and utility are still up for question in the absence of a comprehensive strategy, the crucial distinction between a helpful "simulation" and an accurate "prediction" is often overlooked. MDDI may currently be simulated using a variety of in silico applications. SIMCYP is one such programme.

### **Virtual screening19**

To conduct a virtual screening, lead molecules are docked with the biological target. There is then a scoring pattern that is used in the next step. This may be accomplished using a variety of programmes. Some of these tools can be purchased, while others can be downloaded for free.

### **Commonly used software for drug design or intermediate steps thereof**

While Table 2 provides a full list of commercially accessible drug discovery software programmes, Table 3 provides a list of regularly used intermediate stage drug design tools.

### **Drivers in implementing *in silico* models**

- An increase in the use of *in silico* technology has been attributed to lower medication attrition rates.
- *in silico* models for early ADME/Tox screening are spurred by costly failures in late drug development.
- The development of *in silico* ADME/Tox screening products is fueled by increased computing capacity.
- The use of improved and dependable models by pharmaceutical corporations is boosted.
- Rapidly identifying targets is driving the use of *in silico* models, which are designed to screen targets as they are identified.
- Companies in the pharmaceutical and *in silico* product industries have worked together to create "global" offthe-the-shelf items as well as "local" customised ones.

### **Restraints in implementing *in silico* models**

- It is difficult to enhance *in silico* ADME/Tox models due to the lack of reliable/accurate experimental data
- The predictive efficacy of many *in silico* ADME/Tox technology is yet untested. •
- Potentially safe and viable therapeutic candidates may not be tested *in vitro* or *in vivo* if they fail to perform well in a computer simulation.
- There is no comprehensive record of successful projects in which modelling and simulation had a significant impact that is updated on a regular basis
- Constraints exist due to a dearth of test standards and proof of concept

### **CONCLUSION**

There is a lot of work put into weeding out chemicals that may produce many adverse effects or interact with other medications in the identification of new therapeutic candidates. *In silico* approaches aid in this regard and they are going to become a fundamental concern in any strict drug discovery procedure. *In silico* technology alone cannot guarantee the identification of novel safe and effective lead molecule but more realistically future success rely on the right



integration of new promising technologies with the knowledge and methods of conventional medicinal chemistry.

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**A DETAILED REVISION OF MICROBIAL BIOSURFACTANTS**

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**Abstract**

Microorganisms produce biosurfactants, which are surface-active chemicals. They are non-toxic, biodegradable, and environmentally friendly. Various microbial surfactants have been updated in this review. Fermentation conditions, environmental variables, and nutrient availability all influence the formation of biosurfactants. Biosurfactants extracted from the cell-free supernatant using solvent extraction and their qualitative and quantitative analysis have been described with relevant equipment information. The biosurfactant's applications include biomedical, cosmetic, and bioremediation applications. Trace elements such as rhamnolipids, sophorolipolipids, trehalose lipids, rhamnoglycolipids, cellobiol lipids, polyglycerol, diglycosyl diglycerides, fatty acids and polyol lipids are examples of biosurfactants found in microorganisms. In the bioremediation of gasoline spilt soil and petroleum oily sludge, rhamnolipid biosurfactants generated by *Pseudomonas aeruginosa* DS10-129 proved to be an important bioremediation tool. By freeing the weathered oil from soil matrix and increasing the bioavailability of hydrocarbons for microbial breakdown, rhamnolipid biosurfactant improved the bioremediation process. Hydrocarbon-contaminated locations might benefit from its use in the cleanup process. For oil-contaminated ocean habitats, biosurfactants from marine microorganisms have considerable promise. rhamnolipids; fermentation; emulsification; bioremediation; as well as qualitative and quantitative evaluation.

**Keywords:** Microbial Biosurfactants surface-active chemicals. Fermentation, environmental variables,

**1 Introduction**

A range of yeasts, bacteria, and filamentous fungi (Mata Sandoval et al., 1999; Chen et al., 2007) create biosurfactants from a variety of substances, including sugars, oils, and wastes (Mata Sandoval et al. 1999; Chen et al., 2007). *Pseudomonas aeruginosa* biosurfactant production studies, on the other hand, frequently employ carbohydrates and vegetable oils as substrates (Rahman et al., 2002 a,b, 2003; Raza et al., 2007). SURFACE ACTIVE AGENTS or SURFACTANTS are surface chemical works that may be done using amphiphiles that create micelles. To put it another way, surfactants are a good way to characterise both soaps and detergents. The hydrophobic end and the hydrophilic end are the two endpoints of any surfactant. An alkyl-a-alkyl-â-hydroxy fatty acid chain makes up the hydrophobic portion of the molecule's structure. An alcohol, carbohydrate, amino acid, peptide ring, phosphate, carboxylic acid, or cyclic peptide can serve as the water-soluble end (hydrophilic). As a result, the hydrophobic moiety is often a C8 to C22 alkyl chain or alkylaryl that may be straight or branched (Van Ginkel, 1989). It is feasible to employ biosurfactants in a wide variety of industrial processes because of their unique features (Kosaric, 1992). Biosurfactants that are chemically manufactured are commonly utilised in cosmetics since they are usually derived from oil. In both aqueous solutions and hydrocarbon mixtures, biosurfactants lower surface tension, critical micelle concentration (CMC), and interfacial tension (Banat, 1995; Rahman et al., 2002c, d).

## **2 General Classification**

Each polar moiety of a surfactant can be categorised according to the type of its charge. Anionic surfactants have a sulphonate or sulphur group that is responsible for their negative charge. Most non-ionic surfactants are polymerization products of 1, 2-epoxyethane, which is a non-ionic surfactant. Positively charged quaternary ammonium groups describe cationic surfactants. Amphoteric surfactants, on the other hand, include both positively and negatively charged moieties in the same molecule (Van Ginkel, 1989). There are two types of biosurfactants: lowmolecular-mass molecules that effectively decrease surface and interfacial tensions and highmolecular-mass polymers, which cling securely to surfaces (Rosenberg and Ron, 1999). Sophorolipids, rhamnolipids, and biodispersan are some instances of low-molecular-mass molecules, whereas food emulsifiers (Sheperd et al., 1995) and biodispersan (Rosenberg,

1993) are examples of high-molecular-mass polymers. Biosurfactants may be produced by a variety of microorganisms, each of which produces a different kind. This is mostly determined by the molecular structure of the biosurfactant in question. To give only a few examples, Rasman et al. (2002a,b, 2003) used rhamnolipids from *Pseudomonas aeruginosa* DS10-129, Davis et al. (2001) used sophorose lipids from *Torulopsis bombicola* and *Bacillus subtilis* ATCC 2132 to make surfactin. Based on their structure, Kosaric (1992) divided biosurfactants as hydrolyzed and cross-linked fatty acids, polysaccharides, glycolipids, lipoprotein-lipopeptides, phospholipids, and full cell surfaces. On the other hand, Biermann et al., (1987) group biosurfactants as glycolipids, lipopeptides, phospholipids, fatty acids, neutral lipids, polymeric and particulate compounds (Table 1). Biosurfactants may be divided into four basic categories: glycolipids, phospholipids, lipoproteins/lipopeptides and polymeric. (Healy et al. 1996).

## **2.1 Glycolipids**

Glycolipids are the most well-known biosurfactants. Glucose, mannose, galactose, glucuronic acid, rhamnose, and galactose sulphate are just a few of the mono-, di-, tri-, and tetrasaccharides found inside. Phospholipids from the same microorganism often share the same fatty acid makeup (Veenanadig et al., 2000; Chen et al., 2007). Carbohydrates and long-chain aliphatic or hydroxyaliphatic acids are also constituents of these substances (Desai and Banat, 1997). There are a number of glycolipid disaccharides that have been extensively researched, the best known of which being rhamnolipids, trehalose, and sophorolipids (Desai and Banat, 1997; Karanth et al., 1999). These glycolipid bioemulsifiers are acylated with long-chain fatty acids or hydroxyl fatty acids (Rosenberg and Ron, 1999).

### **2.1.a Rhamnolipids**

Surfactant containing rhamnose and 3-hydroxy fatty acids is produced by *Pseudomonas* bacteria (Lang and Wullbrandt, 1999; Rahman et al., 2002b). It has been extensively documented that the rhamnolipids generated by *Pseudomonas aeruginosa* are a combination of four homologous species: RL1 (RhC10C10), RL2 (RhC10), RL3 (Rh2C10), and RL4 (Rh2C10)

(Syldatk and Wagner, 1987; Lang and Wagner, 1987; Rahman et al., 2002b). Phenolipids were synthesised using virgin olive oil by *Pseudomonas fluorescens* NCIMB 11712, which produces methyl pentose monosaccharides (Healy and colleagues 1996). When two moles of rhamnose sugar are condensed, they generate disaccharide rhamnolipids, which are a kind of lipid. In between the hydrophobic and acetal groups is an acetal group. When it comes to the lipid portion of the molecular structure, however, the ester and carboxyl groups are present. To remove hydrophobic chemicals from polluted soils, rhamnolipids generated by *Pseudomonas aeruginosa* strains are some of the most efficient surfactants for the job (Rahman et al., 2006). Because of their low critical micelle concentration (CMC) and strong attraction for hydrophobic organic molecules, they have low average minimum surface tension (30 – 32 mNm<sup>-1</sup>) and high average emulsifying activity (10.4 – 15.5 Uml<sup>-1</sup> filtrate) (Van Dyke et al., 1993).

### **2.1.b Sophorolipids**

*Torulopsis* sp. produces (SLs) a category of biosurfactants. Sugar and a hydroxyl fatty acid are joined together by a -glycosidic bond in sophorolipids (Asmer et al., 1988). A lactonic SL is a lactonic SL that is acidic (non-lactonic), according to Hu and Ju (2001). Intramolecular esterification of the hydroxyl groups of the acidic SLs and the lactonic SLs generates macrocyclic lactone rings with the sophorose's hydroxyl groups, respectively, in the acidic SLs. When it comes to economic and scientific interest, it has previously been suggested that lactonic SLs had a greater advantage over their acidic counterparts until recently. While the acetylated lactonic SLs have been used as antidandruff, bacteriostatic, and deodorant agents in the cosmetics industry, their biocidal action has not been shown (Mager et al., 1987).

### **2.1.c Trehalolipids**

In this case, we're dealing with glycolipids. Trehalose esters on the cell surface are responsible for the serpentine development found in several members of the *Mycobacterium* genus (Asselineau and Asselineau, 1978). Trehalose, a disaccharide connected at C-6 and C-6' to mycolic acid, is found in most *Mycobacterium*, *Nocardia*, and *Corynebacterium* species. Fats that are long, branching, and hydroxy are known as mycolic acids. *Rhodococcus erythropolis* and

*Arthrobacter* sp. trehalose lipids were found to reduce surface and interfacial tensions in culture broth by 25-40 mNm<sup>-1</sup> and 1-5 mNm<sup>-1</sup>, respectively (Li et al., 1984).

## **2.2 Lipoproteins and Lipopeptides**

There are seven amino acids in lipopeptides (also known as surfactins) generated by *Bacillus* sp. that are linked to carboxylic and hydroxylic groups of a 14-carbon acid. Even at low concentrations (0.005 percent), surfactin may lower the surface tension of water from 72 to 27 micrometres per square inch, making it one of the most effective biosurfactants (Kakinuma et al., 1969). One of the most potent biosurfactants is *Bacillus subtilis* ATCC 21332's cyclic lipopeptide surfactin. Surfactin's capacity to lyse mammalian erythrocytes and to generate spheroplasts is another key feature (Bernheimer and Avigad, 1970). Haemolysis on blood agar is being used to identify the formation of surfactin in bacteria.

## **2.3 Fatty Acids**

As a result of microbial oxidation, fatty acids derived from alkanes were considered surfactants (Rehm and Reiff, 1981). Additionally, micro-organisms synthesise complex fatty acids that are made of OH groups and alkyl branches. Corynomucolic acids, which are surfactants as well as complex acids, are one such example (Kretschner et al., 1982). A fatty acid's hydrophilic or lipophilic balance is directly proportional to the length of its hydrocarbon chain. The C12-C14 range of saturated fatty acids is the most effective for reducing surface and interfacial tensions (Rosenberg and Ron, 1999).

## **2.4 Phospholipids**

Microorganisms' membranes are known to be heavily populated with phospholipids. In the presence of certain hydrocarbon-degrading bacteria or yeast, the concentration of phospholipid rises significantly. If, for example, you use *Acinetobacter* sp. HO1-N cultured in hexadecane, phospholipids (primarily Phosphatidylethanolamine) are formed (Kaeppli and Finnerty, 1979). *Thiobacillus thiooxidans* produces phospholipids, which are essential for wettability of the sulphur required for growth (Beeba and Umbriet, 1971). *Rhodococcus erythropolis* cultured on

n-alkane generated phosphatidylethanolamine, which reduced water-to-hexadecane interfacial tension to less than 1 mNm<sup>-1</sup> and CMC to 30 mgL<sup>-1</sup> (Kretschmer, 1982).

## **2.5 Polymeric Compounds**

Polymeric biosurfactants such as emulsan, liposan, mannoprotein, and polysaccharide-protein complexes have been extensively researched (Desai and Banat, 1997). *Acinetobacter calcoaceticus* RAG-1 was the source of the bioemulsifier emulsan, which was isolated by Rosenberg et al. (1979). Even at a concentration of 0.001 percent to 0.01%, it is an excellent emulsifying agent for hydrocarbons in water. Emulsion stabilisers like this one are so effective that they can withstand an oil-to-water ratio of 1:4 without losing their capacity to resist inversion (Zosim et al., 1982). An extracellular water-soluble emulsifier was created utilising *Candida lipolytica* by Ciriglian and Carman (1984). A heteropolysaccharide comprising glucose, galactose, galactosamine, and galacturonic acid made up 83 percent of the carbohydrate and 17 percent of the protein. Mannoprotein produced by *Saccharomyces cerevisiae* has outstanding emulsifying action toward a wide range of oils, alkanoids, and organic solvents, according to Cameron and colleagues (1988). When the emulsifier is refined, it comprises 44 percent mannose and 17 percent protein, respectively. Biodispersan, alasan, food emulsion, protein complex, and insectide emulsifiers were other polymeric biosurfactants found in the mannoprotein.

## **3 Biosurfactant Production**

Many researchers have used a variety of bacteria in the production of biosurfactant in growth medium. The vast majority of the microorganisms utilised in these tests were found to be contaminated by petroleum hydrocarbon byproducts or industrial waste (Rahman et al., 2006; Benincasa, 2007).

### **3.1 Factors affecting biosurfactant production**



The development of biosurfactants is influenced by a variety of variables. Environmental and dietary aspects such as the supply of carbon substrate are included.

### **3.1.a Environmental Factors**

As with any other chemical reaction, the synthesis of biosurfactants can be impacted by a variety of circumstances. The formation of biosurfactants is affected by environmental conditions like as pH, salinity, and temperature (Rahman al., 2002b; Ilori et al., 2005; Raza et al., 2007). Under harsh conditions of oil reservoirs, microorganisms are needed for Microbially Improved Oil Recovery (MEOR) (in situ).

As a result of extreme temperature, pressure, salinity, and low oxygen levels. *Pseudomonas* strains MEOR 171 and MEOR 172 generated biosurfactant that was unaffected by temperature, pH, and Ca, Mg concentrations in oil reservoirs (Karanth et al., 1999). Biosurfactant production is influenced by environmental variables such as oxygen availability and growth circumstances such as pH, temperature, agitation and cellular activity, as stated by Desai and Banat (1997). Biosurfactant synthesis is also affected by salt concentrations, which have an impact on cellular function. Slightly reduced CMCs in several biosurfactants were seen in samples with salt concentrations of up to 10% (w/v) (Abu-Ruwaida et al., 1991).

### **3.1.b Nutritional factors**

Biosurfactants have been produced using a variety of carbon substrates. Biosurfactant production is, in fact, affected and influenced by the nature of the environment in which it is produced.

Substrate made of carbon (Singer, 1985; Raza et al., 2007). Biosurfactant-producing microbes have found diesel and crude oil to be excellent carbon sources (Ilori et al., 2005). In addition to glucose, sucrose and glycerol, several water-soluble carbon substrates have also been shown to be useful for biosurfactant synthesis (Desai and Banat, 1997; Rahman et al., 2002a). Large batch reactors were employed to cultivate *Gordonia amarae* and produce biosurfactant in the treatment of wastewater by Pagilla et al. (2002), who used soluble acetate and sparingly soluble hexadecane as carbon substrates. In addition, the nutrient concentrations, pH, and the age

of the culture were shown to alter the yield of rhamnolipid formation. It's good news because hydrophobic sources of biosurfactant synthesis, such as maize oil, lard (which is high in unsaturated and saturated fats) and long-chain alcohols (100 - 165 mg g<sup>-1</sup> substrate). Glucose and succinate acid, on the other hand, yielded only 12 to 36 mg g<sup>-1</sup> substrate (Mata-Sandoval et al., 2000). In 1989, Robert et al. discovered that *Pseudomonas aeruginosa* could produce rhamnolipids from a range of carbon sources, including C11 and C12 alkanes and succinate. They also used pyruvate, citrate, fructose, and glycerol.

### **3.2 Estimation of biosurfactant activity**

Emulsion stability, hydrophilic-lipophilic balance, and surface and interfacial tension changes are all measured in this process (HLB). A tensiometer is a simple tool for determining the surface tension at water/oil and water/air interfaces, respectively. Addition of biosurfactant reduces the surface tension of distilled water from 72 mNm<sup>-1</sup> to 28 mNm<sup>-1</sup> (Rahman et al., 2006). By decreasing water's surface tension with a biosurfactant, the Critical Micelle Concentration (CMC) for amphiphilic molecules to form supramolecular structures such as micelles, bilayers, and vesicles rises (CMC). A biosurfactant's efficiency is frequently assessed using the CMC, which measures the biosurfactant's ability in an aqueous phase (Desai and Banat, 1997). Many studies have used a variety of analytical approaches to analyse and characterise biosurfactants. Biosurfactant, bacterial, and solvent types are all included in Table 2, together with any supporting documentation and the specific type of analytical technique employed.

### **4. Applications of Biosurfactant**

Biosurfactants have been studied and used in a variety of ways. Its importance in virtually every facet of human existence cannot be overstated. Numerous synthetic, mostly petroleum-based chemical surfactants today fill the vast market need for these surfactants.. These substances are hazardous to human health and the environment, and they are also incapable of decomposition. It is also possible that they may bio-accumulate and that their manufacturing, procedures, and byproducts may be harmful to the environment. Biosurfactants are becoming

more popular as an alternative to chemical surfactants because of strict environmental restrictions and a growing awareness of the need to safeguard the ecosystem (Banat et al., 2000; Benincasa, 2007). It's becoming increasingly clear that biosurfactants have the potential to be performance-enhancing chemicals in a variety of disciplines. Today, biosurfactants are mostly employed for oil recovery enhancement and hydrocarbon bioremediation research (Rahman et al., 2004, 2006). 17 million metric tonnes (t) of surfactants (including soaps) were produced worldwide in 2000, with an estimated growth rate of 3 to 4% per year worldwide and 1.5 to 2.0% per year in the EU (Whalley, 1995). Surfactant applications in industry are categorised based on the method of application. Detergents and cleansers use 54% of these; textiles, leather, and paper use 13%; chemical processes use 10%; cosmetics and medicines use 10%; food use 3%; agriculture use 2%; and other uses include 4% each (8 percent ).

#### **4.1 Bioremediation**

Oil leakage and transportation from one area to another during offshore production (drilling) is wreaking havoc on aquatic life. The large oil spills and discharge during the Gulf War in 1991 and 1992 is a clear illustration. Between January and May 1991, an estimated 11 million barrels of oil were discharged into the Arabian Gulf, damaging more than 800 kilometres of Kuwaiti and Saudi Arabian shoreline. The cleanup will cost more than \$700 million, according to estimates. The oil spilled in the Gulf had disastrous implications for the area's marine species, including endangered hawksbill and green turtles, thousands of cormorants (a kind of marine bird), and 400 to 500 tonnes of fish that perished as a result of exposure to oil or polluted water. Moreover, major oil spills in the high seas and on beaches have caused massive ecological and societal disasters (Shaw, 1992; Burns et al., 1993; Burger, 1993). Rahman et al. (2003, 2004, 2006) investigated the bioremediation of n-alkanes in petroleum sludge including oil and found that the concentration of n-alkanes in the sludge was reduced from 200,000 to 100 Cp (Hayes et al., 1986). As a result, despite the failure of standard chemical surfactant treatment, it was possible to flow heavy oil 26,000 miles in a commercial pipeline following this treatment. Miller (1995); Mulligan and Wang (2006) employ biosurfactants in the bioremediation of areas polluted with dangerous heavy metals such as uranium, cadmium, and lead. *Pseudomonas*

aeruginosa isolate S8 from oil-polluted sea water degraded the hydrocarbons hexadecane, octadecane, and nanodecane by 47 percent, 58 percent, 73 percent, and 60 percent, respectively, when cultured for 28 days under laboratory conditions, according to Shafeeq et al., (1989). Ex situ bioremediation of a gasoline-contaminated soil was improved by treating chicken litter and coir pith with rhamnolipid generated by *Pseudomonas aeruginosa* DS10-129 (Rahman et al., 2002a). By introducing a microbe mixture to soil polluted with gasoline and provided with nutrients and oxygen, benzene, toluene, ethylbenzene, xylene, and trimethylbenzene were destroyed (Kosaric, 2001). The grease content is 87.4%. After 56 days, a bacterial consortium, nutrients, and rhamnolipids decomposed 100% of the sludge containing C8-C11 alkanes, 83-98 percent of C12-C21 alkanes, 80-85 percent of C22-C31 alkanes, and ultimately 57-73 percent of C32-C40 alkanes. When Boscan Venezuelan heavy crude oil was treated with emulsan in another experiment, oil viscosity was lowered from 200,000 to 100 Cp (Hayes et al., 1986). As a result, despite the failure of standard chemical surfactant treatment, it was possible to flow heavy oil 26,000 miles in a commercial pipeline following this treatment. Miller (1995); Mulligan and Wang (2006) employ biosurfactants in the bioremediation of areas polluted with dangerous heavy metals such as uranium, cadmium, and lead. *Pseudomonas aeruginosa* isolate S8 from oil-polluted sea water degraded the hydrocarbons hexadecane, octadecane, and nanodecane by 47 percent, 58 percent, 73 percent, and 60 percent, respectively, when cultured for 28 days under laboratory conditions, according to Shafeeq et al., (1989). Ex situ bioremediation of a gasoline-contaminated soil was improved by treating chicken litter and coir pith with rhamnolipid generated by *Pseudomonas aeruginosa* DS10-129 (Rahman et al., 2002a). By introducing a microbe mixture to soil polluted with gasoline and provided with nutrients and oxygen, benzene, toluene, ethylbenzene, xylene, and trimethylbenzene were destroyed (Kosaric, 2001).

#### **4.1. b Other Applications**

There are a number of applications for biosurfactants in the food industry, most often as food additives (emulsifiers). Ethoxylated monoglyceride derivatives, such as freshly synthesised oligopeptides derived from monoglycerides and lectins, are examples of these compounds (Bloomberg, 1991). Improved flavour, taste, and quality have been achieved with low health

risks thanks to the use of these emulsifiers. Additionally, biosurfactants can be used in the agriculture business. Rhamnolipids have been shown to be extremely efficient against three typical taxa of zoosporic plant diseases by Stanghellini and Miller (1997); *Pythium aphanidermatum*, *Phytophthora capsici*, and *Plasmopara lactuceae*. The lysis of the whole zoospore population occurred in less than a minute when the concentration of purified mono- and di-rhamnolipids ranged from 5 to 30 mgL<sup>-1</sup>. Herbicides and pesticides can benefit from the inclusion of bioemulsifiers in their formulations (Rosenberg and Ron, 1999). Bioemulsifiers (glycolipopeptides) produced by *Bacillus* strains are used to emulsify immiscible organophosphorus insecticides as one illustration (Patel and Gopinathan, 1986). There have been reports of biosurfactant use in the cosmetic and pharmaceutical sectors as well (Cameotra and Makkar, 2004).

#### **4.2 Reduction of CO<sub>2</sub> Emissions**

The greenhouse effect is a naturally occurring phenomenon that assists in the heating of the earth's surface and atmospheric gases such as CO<sub>2</sub>, water vapour, and methane, which can influence the planet's energy balance by absorbing long wave radiation (infrared) released from the surface. Biosurfactants have been demonstrated in studies to play a role in reducing, if not completely eliminating, CO<sub>2</sub> emissions into the atmosphere. It's no surprise that the Kyoto Protocol was agreed by the UNFCCC in 1997 to reduce greenhouse gas emissions (Kyoto Protocol, 1997). Assuming that overall surfactant production in the EU remains constant until 2010, the amount of oleochemical surfactants might be raised from around 880kt in 1998 to around 1,100kt in 2010, a 24 percent increase. This replacement decreases surfactant CO<sub>2</sub> emissions by 8% during their whole life cycle. Total substitution has a theoretical maximum potential of 37%. (Table 3). Because the surfactant industry is likely to expand, prevented CO<sub>2</sub> emissions are expected to exceed 8% of present surfactant life-cycle CO<sub>2</sub> emissions. Furthermore, the manufacture of oleochemical surfactants averted an estimated 1.5 million tonnes of CO<sub>2</sub> emissions in 1998. (Patel, 2004).

#### **5. Marine Microorganism Biosurfactants**

Marine microorganisms are a largely untapped type of organisms used in manufacturing, with new research revealing that just 1% of marine microorganisms are culturable, implying that metagenomics has a lot of potential. Biosurfactants, which are perfectly suited for the bioremediation of oil polluted areas in the sea, which is a common occurrence on the high seas these days, are among the different bioactive chemicals being explored, both from cultivated and uncultured marine microorganisms.

Glycolipids, lipopeptides and lipoproteins, phospholipids and fatty acids, polymeric biosurfactants, and particulate biosurfactants are all produced by marine microorganisms (Desai and Banat, 1997). Table 4 lists important biosurfactants produced by marine microorganisms.

Various tests, such as calorimetric rhamnolipid synthesis (Yuste et al., 2000), capacity to generate clear halos in methylene blue/ cetyl trimethyl ammonium bromide (CTAB) or Nacetyl pyridinium chloride - methylene blue agar (Lin et al., 1998), and haemolysis of RBC (Carrillo et al., 1996; Morikawa et al. (1992) proposed a technique in which a colony on a L-agar plate covered with oil was regarded a biosurfactant producer since it was surrounded by an emulsified halo. A drop collapse test for bacterial colonies generating surfactants was also suggested as a quick and sensitive approach (Haba et al., 2000). A tensiometer (Dungar and Schink, 1995) is recommended for measuring biosurfactant activity since it monitors the surface tension at the air/water or oil/water interface. In an aqueous test setup, biosurfactant's capacity to form a suspension of hydrocarbons such as n-hexadecane (Kim et al., 2000) or kerosene (Haba et al., 2000) or a combination of n-hexadecane and 2 methyl naphthalene (Navon- Venicia et al., 1995) or dodecane (Burd

Marine biosurfactants are thought to be extremely beneficial in preventing ocean contamination caused by oil spills and frequent ship operations. The rate of biodegradation of a specific carbohydrate is determined by its dispersion site, and degradation is accelerated when insoluble water molecules are dissolved, solubilized, or emulsified (Mattai et al., 1986). Biodegradable biosurfactants from marine microorganisms increase bioavailability of poorly soluble polycyclic aromatic hydrocarbons such as phenanthrene (Gilewics et al., 1997; Olivera et al., 2003) and resins, whereas synthetic detergents add to the environmental problems of the aquatic environment (Venkateswaran et al., 1995).

Spraying a combination of biosurfactant sophorolipid and yellow clay over marine algal (Cochlodinium) blooms has been found to control them (Lee et al., 2008). After 30 minutes of treatment, the biosurfactant-yellow clay combination had a removal effectiveness of more than 90%. Components of the autochthonous microflora of the marine environment, such as *Acinetobacter* spp. T4, begin acting on the oil pollution by producing metabolites that can enhance *Pseudomonas putida* development (Nakamura et al., 1996; Delille, 2000). The physicochemical features of water are also shown to be influenced by dissolved organic molecules as a result of the action of marine bacteria (Goutx et al., 1990). In the extracellular lipid medium, 1mg of bacterial protein produces 16-289g of carbs and 8 to 188g of lipids, according to the researchers. By analysing 16s rRNA from oil spilled seawater along Thailand's coast, Maneerat and Phetrong (2007) identified eight strains of biosurfactant-producing marine bacteria, including *Vibrio parahaemolyticus*, *Bacillus subtilis*, *Micrococcus luteus*, *Myroides* sp., *Acinetobacter anitratus*, and *B. pumilus*, and studied the characteristics of selected biosurfactants. Based on a drop collapse test, Batista et al. (2006) recovered a large number of Gram positive bacteria capable of creating biosurfactants from petroleum polluted locations. It was also discovered that glucose was a better carbon source for screening surfactant and/or emulsifier-producing isolates than fructose, sucrose, or kerosene. The creation of seabed gas hydrates as a result of surfactant synthesis by *Bacillus subtilis* and other species under anaerobic circumstances was investigated (Zhang et al., 2007). Natural gas vents are discovered to have a high proclivity for dispersing this bioproduct in porous substrates.

## **6 Advantages and disadvantages of biosurfactants**

Biosurfactants offer several benefits over synthetic surfactants, according to scientific study. Biosurfactants provide the following benefits (Kosaric, 1992; Mulligan and Wang, 2006).

### **6.1 Merits**

- Due to their rapid decomposition by microorganisms, biosurfactants do not constitute a significant environmental risk.



- Toxicity was 50 percent lower in testing using *Rhodococcus* species 413A glycolipids than in studies using Tween 80 for naphthalene solubilization (Kanga et al., 1997).
- They can be used in cosmetics, medicines, and food additives because of their biocompatibility.
- It is possible to make biosurfactants using inexpensive basic ingredients that are readily available.
- In the case of bulk manufacturing, biosurfactants may also be made from industrial wastes and byproducts, and this is of special importance.
- There are a number of environmental applications for biosurfactants, such as oil spill containment and biodegradation and detoxification of industrial effluents, and bioremediation of polluted land.

As complex organic compounds with distinct functional groups, biosurfactants frequently have specialised actions. Toxin detoxification, deemulsification in the industrial sector, and certain cosmetic, medicinal, and food applications would all benefit from this. Despite the various benefits that biosurfactants have demonstrated, the following associated disadvantages have also been identified (Kosaric, 1992).

## **6.2 Demerits**

- Biosurfactant manufacturing on a large scale may be too costly. When combined with the use of waste substrates, this problem may be alleviated by reducing the total expenses by reducing pollution at the same time.
- In pharmaceutical, culinary, and cosmetic applications, biosurfactants are particularly important since they are difficult to get in pure form. This is due to the fact that diluted broths may need a number of further processing processes.
- It is quite unusual to find strains of bacteria that are overproducing, and those that are identified tend to be extremely underproductive. With addition, the sample has to be coated in complex media.



- The control of biosurfactant synthesis is poorly understood; it appears to reflect "secondary metabolite" regulation. As a result, secondary metabolite synthesis occurs when a nutrient is depleted in a batch culture, as seen in Figure 1. The sluggish development rate of culture and the morphological alterations it entails are directly linked to this phenomena. O<sub>2</sub>-limitation has been cited as an important factor in determining the synthesis of biosurfactants
- The high level of foam generation makes it difficult to increase manufacturing yields. Immobilized systems give an improvement in productivity of roughly 3 gl<sup>-1</sup>h<sup>-1</sup> compared to diluted medium (Fiechter, 1992).

Type of biosurfactant	Microorganism
Trehalose lipids	<i>Arthrobacter paraffineus</i> <i>Corynebacterium sp.</i> <i>Mycobacterium sp.</i> <i>Rhodococcus erythropolis, Norcardia sp.</i>
Rhamnolipids	<i>Pseudomonas aeruginosa</i> <i>Pseudomonas sp., Serratia rubidea</i>
Sophorolipids	<i>Candida apicola, Candida bombicola</i> <i>Candida lipolytica</i> <i>Candida bogoriensis</i>
Glycolipids	<i>Alcanivorax borkumensis</i> <i>Arthrobacter sp., Corynebacterium sp.</i> <i>R. erythropolis, Serratia marcescens</i> <i>Tsukamurella sp.</i>
Cellobiose lipids	<i>Ustilago maydis</i>
Polyol lipids	<i>Rhodotorula glutinus</i> <i>Rhodotorula graminus</i>
Diglycosyl diglycerides	<i>Lactobacillus fermentii</i>
Lipopolysaccharides	<i>Acinetobacter calcoaceticus (RAG1)</i> <i>Pseudomonas sp., Candida lipolytica</i>
Arthrofactin	<i>Arthrobacter sp., Corynebacterium sp.</i>
Lichenysin A, Lichenysin B	<i>Bacillus licheniformis</i>
Surfactin	<i>Bacillus subtilis, Bacillus pumilus</i>
Viscosin	<i>Pseudomonas fluorescens</i>
Ornithine, lysine peptides	<i>Thiobacillus thiooxidans</i> <i>Streptomyces sioyaensis</i> <i>Gluconobacter cerinus</i>
Phospholipids	<i>Acinetobacter sp.</i>
Sulfonylipids	<i>T. thiooxidans</i> <i>Corynebacterium alkanolyticum</i>
Fatty Acids (Corynomycolic acids, spiculisporic acids, etc)	<i>Capnoytophaga sp.</i> <i>Penicillium spiculisporum</i> <i>Corynebacterium lepus</i> <i>Arthrobacter paraffineus</i> <i>Talaromyces trachyspermus</i> <i>Norcardia erythropolis</i>
Alasan	<i>Acinetobacter radioresistens</i>
Streptofactin	<i>Streptomyces tendae</i>
Particulate surfactant (PM)	<i>Pseudomonas marginalis</i>
Biosur PM	<i>Pseudomonas maltophilia</i>

Table 2. Analytical methods used for the qualitative and quantitative analysis of biosurfactant

Biosurfactant & Bacteria	Analytical Method	Chemicals/Solvents required	Reference
<b>Rhamnolipids</b> <i>Pseudomonas aeruginosa</i>	TLC	CHCl <sub>3</sub> /CH <sub>3</sub> OH/CH <sub>3</sub> COOH	Arino et al. (1996)
	HPLC	CHCl <sub>3</sub> /CH <sub>3</sub> OH	Rahman et al. (2002b)
	HPLC	CH <sub>3</sub> CN	Chayabutra et al. (2001)
		2-Propanol-NH <sub>4</sub> OH-H <sub>2</sub> O	Chayabutra et al. (2001)
	Western blot		Olvera et al. (1999)
	TLC	Carbenicillin, Tetracycline	Olvera et al. (1999)
	HPLC	CH <sub>3</sub> CN-H <sub>2</sub> O	Schenk et al. (1995)
	HPLC	Tetrahydrofuran-H <sub>2</sub> O	Sekelsky and Shreve (1999)
	HPLC	CH <sub>3</sub> CN/Phosphate buffer pH 6	Wild et al. (1997)
	TLC	CH <sub>3</sub> OH/H <sub>2</sub> O	Rahman et al. (1999)
	FTIR		Wu and Ju (1998)
	TLC	Solv. A: CHCl <sub>3</sub> /CH <sub>3</sub> OH/CH <sub>3</sub> COOH Solv. B: 2-Propanol-NH <sub>4</sub> OH-H <sub>2</sub> O	Wu and Ju (1998)
	<i>P. aeruginosa</i> LBI	HPLC	CH <sub>3</sub> CN/H <sub>2</sub> O
<i>P. aeruginosa</i> 57RP	TLC	CHCl <sub>3</sub> /CH <sub>3</sub> OH/H <sub>2</sub> O	Benincasa et al. (2002)
	HPLC-MS	CH <sub>3</sub> CN/H <sub>2</sub> O	Deziel et al. (2000)
<i>P. aeruginosa</i> UG2	TLC	CHCl <sub>3</sub> /CH <sub>3</sub> OH/CH <sub>3</sub> COOH	Deziel et al. (2000)
	HPLC	CH <sub>3</sub> CN-H <sub>3</sub> PO <sub>4</sub>	Mata-Sandoval et al. (2000)
	ESI	N <sub>2</sub>	Mata-Sandoval et al. (2000)
<i>P. aeruginosa</i> 47T2	HPLC-UV	CH <sub>3</sub> CN-H <sub>3</sub> PO <sub>4</sub>	Mata-Sandoval et al. (1999)
	HPLC	CH <sub>3</sub> CN/CH <sub>3</sub> COOH	Haba et al. (2000)
	TLC	CHCl <sub>3</sub> /CH <sub>3</sub> OH/CH <sub>3</sub> COOH	Haba et al. (2000)
<i>P. fluorescens</i>	TLC	CH <sub>3</sub> CN/H <sub>2</sub> O	Caldini et al. (1995)
<b>Lipopeptide</b> <i>Bacillus licheniformis</i>	FTIR		Thaniyavarn et al. (2003)
	HPLC-MS	CH <sub>3</sub> CN/TFA	Thaniyavarn et al. (2003)
<b>Sophorolipid</b> <i>Candida bombicola</i> <i>Torulopsis sp.</i>	HPLC with ELSD		Davila et al. (1997)
	HPLC-UV	CH <sub>3</sub> CN/H <sub>2</sub> O	Hu & Ju, (2001)
	FTIR		Hu & Ju, (2001)
<b>Phospholipid</b> <i>Acinetobacter sp.</i>	GC-MS	CHCl <sub>3</sub> /CH <sub>3</sub> OH (Extraction Method)	Koma et al. (2001)
<b>Trehalose lipid</b> <i>Rhodococcus sp.</i> P32C1	HPLC	CH <sub>3</sub> CN	Maghsoudi et al. (2001)
<b>Surfactin</b> <i>Bacillus subtilis</i> ATCC 21332	HPLC	CH <sub>3</sub> CN/TFA	Davis et al. (2001)

TLC= Thin Layer chromatography; HPLC= High Performance Liquid

Chromatography; FTIR = Fourier transform infrared spectroscopy; GC/MS = gas

Chromatography with Mass Spectroscopy

Table 3. Potential to substitute petrochemical by oleochemical surfactants in the EU by 2010.

Surfactants	EU Production	High RRM Scenario	Change %
	1998 (kt)	2010 (kt)	
ANIONICS			
LAS-Pc	409	409	0
SAS-Pc	69	69	0
AS-Pc	43	16	-63
AS-Pc	64	91	42
AS-Oleochemical	74	37	-50
AE3S-Oleochemical	172	209	21
Other anionics-Pc	47	28	-42
Other anionics-Oleochemical	32	51	63
NONIONICS			
AE-Pc	255	128	-50
AE-Oleochemical	383	510	33
Other-ethoxylates-Pc*	26	26	0
Other-ethoxylates-Oleochemical <sup>†</sup>	233	233	0
<b>TOTAL</b>	<b>1,807</b>	<b>1,807</b>	<b>-</b>
Oleochemical Surfactants	884(49%)	1,095(61%)	24
Petrochemical Surfactants	923(51%)	712(39%)	-23

Note: Cationic, amphoteric, and several nonionic surfactants are not included in this table since they are less relevant. RRM stands for Renewable Raw Materials. AES is for Alcohol ether sulfurate; AS stands for Alcohol sulphate; Pc stands for petrochemical feedstock; and LAS stands for linear alkylbenzene sulphate. In addition to PKO, CNO, and PO, there are other acronyms for "secondary alkane sulphonate" (SAS) and "coconut kernel oil." PKO and CNO

products have 7 ethylene oxide (EO) units on average, whereas PO products include an average of 11 EO units.

Table 4. Marine microorganisms and some types of biosurfactants (Maneerat et al., 2005)

Biosurfactant	Organisms	Reference (s)
Glycolipids		
Glucose lipids	<i>Alcanivorax borkumensis</i> <i>Alcaligenes sp.</i>	Abraham et al. (1998) Poremba et al. (1991)
Trehalose lipids	<i>Arthrobacter sp.</i>	Schulz et al. (1991)
Lipoproteins		
Ornithine lipids	<i>Myroides sp. SMI</i>	Maneerat et al. (2005)
Phospholipids and Fatty acids		
Bile acids	<i>Myroides sp. SMI</i>	Maneerat et al. (2005)
Polymeric biosurfactants		
Lipid-carbohydrate-protein	<i>Yarrowia lipolytica</i> <i>Pseudomonas nautica</i>	Zinjarde and Pant (2002) Hussein et al. (1997)
Particulate biosurfactants		
Whole cells	<i>Variety of bacteria</i>	Denger and Schink (1995) Gilewicz et al. (1997) Zinjarde and Pant (2002)

Microorganisms produce biosurfactants, as detailed in this review. Various analytical techniques for detecting and quantifying biosurfactants are discussed in this paper. Few species in the indigenous microbial flora produce biosurfactants in the natural environment in order to cope with a variety of harsh circumstances. As an example, if we utilise biosurfactants in environmental remediation, the final product needs to be free of microbial loading, however the product's quality may be affected due to this. However, biosurfactants used in pharmaceutical and cosmetic products must fulfil a variety of regulatory requirements. Increasing the production of biosurfactants to industrial levels is a difficult task. It is evident that a suitable surfactant must be found for industrial scale-up since the end products are influenced by the nutrient, microbe, micronutrient, and environmental conditions. To put these microorganisms to use in the industrial sector, we need to learn more about their physiology and genetics.

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**BIO-SIGNALS IN MEDICAL APPLICATIONS AND CHALLENGES  
USING ARTIFICIAL INTELLIGENCE**

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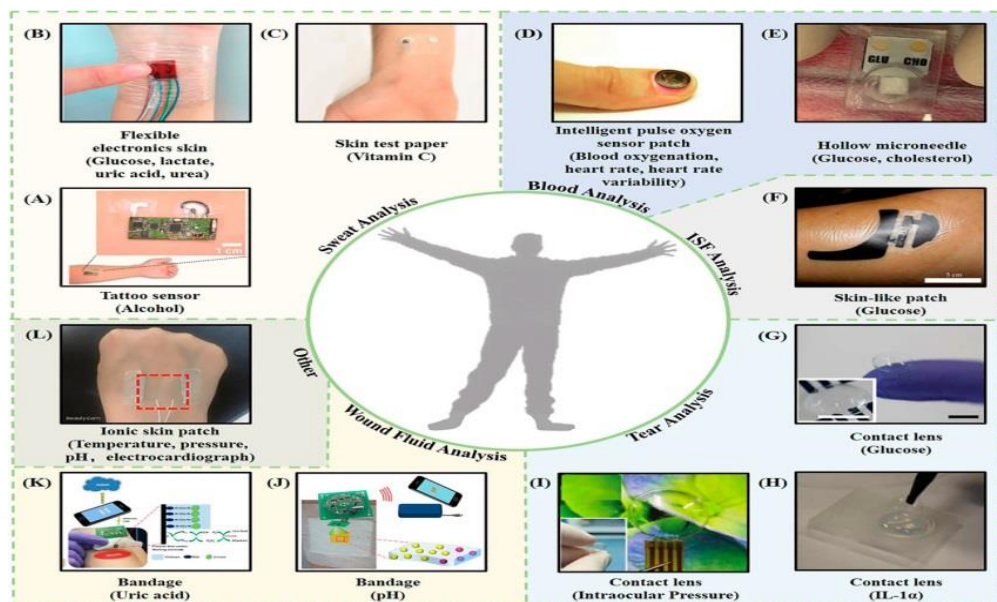
**INTRODUCTION**

Artificial Intelligence (AI) was born from the idea of two great scientists—Herbert Simon and Allen Newell. In 1958, they proposed that various interdisciplinary departments and professional sectors cooperate and develop science and its applications [1]. AI started its journey from mathematical logic, knowledge, and reasoning concepts and became a branch of Computer Science by serving all other disciplines as per their needs and by producing useful

products. The concepts of AI are built on knowledge base, algorithm design, and expert systems, and they include features such as Problem Solving, Perception, Natural Language Understanding, Logic Reasoning, Neural Networks, Machine Learning, and Learning. AI has emerged alongside new technologies in education, industry, finance, travel, automated industry, and the media sectors [2,3].

AI has also become a mandatory and intelligent approach to deal with issues in the healthcare industry. AI can be defined differently in different areas, and the best way to address this is for machine intelligence to imitate human intelligence. The biggest challenge in healthcare is that doctors cannot spend enough time on data analysis due to excessive workload. Data scientists can help in the processing and analysis of data, and in comparing the data of various diseases. A patient's medical records can be analyzed, and patterns can be detected and used to characterize the behavior of the disease. AI healthcare researchers are currently undertaking studies worldwide. Countries such as the USA, the UK, and Israel are on the frontline of promoting research into AI, and the USA is currently ranked at number one, with 49 healthcare startups. The challenges of AI healthcare involve the achievement of high reliability and accuracy. These are required in order to supply services and maintain confidentiality and privacy of data [4]. Signal Processing is a subfield of electronic engineering that includes sound and images. It is also part of the medical imaging field and is utilized in X-rays, CT scans, and MRI. Digital signal processing is used to denoise the noise of speech signals. Bio-signals can be measured in many ways, including by electrooculogram (EOG), electroencephalogram (EEG), electromyogram (ERG), and electrocardiogram (ECG), which is an electronic amplifier used to find the difference between input voltages attached to the skin. The magnetic amplifier is a galvanic skin response [5]. Wearable Biosensors are used to monitor the subject's health using sensors or biomarkers. Bio-sensor devices can be used on the head or inside the oral cavity, or they can take the form of wristbands, textile devices,

ear buds, finger rings, smart watches, skin mounted chips, gloves, or electronic chips. Different types of sensors, such as saliva-based sensors, implant sensors, sweat-based sensors, tear-based sensors, arm patches, oral cavity guards, or foot-mounted sensors are used for medical health monitoring. This author has previously discussed wearable devices that are non-invasive and practical and are scalable for commercial production [6]. Bio-medical signal processing is generally used to observe human body parts, tissues, protein sequences, gene structure, and organ images. Bio-signals will help to identify the internal details of organs. The observation is assessed by a biologist and radiologist, and the reports are verified by specialist doctors in order to identify the patient's illness. The bio-signal approach helps in monitoring the patient during the investigation, throughout the progress of treatment and at every stage of the disease. A bio-medical instrument is used to send data to or receive data from the body. Sampling instruments, such as BMI measuring instruments, audiometers, blood cell counters, BP meters, blood flow meters, and GSR meters [7], and different types of bio-signals and their usage, are shown in Figure 1.



**Figure 1.** Different types of wearable bio-signal devices and utilities.

The organization of the paper is as follows: Section 1 introduces the paper, and the concept of bio-signals is discussed. An exhaustive literature survey on bio-signals and their applications is carried out in Section 2. In Section 3, different AI methods are used to process input and help to decide on the application. In Section 4, different AI algorithms are discussed that can be applied to applications to improve. In Section 5, the latest trends in bio-signals application in the medical industry are discussed. In Section 6, challenges in bio-signals are discussed.

### **Role of Bio-Signals in Medical Applications**

#### Bio-Signals with Artificial Intelligence

There have been great success stories about the reach and advancements of AI technology in the medical area. Some of the applications, such as smart watches and wearable devices, are used to sense the pulse rate and irregularity in monitoring through algorithms and in the prediction of heart stroke. They will monitor the activity of a person. As per the authors, it was proven that the size of the brain is larger than the common size for those with heart stroke. The life of the brain will also reduce by 1.1 years of the average lifetime of the brain. It will work one hour more than the regular brain capacity. Echocardiography examination can predict a person's cardiac attack up to two weeks prior to the event [8].

Sleep detection with a bio-signal AI application is used to detect the sleep stages of the person using AI with asleep analysis algorithm, which uses the concepts of pattern recognition and rule evaluation [9]. Bio-signals help in perceiving the emotions of a person while they are returning home from the office. It is possible to know the pulse rate of a person while walking. If at all the pulse rate crosses a limit, only then will the device send a message to the person's family. It also helps us to know the actual mindset of a person's emotions [10].

Another application with bio-signal recognition is to know the emotions of a car

racer while driving a car in a car racing competition. It can be evaluated using the intelligent emotion reorganization algorithm. This system will read the values from the wearable device to send the signals to the reorganization module and then classify the results based on an adaptive neuron fuzzy inference system [11]. A severe infection, such as cancer, can easily be identified with blood investigation using the total tally counter to count the first leucocytes and then parasites under high power fields (HPF).

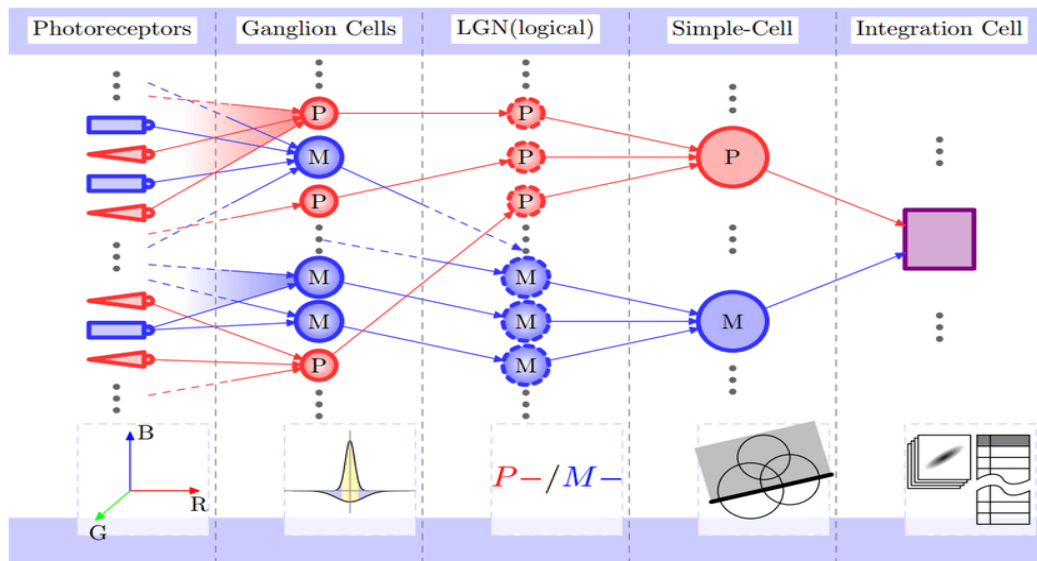
This count is directly recorded in CSV files, having no scope for human error. TTC counts outside of the range signify that some infection or cancer exists in the blood. It is a very simple, easy, and low-cost investigation [12].

AI in wearable devices use bio-signals, and literature work reveals that AI concepts can be used to predict heart diseases at early stages, but applying AI on wearable devices is the proposed model by the author. Cardiovascular-related diseases can be monitored through a digital setting on devices. Atrial fibrillation detection was performed using a forest plot using the R Package. Deep learning methods are used on the bio-signal values recorded by wearable device data, such as ECG and PPG Bio-signals [13].

Bio-signals Processing Architecture: Bio-signals are used in the medical field to assess the environment. This technology is used for the better detection, diagnosis, and treatment of many life-threatening diseases. Figure 2 will explain the signal processing flow. The steps include selecting the dependent variables, analysis, type of sensor that needs to be used, observing input signal, collecting the data, and visualizing. Finally, we can analyze the input using technical and efficient algorithms to classify, predict, and find a correlation or covariance, etc.

The data have been collected from various types of biosensor wearable devices. Different types of Bio-signals are recorded through these devices and stored on the device. The simulator/application use dynamic data that can be updated on the cloud. The data storage format can be in different modes, but we preprocess the data and perform different analytics or statistical approaches. The

processed data are sent to the application engine to apply AI concepts and the results are extracted. The generated reports are viewed over different report generation tools such as data visualize, tabular tool, mat plots, etc. The notification is generated on the event generator, effectors are reacted to the environment, and agents perform assertion.



**Figure 2.** Architecture diagrams of bio-signals processing environment.

*Basic Concepts and Applications in the Medical Industry*

AI has taken the lead over the biomedical discipline in the detection of various diseases. Accurate identification of medical and health complications can be completed. The most common approaches in medical imaging are used for preliminary suspects and investigation. This method will process images with

the help of different AI techniques and as per the observations made concerning the applications, results are found. A three-dimensional brain MRI scan is used to create a three-dimensional image view of the brain to detect lesions and find any faults that exist on the tissue (such as tissue stiffing, infection on tissue, nerve damage, etc.). The segmentation of lesions using the concept analysis will observe images of the white and gray matter and cerebrospinal fluid. It computes the feature using SVM, where lesions exist only in white matter, and the result was observed that there is an increase in performance in compression with previous methods. Sensitivity is 99%, specificity is 80% and accuracy is 99% [14].

Medical Imaging is a highly active field of research in the biomedical industry. AI algorithms are used to process digital images and classify various diseases. In a previous study, 80 MRI images were referred from the Harvard Medical School database. The study was on various methods to classify diseases such as Pick's, Huntington's, cerebral calcinosis, and Alzheimer's using Otsu's thresholding. We use Euclidean distance methods to analyze the clusters of classes with the histogram binning approach. The similarity can be measured using a base of Euclidean distance value. The classifications of classes are carried out using the binary threshold method and dendrograms [15].

Bio-signals are used in various applications using intelligent devices such as the electrocardiogram (ECG). This ECG can have low power consumption and low data loss features. It can not only work with low-energy wireless communication protocols, but also use a smart phone for the display of ECG output. ECG is used for synthetic waveform, which monitors the heart behavior, such as excitement assessment, recovery rate, etc. The author's latest intelligent proposal is that an ECG waveform is given as input, and with the help of ADS, we convert an analog signal to a digital signal. MSP is used for data processing, BLE is used for transmission, and data are collected on a smart phone using Bluetooth technology. The results obtained in the above process

are that the loss rate of ECG packets has reduced from 13.26% to 0.63% and no packet transmission over time has risen from 98 to 633 packets with the new intelligent ECG system [16].

Vital signals are important parameters to check the basic health profile of the subject, which includes blood pressure, blood oxygen, respiration rate, and temperature and pulse rate being the basic biomarkers to check the fitness of a subject. Electrodes and pulse sensors are used to sense the ECG signals, pulse rate, humidity and temperature. This information is sent to an app, web browser or the local web browser [17].

Bio-signals are used in electrocardiogram (ECG) for cardiology examination used for heart regularization. It helps us to find out the damage in the heart and the size and location of holes in the heart. These signals may have noise issues, or they have unacceptable ECG waveforms for the investigation process. Deep learning methods are used to classify the ECG waveform as acceptable or not. Four conventional neural networks are used to be defined with a different number of layers, kernels, learning rate, etc., in architecture models. The results in the above models with a cutoff value of 0.05 have an 88% success rate in the detection of unaccepted ECG waveforms [18]. Takumi Toya *et.al.* [19] use a 12-lead ECG in the medical area of peripheral micro vascular endothelial function for an index of vascular ageing. An AI algorithm is trained to estimate age and sex, determining age and chronological age ( $\Delta$  age). Additionally, the hazard ratio was 4.72; 95% CI, 1.24–17.91;  $p = 0.02$ .  $\Delta$  age was significantly associated with an increased risk.

Electroencephalogram (EEG) is a bio-signal used to observe brain activity by attaching a small disc of electrodes to the scalp of the head. The brain cells communicate with an outside monitoring system using electrical impulses at all times, even while sleeping. This examination is used to know the patterns of the brain and test any head injuries, tumors, dizziness, seizures, and sleeping disorders. EEG investigation will not have any side effects. EEG bio-signal



methods will assess the sleep stage scoring, seizure detection, mental workload, and emotional detection. The motor imaginary movement method will find the movement of the tongue/limbs. CNN architecture was designed as an efficient method in comparison with LSTM and RNN networks. EEG data are used to measure mental stress and complexity task performance. The SAE model with new architecture is doing well in comparison with other models. Sleeping stages are stage 1, 2, 3, and 4 [20].

Tremors and epileptic seizures are disorders of the neural system. Early diagnosis always helps in giving better treatment and results. EEG signal capture will help to monitor the functionality of the brain. This author uses the Bonn dataset; the Tunable Q wavelet transform (TQWT) method preprocesses the EEG signal. The feature extraction is performed using fuzzy entropy methods, feature reduction is used in auto encoders, and classifications are performed using fuzzy and non-fuzzy algorithms, ANFIS-BS, able to achieve an accuracy of 99.79% [21].

Electroencephalogram (EEG) bio-signals are used in real-time applications to know whether a person addresses questions with positive or negative mental pressure. The analysis of mental pressure helps us to know the facts of problem solving. This approach uses unsupervised learning in the classification of the classes. The preprocessing of EEG signals is performed based on the division of data, and feature selections are applied. The classification of the obtained dataset is applied. Feature selection is obtained using forward greedy attribute selection and gain ratio feature selection methods. Clustering analysis is conducted using two approaches; one is personal data analysis and the other is channel data analysis. The survey gives solutions for two problems. One of the most effective features is classification, and extra knowledge is used to classify the classes [22]. Another application is predicting children's grade failures using an ML model, which is used to classify (KNN algo) based on three variables, and the results showed that poor performance in math is 55% and

language is 74%.

Electromyography (EMG) is a bio-signal used to examine if the muscles respond to the nervous system properly or not. It helps in the detection of diseases, disorders, neural problems, or damages in the neural system. The various diseases used to detect using EMG include nerve injuries, degenerative conditions of the nerve. The procedure for the EMG test will use a needle electrode inserted into the muscles, which is used to record the muscles' functionality. EMG examination is carried out in COVID-19 patients after detecting negatives to discover any blocks in the nervous system and to check whether they have been exposed to fatigue, dizziness, calf cramping, or exhaustion under stress. This study was a study of three COVID-19 patients kept under observation with mild health issues. Cases 1 and 2 could tolerate but case 3 was not able to tolerate the needle electrodes in the muscles. The result of the EMG examination was able to find an inference pattern. Case 1 and case 2 were able to perform due to the short duration, low amplitude of motor unit action potential, and myalgia. In case 3, the EMG test was unable to be performed due to muscle pain while going through the procedure [23].

Hand recognition and gesture recognition are more challenging, especially in contactless health treatments such as for COVID-19. Contactless treatment, service in the hospital and quarantine need some actions for basic needs and response to the doctors. Some gestures, such as feeling good or require something, can be standardized by the hospital. EMG signals are used to recognize the gestures of hands or fingers. Electrodes are fixed to the hand, wrist and fingers. The time division features are extracted and machine algorithms are used for the classification of type of gesture. An ANN-based classifier achieved 0.940 accuracy [24].

Tele rehabilitation is a traditional treatment that will be used to monitor the muscular activities of the patients and the effectiveness of home exercise. This application is most effective in physiotherapist treatments. The electromyography

biofeedback system device helps to monitor the patients at remote places. It helps to monitor muscular activity after injuries and major surgeries. AI is added to support the medical industry with technology. This device has five module roles Module1: accept the input through EMG electrodes for sensors; Module2: biofeedback device gadgets are designed along with two mobile phones with designed applications, and Modules 3,4, and 5 are used to implement a check of EMG signal [25].

Electroencephalograms (EEG) are used in the medical industry to identify disorders and changes in behavior and to monitor the activity of the brain. It is observed generally in liver transplant and heart transplant patients. EEG is an examination performed through an external metal disc attached to the scalp. It has no side effects. EEG is also used to authenticate a person's identity. There are many biometric methods used to identity authentication, such as DNA, face reorganization, fingerprint, hand geometry, typing rhythm, and voice. In biometric reorganization, many considerations should be satisfied; for example, every person should have distinct characteristics, invariant over time, and this should be measurable. This examination has three stages of study. Stage one—we perform four tasks: person to relax, close eyes, and be still. The next task is to take the observation of limb movement activity without moving the limbs. Another task is to generate finger rotation activity. The next stage is feature extraction and finally, classification rules are applied using a support vector machine algorithm to calculate the false acceptance rate and false rejection rate, and 100% accuracy has been improved using the voting rule [26].

AI is used to classify the EEG collected data for application in very short-term memory assessment. Short-term memory can remember the small visual details of an image or picture at one sight. Some details include color, shape, location, and characteristics of the image. Short-term memory has two limitations: capacity of memory and time limit. The brain will see, observe and try to store in the memory. This experiment was conducted with 12 patients showing two images,

A and B. Later, we asked a few questions and calculated the order of display image, type of the image, and correctness of the answer, and classification was obtained using four methods of AI, which are SVM, KNN, Navi Bayesian, and Random Forest. The classification result declares that 90.12% of correct answers in the orders of the image shown are drawn from the persons. A total of 90.51% of emotional people can answer the time and type questions correctly [27].

Electrooculography (EOG) is a bio-signal used to observe eye movements and to record the cornea–retina potential difference. The electrodes are placed above and below the right side or left side of the eyes. Of two electrodes, one is positive and another one is negative. The eyes will move to either side, and we can record the position of potential difference between the electrodes. The real-time applications are implemented to guide wheelchair patients and HCI applications for people who suffer from brainstem strokes, injuries to the brain and spine, etc. The spectrum of studies is carried out on EOG bio-signals in medical areas such as cranial nerves (CN) to record the positive and negative waveforms. In this study, 18 patients who had brain surgery have kept practicing this technology [28].

Mechanical devices such as wheel chair, mechanical arms, aerial vehicles, and toys cars are controlled by neuroscience. The real-time bio-signals (EEG) of the human brain are recorded. These signals are processed on a Raspberry Pi3 circuit board. The open-source code used to process the signals include brain flow, sLORETA and TAPEEG. The artificial intelligence and machine learning are used to control the robots [29].

### **Data Sources**

Data sources are taken from critical health issues. The eICU Research Institute maintains a collaborated database of patients [30]. It has a two-year track record of 2014 and 2015. It maintains the patient's history, ICU data and lab examination details. The database contains patient details such as name, gender, joining date, discharge date, weight of patient at joining and discharge, patient status, etc., which are stored in tables. These data are used to analyze

patient care. Munich Bio-voice corpus is used to record the voice of the human and record their pulse and project the complete treatment. Bio-signals including pulse and voice recording analyze the data and predict the heart rate. The project works in two phases. Phase 1 uses regression and classification, and Phase 2 uses a diffusion map for feature extraction. The AUMC (Ajou University Medical Center) is used to record the ECG bio-signal details of patients and apply transfer learning for classification. We evaluate performance using mean squared error [31]. VitalDB consists of the example dataset containing bio-signal data. The EEG dataset is stored in a csv file in the public domain and contains almost 30 attribute values such as ECG, number of days in ICU, weight, gender values, etc. A Convolution Neural Network is used to classify and predict the mortality rate.

### **Methods in Artificial Intelligence and Machine Learning**

Algorithms are used to achieve the targeted task in a step-by-step process. The Computer Science industry has taken the world to the next level by improvising their thinking and introducing AI algorithms, which have advanced features such as supporting large and complex data as input and fast execution, and an intelligent factor of these algorithms is that it can make decisions. The major concept of AI is to build the concept to make the machine think as humans do in decision making or behavior, and machine learning is a concept to learn from traditional and current data. It maintains a training dataset and makes a decision based on the historical dataset. AI algorithms are designed for different purposes, such as classification of data, regression analysis, and clustering of data [36,37].

### **AI Classification Algorithms**

The classification of data is used to segregate data based on some common

factors. Data can be of a structured or unstructured format [38]. Classification algorithms are used to build the model and to train the data into labeled classes. The trained model will help in predicting to which class the new entry belongs with respect to training the model. Classification can be binary, multiclass, or multilabel [39,40].

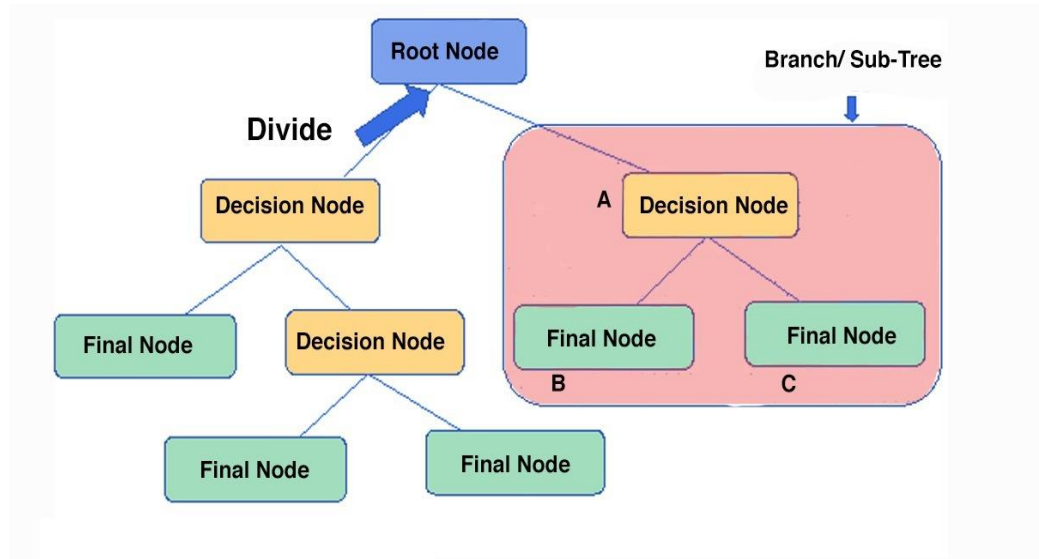
### **Navi Bayes (NAB) Classifier Algorithm**

This is one of the most popular algorithms used for the supervised learning approach and it is based on the Bayes theorem, which helps in handling classification problems in data partition [41]. It will build the most efficient machine learning model to predict correctly based on the training model. Most population applications built using the NAB algorithm are email filtering, text analysis, and research data. NAB is based on Bayes law and is used to determine the posterior probability.

### **Tree Algorithm (DTA)**

The approach used to help the statistical approach to decide on information and available data exists in the system. Classification has a learning phase and predication phase in machine learning. DTA is a supervised learning algorithm that can solve classification

and regression problems. The attribute is arranged into a tree-like structure from the parent node to child nodes till it reaches conclusion leaf nodes. The general tree classification structure is shown in Figure 3. Decision trees are of two types: categorical variable decision tree and continuous variable decision tree. Categorical values have only one dependency variable, but continuous variable has more than one dependency variable. Some algorithms are designed based on the decision tree concept. Algorithms are Chi-square automatic interaction detection and perform multi-level splits when computing classification trees, ID3, C4.5, CART, and MARS [56].



**Figure 3.** Model Diagram for Decision Tree Algorithm.

Let us consider a dataset that has N-variables, and we need to decide the attribute to be placed in the root node and internal nodes. Another possibility is to arrange the nodes randomly. It was proven that results are very low in this possibility in terms of accuracy. Some calculations are performed to calculate information gain, Chi-square, reduction in variance, entropy, gain ratio, and Gini Index. The maximum attribute values are placed on the root node and other attributes are placed on different sub-levels in ascending order [57]. Random Forest Algorithm (RFA)

This approach worked with the supervised learning technique. It is used for regression and classification problems in machine learning. It is a group of

leanings combined, and very complex problems are solved with multiple classifiers and the current problem is improved. In the random forest, there are multiple decision trees and we take the average and predict the accuracy. Random forest is most efficient for a large range of data items flowing into the decision tree [58]. We can eliminate the over fitting problem because we go for averaging values. The algorithm selects random samples from the dataset, a decision tree constructed for every training case, and predicts the results. The obtained results are obtained by the greatest possible value. This algorithm is also used for anomaly detection in the network. Random forests are frequently used for “black box” models in business models [59], and a sample general model is shown in Figure 4.

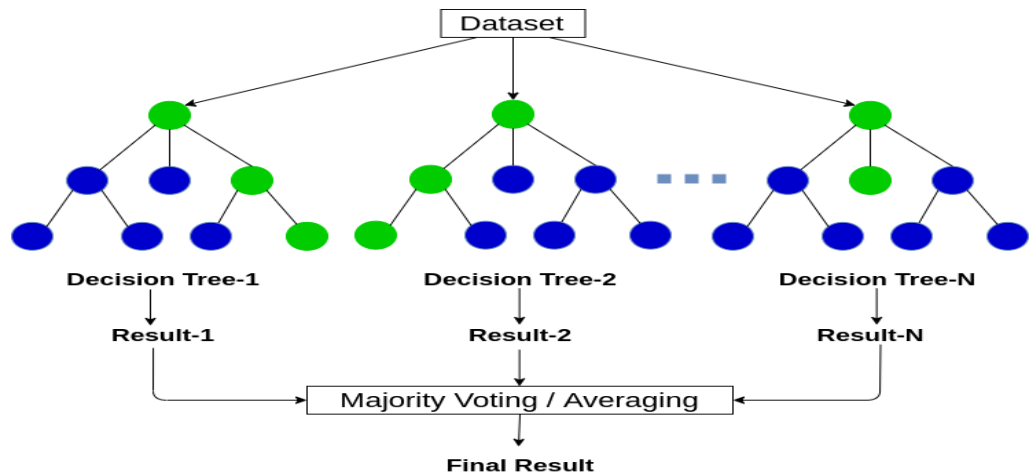


Figure 4. Random forest model algorithms.

### Support Vector Machine (SVM)

This approach is a simple approach to solving the problem in the minimum



number of steps. It helps to solve problems using classification and regression methods. It is the most frequently used for classification problems. SVM uses the N-hyper planes for defining N-features, which help to classify the data points. The separation of data points can be maximum minimum margins and a graph is shown in Figure 5. The support vector data points lie near the hyper planes, and finally, the gap between hyper planes is used to maximize and classify [60]. If the support vector data points are deleted, there is a possibility of changing the direction of the hyper plane. Hyper planes are named as positive hyper plane or negative hyper plane concerning the dividing margin based on the threshold function or cost function, and a graph of the hyper plane is shown in Figure 5. If the output of the squash function is less than the threshold, then it is a negative region, and if it is more than the threshold value, then it falls in the positive region. In a logistic regression problem, we obtain output from the linear function and sigmoid function. If the squash values are less than the threshold, then they are named as a class of zero, and those greater than the threshold are named as class one. SVM applications help in various medical industries in the classification of genes; their behavior is a specific disease and regression helps in the prediction of the future possibility of the disease [61].

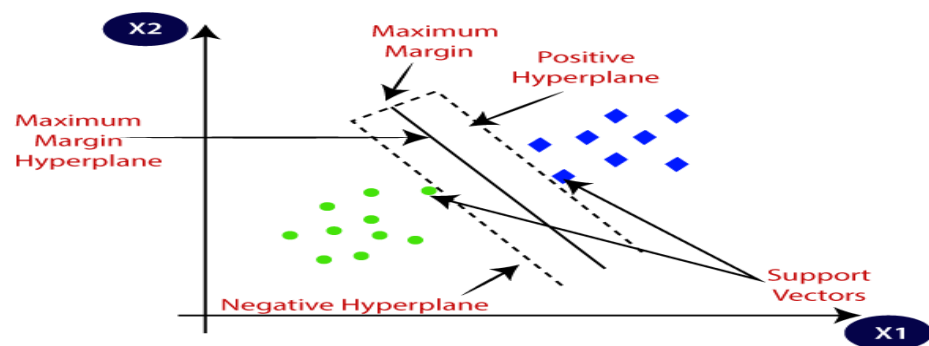
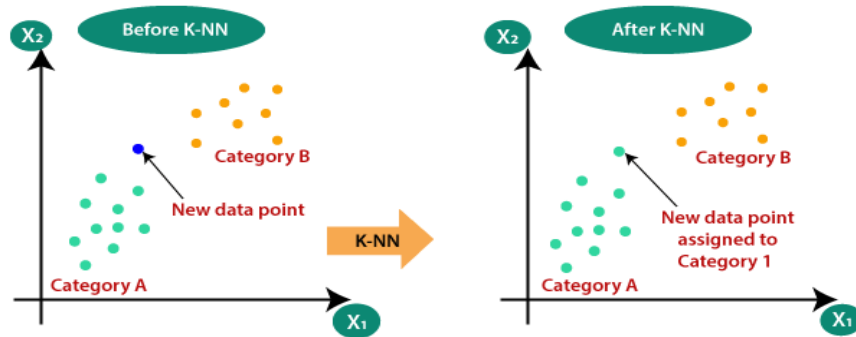


Figure 5. Support vector machine algorithm.

### K-Nearest Neighbor Algorithm

KNN is also used to solve the classification and regression problem. This algorithm uses the supervised learning approach to train the application model. It is widely used to solve a problem such as prediction based on some feature learning [62]. It will classify the new-arrival case study with existing cases or find similarities among the available data classes. KNN has a lazy learner and a non-parametric algorithm as properties. Initially, it will not refer to the training set as a reference study. First, it will store it as a dataset, and then it will classify it later. Once the dataset is stored, it will then classify it as per the similarity among the class labels. A generalized graph is shown in Figure 6 [63].



**Figure 6.** KNN machine learning algorithm.

### Logistic Regression Algorithm

A regression algorithm is used to correlate the data points and to classify the data point into a set of classes. The medical applications for regression analysis for tumor characteristic analysis and classification is benign or malignant. Multi-linear

classifications are used for stage detection of cancer. A linear regression function is used to predict hemoglobin deficiency or blood pressure based on age, weight, gender, etc. Lasso regression methods are used for predicting neonatal sepsis, radiological characteristics, and bipolar disorder [64]. Logistic regression is used to monitor health condition and improve healthy habits on feature selection based on the target set [65]. A multivariate regression algorithm is used to predict disease diagnosis based on the hidden rules in the medical area using clustering,DT, association rules, etc. [66].

### **AI Clustering Algorithm**

The clustering algorithms are used to group the data based on similar patterns and the groups are created based on some specific criteria. The criteria are selected based on the priority and on the behavior of the data and future requirements for deep analysis. The clustering approach is an unsupervised classification of data into self-defined groups. Clustering will not predict any class, but it helps to classify the data. The outcome of clustering will result in knowledge discovery and help to frame the dynamic inferences from the results. The statistical calculations will find the similarities and dissimilarities among the data points to segregate the data into desired cluster groups. Python language will implement clustering algorithms using the Scikit-Learn package.

### **Latest Trends in Bio-Signal Application in the Medical Industry**

The latest medical applications are using bio-signals for speech rehabilitation. Bio- signals can capture the air vibrations below the audible speaking mode. The speech can be captured using articulator, respiratory and laryngeal activities, brain activities, acoustic activity, and muscle activity, and are observed by bio-signals. The speech can be converted into artificial voice or text. Non-contact sensors are used to capture the image to predict the human facial expression and human observations on objects. Bio-signals help us to observe the emotions of a person while answering in the house of judgment. Another application health checkup needs to be

performed for pilots before they take a flight for flying. Clinical observations were performed to check for drug and alcohol use and check for depression or anxiety. The near-field communication is very important for sending children to field trips, forest tracking, missing ships, missing flights and searching for people in a dense forest.

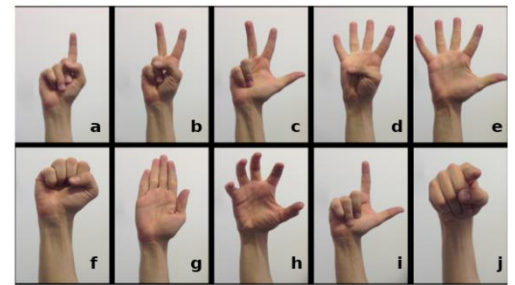
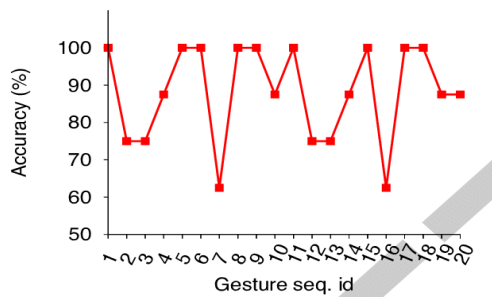
### **Challenges in Bio-Signals**

Medical applications are designed with technology to detect the expected scenarios, monitor the human health system, and predict life hazards; brain readings, etc., are some of the generalized challenges in the medical industry. There is also usage of wheel sensors, inclinometers, voltage meters, gyroscopes, and torque sensors in the feedback process between the nervous system and the human body parts. These sensors help to find any biological changes that occur in the human brain and find how they are received and reflected in terms of behavioral changes. Medical applications need to be developed to correlate the sensors with human brain connectivity. COVID-19 has changed human lives and style of living, and global awareness has changed the mindsets, behavior and the utilization of devices or resources in people. Using hepatic technology, we can eliminate human touch over resources and devices such as ATMs, lifts, etc. Another challenge in the COVID-19 pandemic is maintaining social distancing and creating an alarm system to give information to the police if social distancing is not maintained in a crowded area such as schools, colleges, parks, cinemas halls, etc., using a passive infrared (PIR) sensor with the geo tagging association. Doctors are facing medical challenges in treating COVID-19 patients; patients are isolated in a room and doctors and medical staff only visit patients for rotating checkups and emergency needs. COVID-19 patients are emotionally and mentally stressed and biofeedback monitoring is needed.

### **Summary and Results**

Bio-signals are used to predict the activities of the patient and detect disease.

The datasets available for different types of bio-signals to acquire and signal are processed using various AI approaches to classify and cluster. Regression analysis and learning algorithms are used to improve the efficiency and accuracy of the applications. Gesture recognition is an application to identify the need of the patients in the ICU. Different algorithm accuracies are reflected in the graph as shown in Figure 7a,b, which show the sample gestures. Surface electromyogram (EMG) signals were used and, they recorded the activity of the muscle. One medical application is for patients in the ICU that were physically disabled, and another application studied is the emotion of a person.

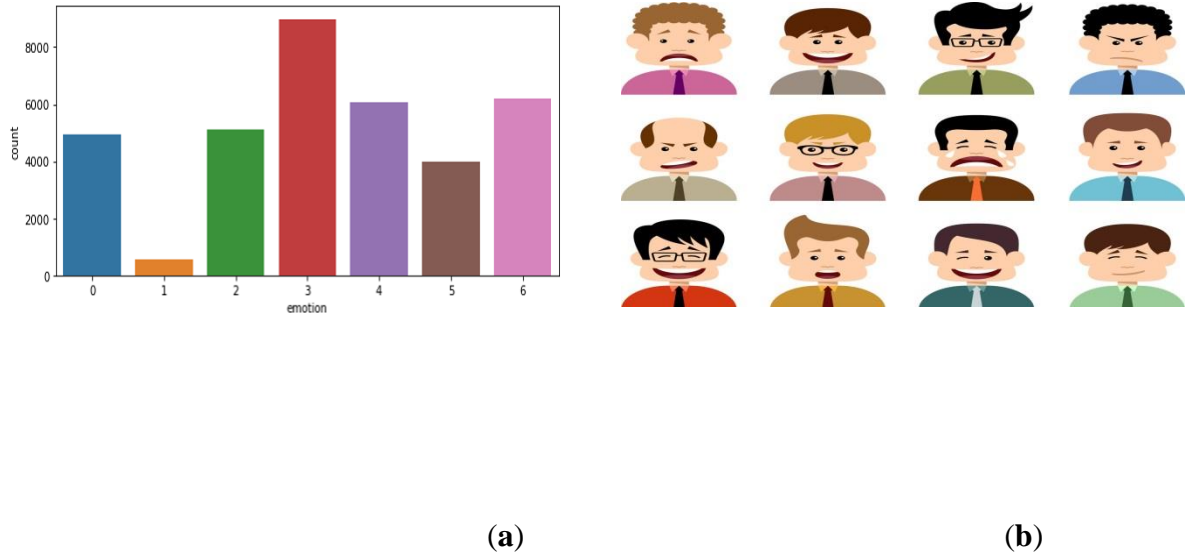


(a)

(b)

**Figure 7.** (a) Accuracy of gesture recognition, (b) hand gestures, reprinted with permission from [85].

. The sample face expressions are shown in Figure 8b and graphical accuracy is shown in Figure 8a.



**Figure 8.** (a) Emotion of a person accuracy, (b) emotion of a person.

### Conclusions and Future Scope

Smart devices and wearable gadgets are embedded with bio-signals in the smart health care system. Some chronic diseases are not treatable and are only manageable. The smart health care system will help to monitor health changes and warn of a threat approaching. A smart device with the latest technology implementation success rate is not comparable with the old traditional system. The future scope is for the smart health care system to have wireless devices that will monitor the health of patients, and cloud data help to analyze the behavior of the medications and the recovery rate.

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**MEDICINAL PLANTS: A MINI  
REVIEW**

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**INTRODUCTION**

The term medicinal plants include various sorts of plants utilized in herbalism and a few of those plants have some medicinal activities. Medicinal plants are the "backbone" of traditional medicine, which suggests quite 3.3 billion people within the less developed countries consume medicinal plants on a day to day. [1] Medicinal plants are the rich resources of ingredients which will be utilized in the event and synthesis of medicine. Further that these plants play a crucial role within the expansion of human cultures round the whole world. India features a rich diversity of plant species in an in depth sort of ecosystems. Around 17,000 species of upper plants, of which approximately 8,000 species are considered medicinal which are employed by village tribal communities like the Ayurveda. Most of the developing countries are using traditional medicine and medicinal plant, as a basis for the upkeep of excellent health, which has been keenly observed by UNESCO, 1996 [2]. Besides, increasing dependence on the utilization of medicinal plants within the developed societies has been drawn to the extraction and progress of some drugs and chemotherapeutics from these plants also as from traditionally used rural herbal remedies [3].

During the past decade, traditional systems of drugs became a topic of worldwide

importance. Present evaluations suggest that, in many rising countries, an outsized section of the population depends on traditional practitioners and medicinal plants to satisfy the requirements of primary health care. Though modern medicines are available in these countries, herbal medicines (phytomedicines) have frequently maintained approval for historical and cultural reasons. Raw materials of medicinal plants often used because the extraction of dynamic elements that are utilized in the synthesis of various drugs. As within the case of laxatives, blood thinners, antibiotics, and anti-malarial medicines, all contain ingredients from plants. Moreover the active ingredients of Taxol, vincristine, and morphine isolated from periwinkle, yew, and opium respectively.

As defined by WHO, health may be a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity. Medicinal plants can make a crucial influence on the WHO goal to make sure, by the year 2000, that each one peoples, worldwide, will lead a sustainable socio-economic productive life [4]. The practice of traditional medicine is prevalent in China, India, Japan, Pakistan, Sri Lanka, and Thailand. In China, about 40% of the entire medicinal consumption is endorsed to traditional tribal medicines. Extracts of the plant, commonly referred to as endod, are used as an efficient molluscicide to regulate schistosomiasis [5]. Other important examples are periwinkle, which produces anti-tumor agents like vinblastine and vincristine; and castor-oil plant, which yields the laxative--castor oil.

Medicinal herbs, possessing penile strength properties and anti-cancer principles are the stress of smuggling to import markets in Germany, France, Switzerland, Japan, the U.K., and the U.S.A. The best-known example, in recent times is *Nothadoytesfoetida*. Ordinarily found in southern India and Sri Lanka, the herb is exploited as a source of anti-cancer drugs. Medicinal plants are an integral element of research developments within the pharmaceutical industry. Such research emphasizes the isolation and direct use of active medicinal constituents, or on the event of semi-synthetic drugs, or still again on the active screening of natural products to yield synthetic pharmacologically-active

compounds. The world marketplace for plant-derived chemicals – pharmaceuticals, fragrances, and color ingredients, alone exceeds several billion dollars per annum. Classic samples of phytochemicals in biology and medicine include taxol, colchicine, vincristine, vinblastine. In Germany, over 1500 plant species come across in some 200 families and 800 genera are processed into medicinal products. Today, Bulgaria, Germany, and Poland are recognized as major exporters of plant-based medicinal products [6]. The development and commercialization of medicinal plant-based industries within the rising countries are reliant upon the supply of amenities and knowledge regarding upstream and downstream bioprocessing, extraction, purification, and marketing of the economic potential of medicinal plants. Additionally, the absence of modernized socio-economic and public healthcare systems emphasizes reliance on rural and lower-income urban populations on the usage of traditional medicinal herbs and plants as corresponding aids to routine pharmaceutical market products. Modern evaluations suggest that over 9,000 plants have known medicinal applications in various countries, and this is frequently without having conducted comprehensive research amongst several indigenous and other communities [7].

### **FUTURE OF MEDICINAL PLANTS**

Medicinal plants have a capable future because there are nearly half million plants around the world, and most of the plants medicinal activities haven't been investigated yet, and their medical activities might be decisive ingredients that interact simultaneously, so their uses can damage or supplement others or nullify their possible negative effects. Support of official medicine- within the treatment of complex cases like cancer diseases the components of the plants proved to be very vigorous. Preventive medicine- It's been proven that the constituent of the plants also characterized by their ability to halt the appearance of some diseases. This may help to reduce the utilization of the chemical remedies which can be used when the disease is already present [6].

**Table 1.** Some medicinal plants of central India having good antioxidant potential (Krishnaiah et al. 2011) [9]

S. N o.	Name of plant	Part studied	Active component (s)
1.	<i>Acorus calamus</i>	Rhizome	Alkaloids
2.	<i>Aegle marmelos</i>	Leaves	Alkaloids, Terpenoids, Saponins
3.	<i>Aloe vera</i>	Leaf	Vitamin A,C,E, Carotenoids
4.	<i>Andrographis paniculata</i>	Whole plant	Diterpenes , Lactones,

#### Significance of medicinal plant to humans:

Medicinal plants have played an important role within the development of human culture, for instance religions and different ceremonies. Many of the fashionable medicines are produced indirectly from medicinal plants, for instance, aspirin. Many food crops have medicinal effects, for instance, garlic. Medicinal plants are resources of latest drugs. It's estimated there are quite 250, 000 flower plant species. Studying medicinal plants helps to know plant toxicity and protect humans and animals from natural poisons. Cultivation and preservation of medicinal plants protect biological diversity, for instance , metabolic engineering of plants. The medicinal effects of plants are thanks to metabolites especially secondary compounds produced by plant species. Plant metabolites include: primary metabolites and secondary metabolites.

Phytotherapy is the use of plants or plant abstracts for medicinal purposes (especially plants that aren't a part of the traditional diet). Phytochemistry is that the study of phytochemicals produced in plants, describing the isolation, purification, identification, and structure of an outsized number of secondary metabolic compounds found in plants.

- Thin layer chromatography (TLC)
- Gel (column) chromatography)
- High performance of liquid chromatography(HPLC)
- Gas chromatography (GC)
- Mass spectrometry
- Nuclear magnetic resonance

### **Plant primary metabolites**

Organic compounds produced within the Plantae have metabolic functions essential for plant growth and development produced in every plant. Include carbohydrates, amino acids, nucleotides, fatty acids, steroids and lipids.

### **Plant secondary metabolites**

Organic compounds produced in Plantae don't have apparent functions involved in plant growth and development. Produced in several plant families, in specific groups of plant families or in specific tissues, cells or developmental stages throughout plant development. Include terpenoids, special nitrogen metabolite (including, on-protein amino acids, amines, cyanogenic glycosides, glucosinolates, and alkaloids), and phenolics [11].

### **CONCLUSION**

Recent and renewed interest in medicinal plants coupled to developments in information technology has fuelled an explosion within the range and content of electronic information concerning medicinal plants as a re-emergent health aid [12]. Recently reviewed diverse sources of such information in traditional abstracting services also as during a sort of online electronic databases. As a results of such developments, access to indigenous peoples and cultures concerning medicinal plants is greatly facilitated. Furthermore, the

active participation of such natural custodians and practitioners of valuable knowledge is guaranteed within the generation of research that specialize in screening programmers handling the isolation of bioactive principles and therefore the development of latest drugs [13].

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**Review on Biomedical Applications of Marine Algae-Derived Biomaterials**

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**Introduction**

Marine algae are virtuous bases of nutrient food sources and bioactive secondary metabolites used in the pharmaceutical industry, biomedical field and also have valuable outcomes on human health. Commonly marine algae are grown in salty or brackish water, sunlight and rocky places rather than sand shingle shores or in a littoral zone. Among all marine flora and fauna, algae are the fastest-growing organisms on Earth and can grow in tropical, cold-temperate, and Polar Regions. In general, marine algae are divided into two categories; the 1<sup>st</sup> one is microalgae, which consist of dinoflagellates, blue-green algae, bacillariophyte, diatoms and the other is macroalgae (seaweeds), which contains green, brown, and red algae. Microalgae have potency to produced extremely high quantity of biomaterials that are used in biomedical fields. Nonetheless, red algae and their derived compounds have stronger biological activity than other algae while seaweeds are the source of human food and gums. The Phycocolloides as like agar-agar, alginic acid and carrageenan are major components of red and brown algae cell walls which are mostly used in pharmaceutical field [1]. The algae are available in both microscopic and macroscopic forms. The green microalgae are the largest group among all marine algae, distributed under Phylum Chlorophyta. The green microalgae like *Spirulina*, *Arthrospira Platensis*, *Chlorella pyrenoidosa*,

*Chlamydomonas reinhardtii*, *Cyanobacterium*, and green motile algae are used as therapeutic drugs to treat various health issues and chronic diseases. The algae have a wide range of biologically active molecules with antimicrobial, antiviral, antifungal, antiallergic, anti-coagulant, anti-cancer, anti-fouling, anti-Inflammatory, and antioxidant properties [2]. The derivative compounds from marine algae replace the synthetic chemicals in drugs as these are seen more in peptides, amino acids, lipids, fatty acids, vitamins and minerals. Earlier reports suggested that the molecules like tannins, flavonoids, phenolic acid, bromophenols, and carotenoids are widely used in pharmaceuticals, cosmetics, and medical fields [3]. The phycoerythrobilin pigments found in red algae are used during the treatment of anti-inflammatory, neurodegenerative, gastric ulcers as well as cancer patients. It has also been used in various food and cosmetic industry [4]. In addition to, the marine algae-derived natural products protect cells by regulating the oxidative stress because it plays a crucial role in inflammatory, carcinogenic reactions. The algal-derived compounds are commonly natural products those have potential to use for anti-cancer and anti-inflammatory drugs. Some marine blue-green algae have cytotoxicity and immunosuppressive activity while red, brown algae also show photoprotective activity. Moreover, the cell wall of marine algae is composed of sulfated polysaccharides such as alginate, carrageenan, ulvan, fucoidan respectively. The algal-derived polysaccharides are biocompatible, multi-functional, therapeutical, promising bioactive material with a wide range of biomedical applications. Entry into pharmaceutical and cosmeceutical markets, the algae-based bioactivities seem to show a prominent future. Commercially, algae-based different bioactive products are widely used due to its efficacy and cost-effectivity but extraction methods need to be developed at the standardization level. Although, new technology is required for algae cultivation to achieve higher productivity and bioactive compounds. Moreover, different conventional procedures are used for breeding of algal strains for bioactive production which is not efficient. But the genetic transformation of algae is enhanced the production of biomaterials. Different biological investigations found that there is no clear evidence about bioactive compounds in algae also seen a lack of

information on genomics and mechanism of gene regulations [5]. So that some major constitutions and limitations are hindering the development of algal research on biomedical applications. So it is necessary to do long-term research and confirm about it. In contrast, algae-based bioactive used in dermatology and cosmetic field, the accurate results to be known when it is sold in market and tested by people. From this review we explored the application of biomaterials and metabolites from various algae which are commonly used in pharmaceutical and biomedical fields [6].

### **Methodology**

A basic and thorough overview of the literature surveyed to identify the biomedical applications of Marine algae-derived biomaterial was conducted till 2021. Many offline and online databases were taken into consideration. The review articles and research papers published by various reputed publishers such as Elsevier, Springer, and Taylor & Francis imprints, Hindawi were considered as the data collection primary resource for this review article. Some online databases including NCBI, PubMed, Google Scholar, ProQuest, Scopus, and EBSCO were also accessed using keywords relating to the topic for data mining. The paid articles were accessed through the Centre Library facility of Siksha O Anusandhan University. The conference proceedings, magazines, WebPages, and book chapters were also reviewed and accessed as the other sources of literature to maximize the information about the current bottlenecks, the extent of research carried out, and the potential utility of the topic. In this review, we discussed about various bioactive materials of different marine algae. The current updates of marine algae-derived biomaterial are the main highlight of this review which will create a deep insight among the researchers about the updates and future research about the field of Marine Biotechnology.

### **Nutritional Activity**

The *Chlorella Vulgaris* (Chlorella) green algae from the phylum Chlorophyta contain protein approximately 50%-60% of its body weight. It is popular as a food

supplement and widely used in the food industry due to its richness in protein and other essential amino acid. It also contains nutrients like  $\beta$ -1,3-glucan,  $\beta$ -carotene, vitamins B-complex and useful minerals like  $K^+$ ,  $Na^+$ ,  $Mg^{+2}$ ,  $Fe$ , and  $Ca^{+2}$ . Most importantly a nucleoprotein found in *Chlorella Vulgaris* is used as a growth factor and tissue repairing. Similarly, various other bioactive molecules found in marine algae are alginate in *Eisenia Bicycles* and *Macrocystis Pyrifera*; Agar in *Gelidiella Acerosa*; Retinol, Thiamine, Riboflavin, pyridoxine, B8, Folic Acid, Cobalamin, C, E in *Spirulina Platensis*; Vitamin C in *Undaria Pinnatifida* and *Porphyra umbilicalis*; Vitamin E in *Nannochloropsis Oculate*; Vitamin A, B1, B2, B12 and C in *Senedesmus Quadricauda*; and Vitamin A, B1, B2, B6, B8 in *Chlorella Pyrenoidosa* [7]. Other side seen that, microalgae can produce polyunsaturated fatty acids with multiple double bonds (PUFAs) as *Phaeodactylum*, *Monodus*, *Nitzchia*, and *Isocrysis* have been used to produce PUFAs while *Cryptocodinium*, *Nannochloropsis*, and other algal species used in the food manufacturing industry[8].

Marine algae are commonly used in food industries to improve the quality of food products. In addition, algae are used in different meat products as pasty, steaks, frankfurters, sausages, and also used in fish foodstuffs, and oils for long-term storage. The algae are also used in cereal or crops, as pasta, flour, and bread. Although, algae are used for the fermentation of foods as cheese, cream, milk desserts, yogurt, cottage cheese, and processed cheese. The algae such as *Enteromorpha Himanthalia elongata*, *Undaria pinnatifida*, and *porphyra umbilicalis* have potency to maintain the anti-oxidant activity of meat and cereal products. Meat and its derived products are rich in proteins and vitamins but sometimes seen that lack of dietary fiber and an excess amount of sodium in meat, which can cause serious health hazards for humans [9]. The addition of algae Sea Spaghetti (*Halomonas elongata*), Wakame (*Undaria pinnatifida*), and Nori (*Porphyra umbilicalis*) in meat can increase K, Ca, Mg, Mn and decrease salt content including fat and water binding properties. In addition, bread is a cereal-based product, to improve its quality green algae *Ulva lactuca*, and 2.5% of powdered *Laminaria* algae were added. Pasta is also a

cereal-based product that has low protein and essential amino acids so high-protein additives are required to improve the quality of pasta. Studied that algae *Undaria pinnatifida*, rich in fucoxanthin was used 10% in pasta. In Indian brown algae, *Sargassum marginatum* was used in pasta for improved bio-functionality and quality. In Chinese, egg noodles were made by the addition of green algae *Monostroma nitidum* for better taste [10].

## **Biological Activities of Marine Alga**

### **Anti-Microbial Activity**

Marine algae have strong antibacterial, anti-fungal, and germicidal properties. The methanol extract of *Sargassum Polycystum* has strong antimicrobial activity. The methanol extract algae contained phenolic and alkaloid compounds which show antimicrobial activity [11]. The extract from *Sargassum Polycystum* has potentially inhibited the growth of bacteria like *Escherichia.coli*, *Proteus vulgaris*, *Erwinia caratovora*, and *Klebsiella pneumonia*. Similarly, the extracts from *Sargassum Polycystum* can prohibit the growth of fungi like *Aspergillus niger*, *Rhizopus Stolonifer*. The chloroform and ethanol extract of *Sargassum tenerrimum* has the highest antibacterial activity against *Staphylococcus aureus*. The c-lactone malyngolide 14 was identified from the dichloromethane of the blue-green alga *Lyngbya majuscula* which inhibits *Mycobacterium smegmatis* & *Streptococcus pyogenes*. The Lyengaroside A 60 was identified from the green alga *Codium iyengarii* shows antibacterial activity. The main antimicrobial agent, which acts against the microbes of the blue-green algae is *Lyngbya majuscula* [12].

### **Anti-Oxidant and Anti-Inflammatory Activity**

The carotenoids found in marine algae have antioxidant property which works as an immunity booster, wound healing, and other medical practices. The carotenoids

from various marine algae have specialized health benefits as follows. The carotene isolated from *Dunaliella salina* shows both antioxidant and anti-inflammatory effects. *Haematococcus pluvialis*, *Chlorella zofingiensis*, and *Chlorella vulgaris* all have antioxidant, anti-inflammatory, and anti-tumor properties [13]. The antioxidant and anti-inflammatory activity are seen in zeaxanthin carotenoids that are produced from *Dunaliella salina* and *Porphyridium cruentum* as well as *Chlorella* protothecoids. Lutein has a specialized therapeutic role in age-related muscular degeneration (AMD), Atherosclerosis, retinal and neural damages. Although, *Dunaliella salina*, and *Chlorella protothecoids* derived carotenoids have anti-Oxidant and anti-Inflammatory activity. The lycoporphins A 142 and B 143 were identified from the Caribbean brown alga *Lobophora variegata* (Dictyotales) which has anti-inflammatory activities and also potency inhibitors of tropical PMA-induced edema in the mouse ear. However, the microalgae *Nannochloropsis Gaditana* and *Chlamydomonas debaryana* produce oxylipins, which help to reduce inflammation [14].

### Anti-Cancer Activity

The Violaxanthin that has anti-inflammatory and anti-cancer potency is extracted from *Dunaliella tertiolecta* and *Chlorella ellipsoidea*. Fucoxanthin which is found in *Phaeodactylum tricornutum* has antioxidant, anti-inflammatory as well as anti-cancerous properties. Curacin A 4 was identified from marine Cyanobacterium *Lyngbya majuscula* that is a new type of anticancer drug. The astaxanthin found in green microalgae *Haematococcus Pluvialis*, *Chlorella zofingiensis*, and *Chlamydomonas nivalis* has both anticancer & antioxidant properties. Most importantly the  $\beta$ -carotene found in *Dunaliella salina* has can specifically identify and destroy only neuroblastoma cells while unreflecting normal healthy cells, due to this ability, the *Dunaliella* has great importance in cancer therapy. The fucoxanthin molecules from diatom are also very effective against inflammation, obesity, diabetes, malaria, and treatment of cancer cells by pro-apoptotic process [15].

### **Anti-Diabetic Activity**

The Dieckol molecules isolated from a brown alga called *Ecklonia cava* are anti-diabetic due to their hepatoprotective role and anticoagulant activities. The report found from in vivo testing that the fucosterol was identified from the brown alga *Pelvetia siliquosa* shows antidiabetic activity [16]. It was recommended to consume as a dietary supplement for the diabetic patient. Similarly, phlorotannins found in *Ascophyllum nodosum* can act against  $\alpha$ -glucosidase and  $\alpha$ -amylase that are helpful to digestion of starch and regulating blood sugar levels. The *Ecklonia stolonifera* species is used for anti-hypolipidemic activities due to the presence of molecules like phlorotannin and eckol. These molecules can help in the reduction of LDL cholesterol level and triglyceride while the increase in HDL cholesterol [17].

### **Anti-Ageing Activity**

In contrast, marine algae exposed to solar radiation can produce anti-aging and photoprotective molecules. All the molecules have the potential to reabsorb ultraviolet rays like UVA and UVB and can prevent the production of free radicals. Some algae are the major source of phenolic compounds with photoprotective Shinorine, Porphyrin-334, polythene, eckstolonol, eckol, sargachromenol, tetraprenyltoluquinol chromane meroterpenoid, scytonemin, and sargaquinoic acid [18] are examples of active compounds in this category. Edible brown algae including *Ecklonia cava*, *Eisenia bicyclis*, and *Ecklonia stolonifera* have another phenolic ingredient called eckstolonol that helps protect skin's HaCat cells from damage caused by sunlight. The Eckstolonol (200M) in table 1 can repair UV-B-induced damage by activating the enzymes catalase and superoxide dismutase, which aids in the removal of excessive ROS [19].

### **Anti-Viral Activity**

Marine algae-derived Phenolic compounds like phlorotannins and Phloroglucinol also have antiviral properties discussed in Table-1 and chemical structures are in Figure-1. In

vitro, the phlorotannins 8,8'-bieckol and 8,4''-dieckol can inhibit HIV-1 reverse transcriptase and protease. 6,6'-Bieckol, a Phloroglucinol compound derived from *Ecklonia cava*, can suppress HIV-1 by generating syncytia formation, lytic effects, and reducing viral p24 antigen synthesis in vitro. Additionally, it is also acting against the enzyme HIV-1 reverse transcriptase, an RNA-dependent DNA polymerase that helps in viral replication inside human cells without any cytotoxicity effect. The Halitunal 63 was identified from the marine alga *Halimeda tuna* that shows antiviral against murine coronavirus A59 in vitro [20].

### **Anti-Fungal Activity**

Cyanobacteria are known as blue-green algae because it contains chlorophyll a and its related compounds. The cyanobacteria can produce secondary metabolism as Biologically active nitrogenous chemicals and cyclic polyethers [21]. An inhibitor of fungal plant diseases, Majuscuiamide C 16, was discovered in the blue-green algae *Lyngby majuscula*. The antifungal properties of dinoflagellates have been demonstrated by the discovery of Goniodomin A 23 from *Goniodoma* (Alexandrium) sp. and gambier acid from *Gambierdiscus toxicus* culture medium, respectively. The Capisterones A 67 and B 68 are identified from green alga *Panicillus capitatus* shows antifungal activity against the marine algal pathogen *Lindra thallasiae*. The meroditerpenoid was identified from the brown alga *Cystoseira tamariscifolia* and characterized as methoxybifurcarenone 138. It has antifungal activity against 3 tomato pathogenic fungi and antibacterial activity against *Agrobacterium tumefaciens* and *Escherichia coli* [22].

### **Immunosuppressive and Cytotoxicity Activity**

According to several investigations found that *Lyngbya majuscula*, a type of blue-green algae native to Venezuela, contains immunosuppressive lipoproteins known as microcolins A 17 and B 18. Murine mixed lymphocytes and murine P388 leukemia are both suppressed in vitro by microcolins [23]. Isorawsonol 30 is a phytochemical derived



from the green alga *Arrainvilla rawsonii* that has anticancer, cytotoxicity, and immunosuppressive properties. In addition, the marine alga provided Communesins A 34, B 35, and Penostatins A 36, B 37, C 38, D 39, and E 40 which shows Immunosuppressive and cytotoxicity activity. The aplysin-9-ene 291, epiaplysinol 292 and debromoepiaplysinol 293, were identified from red alga *Laurencia tristicha*. Debromo-epiaplysinol 293 shows cytotoxicity to the HeLa cell line [24].

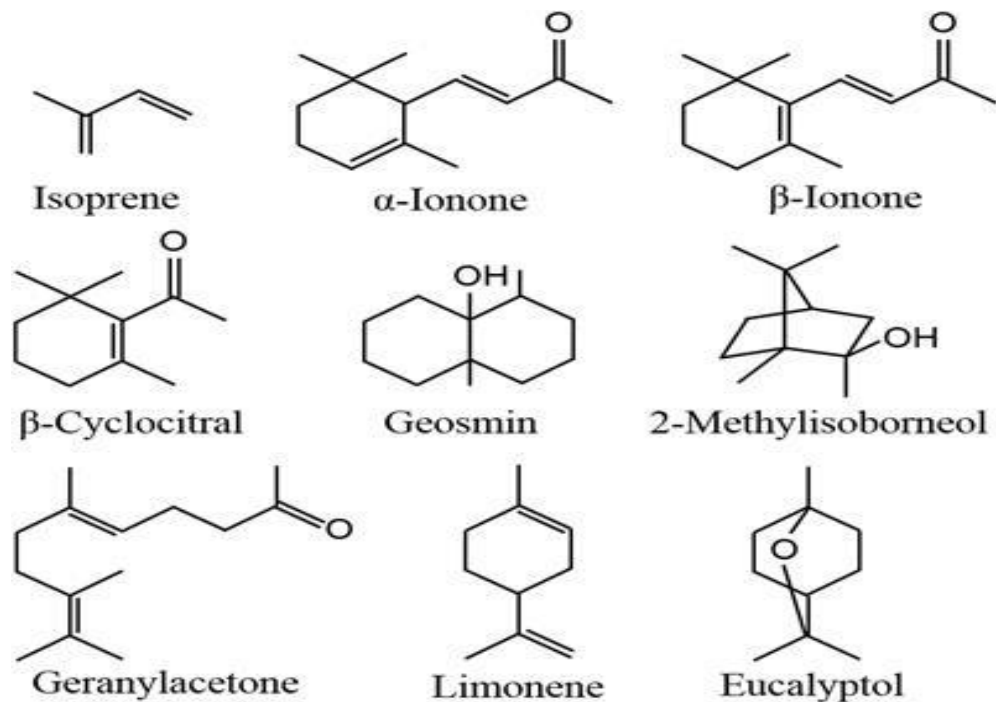
### **Phytoprotective Activity of Marine Algae**

Different species of marine algae have various chemical compositions [25]. As red and brown algae are rich in sulfated polysaccharides such as carrageenan and fucoidan. The Carrageenans are thickening agents often used in food, medicine, cosmetic items, gelling, emulsifying, and stabilizing properties. Reported that, carrageenan bases skin products are antioxidant, detoxifying, cleansing, hydrating, and revitalizing activities. The carrageenan has also photoprotective activity as it protects against the UVB-induced apoptosis in HaCaT cells and inhibits the production of H<sub>2</sub>(ROS) because excess amounts of ROS can cause skin aging and cancers. The chemical structure of carrageenan is in Figure-1 [26]. Brown algae have sulfated polysaccharide called fucoidan, the biological activity of fucoidan is in Table-1 and the chemical structure is in Figure-1. Fucoidan, an antioxidant found in brown algae such as *Ecklonia cava*, *Undaria pinnatifida*, *Costariacrostata*, and *Fucus evanescens*, has photoprotective properties. Fucoidan's photoprotective properties were discovered in UVB-irradiated human skin fibroblasts. As the MMP-1 activity is suppressed by fucoidan's photoprotective properties. UV-irradiated human skin has collagen degradation and photoaging caused by MMP-1. Sulfated polysaccharides diminish NF-B expression by inhibiting NF-B, which in turn lowers MMP-1 levels. The photoprotective action of low-molecular-weight fucoidan is greater than that of UV filtering effects [27]. Aside from that, carotenoids protect photosynthetic organisms like algae and cyanobacteria from the sun's ultraviolet radiation.

The carotenoid content in brown algae increased UVB exposure. The canaliculate plant

*Pelvetia Canilculata* and the fucoxanthin of brown algae have photoprotective activity against UVB-induced photoaging. Photoprotective activities on Human dermal fibroblasts and hairless mice exposed to ionizing radiation have both shown the effect *in vitro* and *in vivo*. Fucoxanthin's photoprotective activity is based on ROS scavenging as a mode of action. There's a UV-sensitive gene called Filaggrin to inhibit wrinkle formation. Fucoxanthin can increase filaggrin promoter activity in UV-induced sunburns [28].

Different species of red algae and their biological activities are discussed below; As *Solieria chordata* have the absorption of UVB light and free radical scavengers. This plant, *Porphyra umbilicalis*, can prevent UV-ray damaged skin from erythema [29]. This plant, *Porphyra yezoensis*, can modify the viability of UVB-exposed HaCaT [30]. *Solieria chordata* can protect synthetic chlorophyll solution from UVB, while *Polysiphonia morrowii* can shield HaCaT from UVB-induced cell damage. The HaCaT can be protected from UVB-induced cell damage using *Chondracanthus tenellus*, and can prevent HaCaT from UVB-induced cell damage are *Bonnemaisonia hamifera*, *Lomentaria hakodatensis*, *Macrocystis pyrifera*, and *Porphyra columbina* [31]. The following section discusses various brown algae species and their biological activity. When used as a UVB irradiated human keratinocyte model, *Sargassum muticum* inhibits wrinkle formation on UVB-induced mice *in vivo* and as a human skin cell model *in vitro*. HaCaT can be protected by *Undaria crenata* against UVB-induced cell damage. Several plants can shield the developing zebrafish embryo from UVB damage, including *Lessonia vadosa*, *Lessonia black*, *Ascophyllum nodosum*, *Saccharina latitissima*, *Fucus vesiculosus*, *Ecklonia maximum*, and *Durvillaea Antarctica* [32].



**Figure 1.** The Algae derived chemical compounds

**Table 1.** List of marine algae and their derived biological active compounds.

S.N o.	Algae species	Compoun ds	Biological activity	Referen ces
1	<i>Ecklonia stolonifera</i>	Phlorofuco furoeckol A & B	Anti- inflammatory.	34
2	<i>Ecklonia. cava</i>	Dieckol	Antitumor activity.	35
3	<i>Ishige foliacea</i>	Octaphlore	Anti-	36

		thol A	inflammatory.	
4	<i>Cystoseira mediterranea, Pterocladia capillacea</i>	Flavonoids & tannin	Antimicrobial.	37
5	<i>Cymopolia barbata</i>	3,7-hydroxycymopolone	Antimutagenic.	38
6	<i>Caulerpa racemosa</i>	Racemosin A	Neuroprotective.	39
7	<i>Caulerpa racemosa</i>	Caulerprenylols A	Antifungal.	39
8	<i>Ulva prolifera</i>	pyrrolopipera-zine-2,5-dione	Antialgal.	40
9	<i>Cymopolia barbata</i>	7-Hydroxycymopolone (PBQ2)	Chemotherapeutic, Anticancer.	40
10	<i>Caulerpa racemosa and Caulerpa genus</i>	Caulerpin	Anti-microbial.	41
11	Brown algae	Alginate	Antitumour, Antifungal.	42
12	Red algae	Carrageenan	Antioxidant, drug delivery.	43
13	Green algae	Ulvan	Anti-microbial.	43

1 4	<i>Adenocystis, Utricularis, Grateloupia, longifolia, Laminaria, guryanovae, Codium, atlanticum, Monostroma nitidum</i>	Sulfated polysaccha rides	Anti-HIV, Anti- tumor, Anti- coagulant.	44
1 5	<i>Arthrospira platensi</i>	Spirulan	Anti-coagulant, anti-thrombic activity.	45
1 6	<i>Isochrysis galbana; chaetoceros, Skeletonema; Pavlova lutheri</i>	Brassica sterol, Stigmaster ol	Anti-bacterial, Hypocholesterol emic.	46
1 7	<i>Ecklonia stolonifera, Ascophyllum nodosum, Ulva lactuca, palmaria palmate, Alaria esculenta.</i>	Phlorotann in	Anti- hypertension, Anti-cancer, Anti-radio- protective, Anti- photocarcinogen ic, Anti-diabetic, Anti-allergy, Anti- proliferative, Anti-antiaging,	47

			Anti-Matrix metalloproteinase.	
18	<i>Myagropsis, myagroides, Brown algae</i>	Fucoxanthins	Anti-inflammatory, Anti-diabetic, Anti-angiogenic.	44
19	<i>Pelvetica siliquosa, Sargassum Vulgare, Undaria, Pinnatifida, Himanthalia, elongate, Chondrus, Crispus, Porphyra, Ulva, and Porphyra species.</i>	Fecosterols	Anti-cancer, Anti-diabetic, Anti-fungicidal.	49
20	<i>Spirulina maxima</i>	Eugenol, Hydroxycinnamic acids, Hydroxybenzoic acids, kaempferol, chrysin, galangin, Pinostrobin	Antioxidant, Anti-hepatoprotective.	50

### **Anti-Coagulant Activity**

The marine algae have anticoagulants properties because those contain sulphated glycosaminoglycans and include sulfated polysaccharides like heparin and heparan sulfate. In the algae group, the Phaeophyta (brown algae), Chlorophyta (green algae) and Rhodophyta (red algae) are the most abundant, among them anticoagulant polysaccharides have been isolated from red and brown algae are carrageenans and fucoidans, respectively. The homogenous polysaccharides of galactose or fucose are commonly found in red and brown algae. However, there was no report on green algae containing anticoagulant polysaccharides. But reported that *Codium fragile* ssp. *tomentose*, of green algae, has excellent anticoagulant polysaccharides. Recently reported that green algae are heterogeneous polysaccharides and homogenous galactan. Algal anticoagulant polysaccharides are used for antithrombin III (AT III) and heparin cofactor II (HC II) that are endogenous inhibitors, called SERPIN. In contrast, some algal anticoagulant polysaccharides are used directly to inhibit fibrin polymerization or thrombin activity without potentiating AT III and HC II. Algal anticoagulant polysaccharides can activate the fibrinolysis system and modulate endothelial cell functions. The bioactive compounds of marine algae show anti-platelet and

### **Conclusions**

Marine algae have potential source of bioactive substances in the medical and cosmetic fields. Marine algae-derived compounds have unique chemical structures with excellent biological activities and are also “natural and healthy” with nontoxic materials. Different species of marine algae have several properties without any toxicity and a good safety profile. Marine algae are produced a wide variety of biological active compounds with significant effects. The marine algae-derived molecules are better than synthetic compounds used in various food and medicinal production. It is used in skincare products also acts as photoprotection.

From the past few decades, the studies on the potential use of marine algae in human health benefits have been increased the importance in various sectors. Microalgae-derived compounds have high demand in pharmaceutical, nutraceutical, cosmetic, animal feed, biological waste treatment, and other multifunctional activities due to the richness in bioactive molecules. Microalgae have the potential activity to treat cancer, inflammation, Alzheimer's, CVDs, malaria, leishmaniasis, TB, HIV etc through major sources of natural bioactive compounds like carotenoids, PUFAs, proteins, polysaccharides, glycolipids. It was also found that different biologically active compounds from marine algae-like aflatoxins, dolostatins, majusculamides, carotenes have an excellent health benefit. So that researchers should be exploring the potential use of bioactive compounds from marine algae in advanced biomedical applications and field of biotechnology. Algae-based biomaterials show a prominent future in pharmaceutical and cosmetic fields. But still there is no clear evidence found about bioactive compounds in algae so needs to long term research to achieve major compounds of algae and that can be used in biomedical applications, the accurate results to be known when it is sold in market and tested by people.

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**HUMAN RESOURCE MANAGEMENT IN EDUCATION: ISSUES AND CHALLENGES**

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**INTRODUCTION**

Human resource management can be seen as the design of formal systems in an organization to ensure effective and efficient use of human talents to accomplish organizational goals. Griffin (1997), defined human resource management as the set of organizational activities directed at attracting, developing and maintaining an effective workforce. Human resource management concerns the procurement or recruitment, staffing, welfare, maintenance, training and retraining, placement, promotion, motivation relationship, compensation or rewards, transfer and discipline of staff. It lies at the care of the efficiency of the organization. Human resource management is a basic function of management that determines the performance of staff in any organization. This simple implies that when staff in the education systems are adequately recruited, selected and supervised, inducted and adequately rewarded, and provided for, properly developed, appraised and promoted on the job, they will be committed to the job, remain dedicated and productive in the education systems. This can simply be put that it is the co-ordination of the activities and efforts of the workers in educational organization so that educational goals are achieved. Hence, human resource management in



education is the process of motivating workers to maximize their performance in order to obtain maximum output starting from the day they are recruited. That means utilizing people to perform duties and functions in the school (Oduma, 2012). Human resources are easily recognized as the most important resource out of the resources required for the production of goods and services. Human resources are the key to rapid socio-economic development and efficient service delivery (Onah, 2008). Without an adequate, skilled and well-motivated workforce operating within a sound human resource management programme, development is not possible.

Every educational system at every level depends heavily on the human resources for execution of its programme. Nwaka and Ofojebe (2010) stated that teachers are the critical resources for effective implementation and realization of the educational policies and objectives at the practical level of classroom. A manager, whether in private or public sector, who underrates the critical role and underplays the importance of people in goal achievement, can neither be effective nor efficient (Oduma, 2012). It is the teacher who ultimately interprets and implements policy as represented in the school curriculum, which is designed to actualize educational goals (Omojunwa, 2007). Maintaining and improving educational standards is only possible through teachers. Teachers therefore are the most indispensable entity in the school. They are the greatest aid to learning. The shortage or poor management of teachers reduces the extent to which the curriculum can be delivered effectively. It should be noted that the major premise of human resources management in education is that the end results of the educative process will be determined by the effectiveness of the teachers who facilitate learning for self-actualization and national development.

Human resource management in education essentially is concerned with three major issues namely.

- i. Assessing the need for staff
- ii. Satisfying the need for staff and
- iii. Maintaining and improving the staff services.

### **Goals and Role of Human Resource Management in Education**

The goals of human resource management in education are to develop the workers and to contribute to goal achievement. Human resource management has some specific roles to play. These are strategic and operational roles.

#### **Strategic Role:**

Human resources are critical for effective educational functioning. Human resources were once relegated to second-class status, but its importance has grown dramatically in the last two decades. Again, its new importance stems from adequately recruited, selected and supervised, inducted and adequately rewarded, provided for, properly developed, appraised and promoted on the job. They will be committed to the job, remain dedicated and productive in the education system. It also represents a significant investment of the educational efforts. If managed well, human resources can be a source of competitive strength for the education. Strategically, human resources must be viewed in the same context as the financial, technological and other resources that are managed in any organization (Onah, 2008).

#### **Operational Role:**

According to Mathis and Jackson (1997). Operational activities are both tactical and administrative in nature. Griffin (1997) sees operational role from the legal perspective because some have regulated various aspects of employee-employer relations. Human resources management is therefore, interested in compliance with equal employment opportunities and observation of labour laws; examples; applicants must be oriented to the organizations, supervisors must be trained, safety problems must be resolved; wages and salaries must be administered. A wide range of activities typically associated with the day-to-day management of people as provided by laws and regulations must be performed efficiently. It is this collection of

activities that has often been referred to as the personnel function, and the newer strategic focus of human resources management has not eliminated. In summary, it is difficult to produce one general interpretation of what human resource management means today.

### **Functions of Human Resources Management in Education**

Human resource management in education is a set of practices and methods of integrating and maintaining the teaching staff in the school so that the school can achieve their purpose and as well as meet the goals for which they were established. It is the motivation and co-ordination of the activities and effort of the teachers in school in order to obtain maximum output from them and consequently achieve the goals of education optimally. The functions include the following:

- i. Staff maintenance
- ii. Staff relations
- iii. Staff development
- iv. Procurement of staff
- v. Job performance reward

### **Staff Maintenance**

This concern making the work environment conducive for workers, pertinent practices include; promotion and transfer, motivation, staff safety, security and health services. It is pertinent that educational establishments have sound policies in respect of staff transfer and promotion to ensure that justice and fairness prevail in dealing with staff. As work to be performed in the school is important, the mood of the man to perform the job is equally important. For maximum and productive goal attainment, the school head must ensure the comfort and happiness of the workers. That can be done through prompt payment of salary, and ensuring a safe and healthy working environment.

### **Staff Relations**

There must be a good communication network in the school to enable workers to be

constantly informed of the progress being made in the school. Workers should be encouraged to participate in planning and decision making in the school. Workers should be encourage by recognizing the staff as human beings with feelings, interest, needs and emotions and treating them as such with fairness and respect.

### **Staff Development**

This is the process of appraising staff performances and identifying their key skills and competencethat need development or training to improve their skills for better performance. It involves providing development programme and training courses that are suitable for the programme. The success of educational organization hinges on the strength and quality of the staff members. There is need to change through training and to improve and grow in competence. This can be done through in-service training, conference, workshop and seminars.

### **Procurement of Staff**

Human resource management functions start with the process of recruitment and selection by which educational institutions get the best personnel to interpret and implement the curriculum programmes. Staffing of schools is a job performed by the ministry of education through its agencies in the federal and state government. Procurement of staff in education deals with obtaining people with appropriate and necessary skills, abilities, knowledge and experience to fillthe vacant teaching posts in schools.

### **Job Performance Rewards**

This involves the design and administration of rewards for jobs performed. It is very important that management, ministry of education and its agencies take the issue of reward system very seriously. Staff performance would increase substantially if they are adequately compensated according to the quality and quantity of work done.

### **Challenges of Human Resource Management in Education**

Human resource management has become notably complex in the sense that as human beings, theyare not reliable for doing one thing over and over in exactly the same way. They

can be expensive depending on their cadres, qualification and skills. Their productivity is highly dependent on the person's ability to instruct. The same content cannot be delivered every time. A number of factors have contributed in this complexity. They include the following:

### **Poor Working Condition**

It is not out of way if staff expects to be paid finance rewards commensurate with the services performed. The ideal thing is to have a systematic producer for establishing a sound reward system and structure. A good remuneration tends to reduce inequalities between staff earnings, raise their individual morale, motivate them to work for pay increase and promotions, reduces inter group friction and employee grievances. Teachers salaries are not paid along side with other civil servants and in some cases, teachers are owed many months of salary areas.

### **Problems of Staffing**

The problem of staffing is enormous. There are problem on the quality and quantity of staff recruited for the education of our citizens. The reason is from poor staff recruitment and selection process. Politicians and God fatherism has taken the upper hand. Some staff rarely stay in the remote areas where the management wants their services. They use to stay in the urban areas for self-convenience. The verification exercise carried out by Universal Basic Education Commission (2000), Shows that an additional 275 to 462 teachers were needed to teach in primary schools in Nigeria.

### **Current Call for the Use of ICT in Education**

As the 21<sup>st</sup> century world is undergoing rapid changes, there is urgency for few educational needs such as the call for use of ICT in education. Current call for ICT usage in education is worthy but, its implementation in the nation is in the toddling stage. Nwufu (2009), evidently noted that ICT penetration and usage remains very low and so the need to train many teachers at all levels in ICT to equip them for reengineering the society through the skills (Offorma, 2009); ICT provides the most expensive means of rapid dissemination of information and imparting knowledge, decentralization of work, expansion of work force and

with ICT, the teacher becomes a facilitator, supervisor and a guide for classroom instruction. However, compulsory acquisition of ICT skill by teachers should be given priority attention despite the fact that most teachers cannot buy the computer set or laptop because of poor salary. Other challenges of human resource management that have direct effect on the achievement of our predetermined educational objectives include;

- i. High rate of students and staff indiscipline
- ii. Funding issues
- iii. Poor recruitment process
- iv. Little or no induction of human resources
- v. Poor supervision/appraisal of staff
- vi. Poor personnel commitment to work and
- vii. Incessant transfer of teachers

### **RECOMMENDATION**

Considering the importance of education in human resource management, the following are recommended.

1. Education should be made attractive by creating a conducive atmosphere for teachers.
2. More government attention is needed for the education sector through improved function as education remains the basis for the progress of all other sectors of society.
3. A united salary structure should be made for all categories of teachers within the education sector.
4. Standard of education in Nigeria should be up dated to meet the rapid social changes in our present Nigeria society.
5. Computer literacy in the spirit of globalization should be brought into the curriculum and the new and the old curricula made coherent for better

productivity.

## CONCLUSION

The paper concludes that education remains a veritable means of human resource management and nation building in Nigeria. Whatever needs to be done in this sector should be done in all sincerity and with every urgency for education to fully achieve its predetermined educational objectives.

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**A REVIEW ON CUSTOMER RELATIONSHIPMANAGEMENT**

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**ABSTRACT**

The company is using various Customer Relationship Management practices like product customization, maintaining communication with the customers regularly and providing best quality product etc. CRM has a certain impact on the profitability of the company. Rate of customer response towards marketing activities is also improving. There are various factors affecting the customer relationship management like working environment of the company, support from top management and co-ordination & synchronization among the departments of the company. Information technology is not used as much as it should be.

**Keywords:** Customer Relationship Management, co-ordination & synchronization

**INTRODUCTION**

Customer relationship management (CRM) is an approach to managing a company's interaction with current and potential customers. It uses data analysis about customers' history with a company and to improve business relationships with customers, specifically focusing on customer retention and ultimately driving sales growth.

One significant characteristic of the CRM concept is the systems of CRM that accumulate the data from a range of different communication media or channels, including an email, telephone, company's website, live chat, marketing materials, and more recently, social media. Through the CRM concept or approach and the systems used to assist it, businesses learn more about their target audiences and how to best provide to their needs. However, adopting the Customer Relationship Management concept or approach may also occasionally lead to discrimination within an audience of consumers, resulting in displeasure among customers and failure of the purpose of CRM.

The biggest management challenge in the liberalization and globalization for a business is to provide and maintain good relationship with the customer. In the past producers took their customers for approved, because at that time the customers were not demanding nor had substitute source of supply or suppliers. But today there is a radical transformation. The varying business environment is characterized by demanding customer, increasing competition, high consumer choice, economic liberalization, more emphasis on quality and value of purchase etc.

All these changes have completed today's producer move from traditional marketing to current or modern marketing. Modern marketing calls for more than developing a product, pricing & promoting it and making it accessible to target customer. It demands to build trust, a binding force and value added relationship with the customers. The process of developing a supportive and collaborative and mutual relationship between the buyer and seller is called customer relationship management (CRM). According to Ashoka Dutt, Head of Citi Bank "the initiative of CRM is to identify the individual customer intimately, so that the company has a customized product ready for him even before he asks for it."

## **PHASES OF CRM**

### **Customer Relationship Management Software**

The thought and idea of customer relationship management begin developing in the early 1970s, when customer satisfaction was measured using annual surveys or by front-line asking. At that time, businesses had to rely on individual mainframe systems to automate sales, but the extent of technology allowed them to categorize customers in spreadsheets and lists. The key year was 1982, when Kate and Robert Kestnbaum introduced the concept of Database marketing, namely applying statistical methods

to analyze and gather customer data.

Four years later, Pat Sullivan and Mike Muhney from Dallas released their customer evaluation system called ACT! based on the principle of digital rolodex, offering for the first time a well-shaped contact management service. The style or trend was followed by numerous developers trying to maximize leads' potential, including Tom Siebel, who signed the first CRM product Siebel Systems in 1993. Nevertheless, CRM as a term became well-liked only in 1997, thanks to the work of Siebel, Gartner, and IBM companies. In the period between 1997 and 2000, leading CRM products were enriched with enterprise resource planning ERP functions, and shipping and marketing capabilities.

### **Mobile CRM**

During 1999, Tom Siebel introduced and design the first mobile CRM app called Siebel Sales Handheld. The thought of a cloud- hosted and moveable customer bases was soon adopted by other leading providers at the time, including PeopleSoft, Oracle, and SAP software's. The first open-source CRM system was design and developed by Sugar CRM in 2004. During this period, CRM was rapidly migrating to darken, as a result of which it became accessible to single entrepreneurs and small teams, and undergo a huge wave of price declination.

### **Social CRM**

Around 2009, developers began considering the options to profit from social media's momentum, and included interactive social CRM features into their customer service applications. The same year, Gartner planned, organized and held the first CRM Summit, and summarized the features systems should offer to be classified as CRM solutions.

## **LITERATURE REVIEW**

Azvine and Nauck [1] propose an intelligent customer relationship management analytics model to solve customers' business problems. Customers are interviewed to determine their issues and to provide customer satisfaction and achieve the performance of the system. To assess, they introduce a business procedure to optimise the decision-making process. They create a system called Intelligent Universal Service Management System (iUSMS) to manipulate the data. Also, it has the ability to learn and obtain the latest knowledge. When a customer calls to report an issue, an operator will simply find that customer's profile and its details. Meanwhile, the system checks the failure using an

automatic evaluation. Someone will be sent to fix the problem and the system will retain the information about the incident. The advantage of a customer focus measure is that it is a tool for creating customized automatic report in order to recognize issues, contacts, and to generate statistics. This system allows the user to customize further information and as the system gives a great deal of freedom to the customers, it engenders trust. Hence, the authors propose a system to be used by customers whereby they are granted permission to use the system to resolve their problem; whereas, the other existing systems do not allow customers to customize their information.

The authors consider the optimization and trustworthiness of the system when customers use it. However, the system fails to address the time spent on each customer as companies today have thousands of issues and it is unclear how the system would be able to handle all of these.

How many operators must be recruited by the company to solve customer problems? The authors do not show any risk factors of the project and security problems of the system, a significant issue given that most customers nowadays want to ensure their account security.

They do not provide any prediction regarding customers' post-behavior in the event that they are faced with issues in future. Öztays [2] proposes a method which greatly enhances the benefits obtained from clients. The authors compare the performance of customer relationship management processes of companies which use multiple criteria decision-making processes. The authors examined the Turkish e-commerce market using an analytical network process and they considered three companies. Company one deals with trade, company two with health and cosmetics products, and company three is a facilitator between other companies. Analysis clarified that company two has the highest standards in CRM performances followed by company one and company three respectively. Finally, the sensitivity analysis showed that ranking is sensitive to shifts in inter-relations and in weights. However, their proposed method has the following drawbacks.

- i. They do not propose any means for ensuring the validity and reliability of a given raw data that they need to analyse.
- ii. They do not propose any method for pictorially illustrating the relationships between major factors.
- iii. While the analytical network process is an appropriate tool for analysis and decision-making, the authors could have used other methods to determine the significance of each factor involved in the

process.

- iv. When evaluating customer relationship management, the authors do not consider the financial effects of each factor on customer relationship management.
- v. They do not consider the effect of customer complaints on customer relationship management.
- vi. In further work, Torkzadeh et al. [3] mention the major obstacles to the success of CRM in pharmaceutical companies and propose a customer relationship framework. First, they set up a focus group and initiated discussion in order to generate the problems.
- vii. Then they conducted a survey and divided the data evenly into two sets. To discuss the main issues and using the first set of data, they used exploratory factor analysis. To verify the factors, and with the second set of data, the authors applied structural equation modeling. The outcomes of the analysis were 7 variables and 21 observed variables that may limit the success of CRM.
  - The issues are as follows:
    - Operating procedure
    - Responsibility and ownership
    - Quality of information created using customer contact
    - Ineffective consolidation of accounting function
    - Difficulty queuing a changing procedure
    - Replacement procedure
    - Time spent in the queue

Phan and Vogel [4] propose a model for consumer buying arrangements and credit behavior. They initiated their survey ten years ago and have been collecting data ever since. The authors sought to examine the effects of unfair pricing on customer relationships followed by the effect on customer relationships of changing costs or restrictions. They proposed several hypotheses and used online analytical processing (OLAP) for data analysis. They ascertained that unfair pricing will lead to a poor relationship. Also, an appropriate business intelligence system and CRM system will enhance the level of satisfaction and the relationship. Increasing costs do not annoy customers as the customers are paying with their credit cards and in this study the company adapts the products and services based on each customer.

King and Burgess [5] propose a novel method by developing a conceptual framework for CRM

and changing that simulation model. The authors clearly discuss the successes and failures of CRM systems. They mention that customers complain about the failure of over 50 % of CRM projects and express their lack of trust in the systems. Hence, they created a model as CRM outcomes (operational and development) and divided this into two segments. In the next stage, they discussed the tangible and intangible benefits of CRM. They used a CLD mapping technique for simulation. Results show the difference between the work quality of an experienced CRM user and that of a new CRM user, indicating that for an experienced user, the diagram has an increasing trend. Finally, departmental support given to the users shows a similar increasing trend.

Richards and Jones [6.7] propose a conceptual model in which they provide customer relationship management's value drivers followed by generating equity for value, brand and relationship which will ultimately lead to customer equity. The rationale for this model is that they believe there is no outcome in terms of benefit to the company. Prior to that, they defined significant CRM core benefits based on various academic papers. Using their proposed model, they want to ascertain whether the management of CRM activities will positively impact on business performance. Furthermore, they adopt customer equity as a measurement tool.

## **I. NEED OF STUDY**

### **Three Reasons Why Manufacturers need CRM (Customer Relationship Management) :**

#### **1) Customer Service Excellence**

How much time is spent by your staff searching answers to fairly basic questions from your customers? Are they getting bounced from person to person? Give your customer the confidence that you're organized and they can get answers to their questions quickly and reliably.

The first area that comes to mind for me is post-sale implementation and delivery of a project. As a manufacturer, your CRM system will include the ability to manage this information and keep your whole team in the loop, thereby getting the job done right and keeping the customer happy. You will incur fewer delays and penalties, and more track on sales.

A solid CRM system will also help you keep follow of any warranty, repair, or service issues. Perhaps your ERP system keeps way of the material side of these issues, but day to day problems, questions, investigation, and service calls are an easy thing for a CRM system to handle and ensure that

nothing gets overlooked.

## **2) Boost Your Sales**

When it comes right down to it, everyone needs to sell more. But how will a CRM system assist that?

The first way it will help your team is when you engage a customer or prospect on a new opportunity. Gathering the customer requirements all in one place will make sure that everyone involved has a very clear idea of what's needed and what the difficulties might be. You can then work with the customer to craft a solution.

We have seen many companies specifically having some challenges when it comes to responding to RFQ's, the main concern being that the process takes too lengthy as it's handed off around the office, or, the configuring method, while a set of standard rules, is done manually. There is often also very less information of why business is being win, or lost. This is incredibly important and valuable information that can be captured in your CRM system.

## **3) Expanding into New Markets**

It might be simple and easy to continue to take orders from existing companies, but introducing new products, moving into new areas, or targeting different companies requires that your sales efforts and hard work are highly managed and effective. As you carry out these activities a CRM system will help in targeting scenario and managing those communications. It will measure the team against the goals set for them. Being organized and attentive, in combination with some good marketing, will mean the difference between success and breakdown with your new initiative. The selling process will be different and it's important to follow that process.

It Conclude that - There's a myriad of different ways a CRM system can help a manufacturing company. It could mean managing distributors as opposed to customers. It may be a way to give more people access to data already in ERP. To read more on this topic, I support you to download this excellent whitepaper from IDC. Give it a read. It goes into a great deal of depth on this topic and has several different thoughts on how CRM will helpful. It also concludes with a list of challenging questions to ask for self-evaluation.

## **II. CRM IN THE INDUSTRY**

The challenge facing all manufacturers is to be flexible enough to react to market changes while at the same time keeping an eye on costs. Modern machinery alone does not guarantee competitiveness. What is essential is the ability to provide customers with professional service and support right from the start.

### **Your CRM software requirements**

Information from ERP, finance and production can all be managed together. Unparalleled service for long term customer satisfaction.

Save money by saving time.

### **The benefits**

With products becoming increasingly similar, the quality of service has become an important factor in ensuring customer satisfaction and fulfillment. Our products help you to create a common knowledge base. The staff members have instant access to all the data and information regarding customers and products, enabling them to answer all queries quickly and proficiently during a call.

CRM software helps and supports to keep everyone in the loop, regardless of their operational level, whether individual staff members, departments or subsidiaries. Various add-ons such as ERP or accounting software ensure a continuous flow of information. The software enables you to save time on a daily basis, especially when searching for documents, vacant appointments or addresses. Even field staffs are flawlessly incorporated into the customer information system. All information that used to be stored separately is now kept in one place, which makes search for it that much simpler, easier and quicker. And as we all know that time is money. This flexible CRM solution helps you handle, manage and deal with customer information throughout your company.

### **Managing appointments**

The appointment calendar lets you view all activities, appointments, events or holidays. You can select from three different views: day, week or month. A particularly useful feature is the shared calendar view. Say you want to schedule a meeting for a number of your colleagues. Well, the shared calendar lets you see when they are all available with just a few clicks of your mouse. You can then



make use of the resource calendar to rapidly find available rooms, projectors or company cars and add them to appointments.

### **Managing documents**

The CRM solution lets you make and deal with different types of documents (MS Word, MS Excel, PDF, e-mails, graphic files, etc.) and create templates. Documents are no longer saved on different computers. This means employees always have right to use to current documents, which are centrally maintained and can be accessed by anyone at any time. The search and filter or sort-out functions can be used to filter and find the keywords in documents; for example, subject field or the date a document was created.

### **Project work**

Project-related data records like activities, appointments, tasks, documents or caller logs are saved in the project report. The project summary can be displayed as a chart, showing the timeline of all activities, appointments, tasks, and so on. Benefit from the resource and process planning that allows you to keep track of all project phases and steps.

### **Address management**

All addresses are stored centrally. You can sort and displaying addresses according to different attributes, using additional fields and categories. The address helps you to make an address with just a few clicks of your mouse: formless and unstructured contact information is transformed into well-structured address data records.

### **Mobile access to data**

Particularly in sales, staff must also be able to access the data and information when away from the office: from PCs at home or from smart phones or laptops when on the move. The Mobility module enables you to coordinate the data between locations or between laptops and head office. You can also access the central database using a Web browser on your mobile device or laptop.

## **III. INTRODUCE CRM IN THE INDUSTRY**

There are four key steps for putting one to one marketing program to work:

### **Step 1 : Identify your customers**

To introduce a initiative that company must be able to trace and contact a fair number of

customers or at least a extensive segment of its valuable customers. It is vital to know the customer information as much as possible, their names, address, habits, and preferences and so on.

**Step 2 : Differentiating your customers**

Customers are different in two major ways, they represent different levels of value, assessment and have different needs. Once the industry or company identifies its customers differentiating them will help the company to focus its efforts and hard work to gain the most advantage with the most valuable customers.

**Step 3 : Interacting with the customer**

Interaction is also a critical and essential component of a successful CRM scheme. It is vital and essential to remember that interaction just not occur through marketing and sales channels, customer act together in many different ways with many different areas of the organization so to promote and foster relationship of all the areas of the organization must be available to the customer.

**Step 4 : Customize your enterprise's behavior**

To lock a customer into a relationship a company must acclimatize some feature of its behavior to meet customer's individual requirements, this might mean group customizing a manufactured product or it might involve tailoring some segment of the service surrounding the product.

**IV.SCOPE AND LIMITATIONS OF STUDY Scope of CRM :**

CRM is management software for sales, marketing and customer service teams as they are the crucial points for any customer contact strategy.

**CRM for sales management :**

A good mobile enabled CRM will allow sales reps to handle and deal with their tasks, activities and meetings from wherever they are, minimizing unwanted administration time and building in best practice into prospect management. Sales managers who need real time clearness in reviewing their team's sales pipeline.

When reviewing CRM choices the sales functionality should cover the basics of:

- Sales force and pipeline management
- Lead, contact and prospect management

**CRM for marketing :**

CRM can provide both marketing and sales functionality within their own operational requirements; but should also enable better cooperation and clearness between teams; putting the lead, viewpoint and customer at the heart of the CRM strategy. Marketing teams can be supported in lead generation efforts, planning and executing multi-channel marketing campaigns, section audiences, deliver targeted messaging at the right time and carry out best practice testing efficiently.[8-12]

Marketing functionality within a CRM system review should include:

- Multi-channel marketing movement management
- Database management
- Social and community media engagement

**CRM for customer service :**

Customer service teams need to be able to send a positive customer experience and to do this they need to be supported by a CRM system that gives them a good record of past customer contacts, support enquiries, technical incidents and product history. Customer service operators require handling calls, emails and social/web enquiries quickly and to the satisfaction of the customer.[13]

When considering CRM functionality for customer service, organizations should review:

- Customer service management
- Knowledge distribution and document management
- Computer Telephony Integration (CTI)
- Agreement management

**Limitations of CRM :**

Limitations of Customer Relationship Management are

- Time constraint is unavoidable limitation of my study.

- Financial problem is also there in completing this project in a proper way.
  - As no work has been done earlier in this regard so shortage of secondary data is also there.
  - Insufficient disclosure of information is also the problem.

## **V.CONCLUSIONS**

From this study it can be concluded that the CRM involvement in industry is satisfactory. The company is using various Customer Relationship Management practices like product customization, maintaining communication with the customers regularly and providing best quality product etc. CRM has a certain impact on the profitability of the company. Rate of customer response towards marketing activities is also improving. There are various factors affecting the customer relationship management like working environment of the company, support from top management and co-ordination & synchronization among the departments of the company. Information technology is not used as much as it should be.

The company is using conventional tools of CRM like personal interviews, quantitative research. The company should use modern tools like e-CRM, data mining, contact center and web based survey tools.

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**On Generalized  $b\omega$ -Closed Sets in Ideal Topological Spaces**

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**Abstract:** The aim of this paper is to introduce the notions of generalized  $b\omega$ -closed sets in ideal topological spaces. Characterizations and properties of  $I_{gb\omega}$ -closed sets and  $I_{gb\omega}$ -open sets are given.

**Keywords:**  $I_{gb\omega}$ -closed set,  $I_{gb\omega}$ -open sets,  $b\omega$ - $X_I$  sets and  $b\omega$ - $Y_I$  sets.

**1. Introduction and Preliminaries**

An ideal  $I$  on a topological space  $(X, \tau)$  is a nonempty collection of subsets of  $X$  which satisfies (i)  $A \in I$  and  $B \subset A \Rightarrow B \in I$  and (ii)  $A \in I$  and  $B \in I \Rightarrow A \cup B \in I$ . Given a topological space  $(X, \tau)$  with an ideal  $I$  on  $X$  and if  $\wp(X)$  is the set of all subsets of  $X$ , a set operator  $(.)^*: \wp(X) \rightarrow \wp(X)$ , called a local function [9] of  $A$  with respect to  $\tau$  and  $I$  is defined as follows: for  $A \subseteq X$ ,  $A^*(I, \tau) = \{x \in X \mid U \cap A \notin I \text{ for every } U \in \tau(x) \text{ where } \tau(x) = \{U \in \tau \mid x \in U\}\}$ . We will make use of the basic facts about the local functions [8, Theorem 2.3] without mentioning it explicitly. A Kuratowski closure operator  $cl^*(.)$  for a topology  $\tau^*(I, \tau)$ , called the  $\star$ -topology, finer than  $\tau$  is defined by  $cl^*(A) = A \cup A^*(I, \tau)$  [18].

When there is no chance for confusion, we will simply write  $A^*$  for  $A^*(I, \tau)$  and  $\tau^*$  for  $\tau^*(I, \tau)$ . If  $I$  is an ideal on  $X$ , then  $(X, \tau, I)$  is called an ideal space.  $N$  is the ideal of all nowhere dense subsets in  $(X, \tau)$ .

**Definition 1.1:** A subset  $A$  of an ideal space  $(X, \tau, I)$  is said to be

- (i)  $\star$ -closed [8] if  $A^* \subseteq A$ .
- (ii)  $\star$ -dense in itself [6] if  $A \subseteq A^*$ .

(iii)  $\star$ -perfect [8] if  $A = A^*$ .

By a space, we always mean a topological space  $(X, \tau)$  with no separation properties assumed. If  $A \subseteq X$ ,  $\text{cl}(A)$  and  $\text{int}(A)$  will, respectively, denote the closure and interior of  $A$  in  $(X, \tau)$  and  $\text{int}^*(A)$  will denote the interior of  $A$  in  $(X, \tau^*)$ .

**Definition 1.2:** An ideal  $I$  is said to be

- (i) codense [4] or  $\tau$ -boundary [14] if  $\tau \cap I = \{\Phi\}$ .
- (ii) completely codense [4] if  $\text{PO}(X) \cap I = \{\Phi\}$ , where  $\text{PO}(X)$  is the family of all preopen sets in  $(X, \tau)$ .

**Lemma 1.3:** Every completely codense ideal is codense but not the converse [4].

**Definition 1.4:** A subset  $A$  of a space  $(X, \tau)$  is called a

- (i) semi-open set [10] if  $A \subseteq \text{cl}[\text{Int}(A)]$
- (ii)  $\alpha$ -open set [1] if  $A \subseteq \text{Int}[\text{cl}(\text{Int}(A))]$
- (iii) b-open set [20] if  $A \subseteq \text{cl}[\text{Int}(A)] \cup \text{Int}[\text{cl}(A)]$

The complement of a semi-open (resp.  $\alpha$ -open, b-open) set is called semi-closed (resp.  $\alpha$ -closed, b-closed) set. The intersection of all semi-closed (resp.  $\alpha$ -closed, b-closed) sets of  $X$  containing  $A$  is called the semi-closure ((resp.  $\alpha$ -closure, b-closure) and is denoted by  $\text{scl}(A)$  (resp.  $\alpha\text{cl}(A)$ ,  $\text{bcl}(A)$ ). The family of all semi-open (resp.  $\alpha$ -open, b-open) subsets of a space  $X$  is denoted by  $\text{SO}(X)$ , (resp.  $\alpha\text{O}(X)$ ,  $\text{bO}(X)$ ).

**Definition 1.5:** A subset  $A$  of  $(X, \tau)$  is called

- i) generalized closed (briefly g-closed) set [11] if  $\text{cl}(A) \subseteq U$  whenever  $A \subseteq U$  and  $U$  is open set in  $(X, \tau)$ .
- ii)  $\hat{g}$ -closed or  $\omega$ -closed set [19] if  $\text{cl}(A) \subseteq U$  whenever  $A \subseteq U$  and  $U$  is a semi-open set in  $(X, \tau)$ .



iii)  $b\hat{g}$ -closed or  $b\omega$ -closed set [20] if  $bcl(A) \subseteq U$ , whenever  $A \subseteq U$  and  $U$  is a  $\hat{g}$ -open set in  $(X, \tau)$ .

The complement of a  $g$ -closed (resp.  $\omega$ -closed and  $b\omega$ -closed) set is called  $g$ -open (resp.  $\omega$ -open and  $b\omega$ -open) set.

**Definition 1.6:** A subset  $A$  of an ideal space  $(X, \tau, I)$  is called

- i)  $I_g$ -closed [3] if  $A^* \subseteq U$  whenever  $A \subseteq U$  and  $U$  is open.
- ii)  $I_{g^*}$ -closed [22] if  $A^* \subseteq U$  whenever  $A \subseteq U$  and  $U$  is  $g$ -open.
- iii)  $I_{\hat{g}}$ -closed [21] if  $A^* \subseteq U$  whenever  $A \subseteq U$  and  $U$  is semi-open.

The following Lemmas will be useful in the sequel.

**Lemma 1.7.** Let  $(X, \tau, I)$  be an ideal space and  $A \subseteq X$ . If  $A \subseteq A^*$ , then  $A^* = cl(A^*) = cl(A) = cl^*(A)$  [17, Theorem 5].

**Lemma 1.8.** Let  $(X, \tau, I)$  be an ideal space. Then  $I$  is codense if and only if  $G \subseteq G^*$  for every semi-open set  $G$  in  $X$  [17, Theorem 3].

**Lemma 1.9.** Let  $(X, \tau, I)$  be an ideal space. If  $I$  is completely codense, then  $\tau^* \subseteq \tau^\alpha$  [17, Theorem 6].

**Result 1.10.** If  $(X, \tau)$  is a topological space, then every closed set is  $b\hat{g}$  or  $b\omega$ -closed set, but not conversely [20].

**Lemma 1.11.** Every  $g$ -closed set is  $I_g$ -closed but not conversely [3, Theorem 2.1].

**Remark 1.12.** The following statements are true in any ideal spaces:

- (i) Every closed set is  $\star$ -closed set but not conversely [8].
- (ii) Every  $\star$ -closed set is  $I_g$ -closed but not conversely [13].

**Lemma 1.13.** [8] Let  $(X, \tau, I)$  be an ideal space and  $A, B$  are subsets of  $X$ . Then the following properties hold:

- (i) If  $A \subseteq B$ , then  $A^* \subseteq B^*$ ,
- (ii)  $A^* = \text{cl}(A^*) \subseteq \text{cl}(A)$ ,
- (iii)  $(A^*)^* \subseteq A^*$ ,
- (iv)  $(A \cup B)^* = A^* \cup B^*$

## 2. $I_{gb\omega}$ -Closed Sets

**Definition 2.1.** A subset  $A$  of an ideal space  $(X, \tau, I)$  is said to be  $I_{gb\omega}$ -closed if  $A^* \subseteq U$  whenever  $A \subseteq U$  and  $U$  is  $b\omega$ -open. **Definition 2.2.** A subset  $A$  of an ideal space  $(X, \tau, I)$  is said to be  $I_{gb\omega}$ -open if  $X - A$  is  $I_{gb\omega}$ -closed.

**Theorem 2.3.** If  $(X, \tau, I)$  is any ideal space, then every  $I_{gb\omega}$ -closed set is  $I_g$ -closed but not conversely.

**Example 2.4.** Let  $X = \{a, b, c\}$ ,  $\tau = \{\Phi, X, \{a\}\}$  and  $I = \{\Phi, \{a\}\}$ . Then  $I_{gb\omega}$ -closed sets are  $\Phi, X, \{a\}, \{b, c\}$  and  $I_g$ -closed sets are  $\Phi, X, \{a\}, \{b\}, \{c\}, \{a, b\}, \{a, c\}, \{b, c\}$ . It is clear that  $\{b\}$  is  $I_g$ -closed but it is not  $I_{gb\omega}$ -closed.

The following theorem gives characterizations of  $I_{gb\omega}$ -closed sets.

**Theorem 2.5.** If  $(X, \tau, I)$  is any ideal space and  $A \subseteq X$ , then the following are equivalent.

- (a)  $A$  is  $I_{gb\omega}$ -closed.

(b)  $cl^*(A) \subseteq U$  whenever  $A \subseteq U$  and  $U$  is  $b\omega$ -open in  $X$ .

Proof. (a)  $\Rightarrow$  (b) If  $A$  is  $I_{gb\omega}$ -closed, then  $A^* \subseteq U$  whenever  $A \subseteq U$  and  $U$  is  $b\omega$ -open in  $X$  and so  $cl^*(A) = A \cup A^* \subseteq U$  whenever  $A \subseteq U$  and  $U$  is  $b\omega$ -open in  $X$ . This proves (b).

(b)  $\Rightarrow$  (a) Let  $cl^*(A) \subseteq U$  whenever  $A \subseteq U$  and  $U$  is  $b\omega$ -open in  $X$ . Since  $A^* \subseteq cl^*(A) \subseteq U \Rightarrow A^* \subseteq U$ . Hence  $A$  is  $I_{gb\omega}$ -closed.

**Theorem 2.6:** If a subset  $A$  of  $(X, \tau, I)$  is  $I_{gb\omega}$ -closed set, then

(1)  $cl^*(A) - A$  contains no nonempty  $b\omega$ -closed set.

(2)  $A^* - A$  contains no nonempty  $b\omega$ -closed set.

Proof.

(1) Let  $A$  be a  $I_{gb\omega}$ -closed set in  $(X, \tau, I)$  and  $F$  be a  $b\omega$ -closed subset of  $cl^*(A) - A$ . Then  $A \subseteq X - F$ . Since  $X - F$  is  $b\omega$ -open and  $A$  is  $I_{gb\omega}$ -closed,  $cl^*(A) \subseteq X - F$ . Consequently,  $F \subseteq X - cl^*(A)$ . We have  $F \subseteq cl^*(A)$ . Thus,  $F \subseteq cl^*(A) \cap (X - cl^*(A)) = \Phi$  and so  $cl^*(A) - A$  contains no nonempty  $b\omega$ -closed set.

(2) The fact is  $cl^*(A) - A = (A \cup A^*) - A = (A \cup A^*) \cap A^c = (A \cap A^c) \cup (A^* \cap A^c) = A^* \cap A^c = A^* - A$ .

**Theorem 2.7.** Every  $\star$ -closed set is  $I_{gb\omega}$ -closed but not conversely.

Proof. Let  $A$  be a  $\star$ -closed, then  $A^* \subseteq A$ . Let  $A \subseteq U$  where  $U$  is  $b\omega$ -open. Hence  $A^* \subseteq U$  whenever  $A \subseteq U$  and  $U$  is  $b\omega$ -open. Therefore  $A$  is  $I_{gb\omega}$ -closed.

**Example 2.8.** Let  $X = \{a, b, c\}$ ,  $\tau = \{\Phi, X, \{a\}\}$  and  $I = \{\Phi, \{a\}, \{c\}, \{a, c\}\}$ . Then  $I_{gb\omega}$ -closed sets are  $\Phi, X, \{a\}, \{c\}, \{a, c\}, \{b, c\}$  and  $\star$ -closed sets are  $\Phi, X, \{a\}, \{c\}, \{a, c\}$ . It is clear that  $\{b, c\}$  is  $I_{gb\omega}$ -closed set but it is not  $\star$ -closed.

**Theorem 2.9.** Let  $(X, \tau, I)$  be an ideal space. For every  $A \in I$ ,  $A$  is  $I_{gb\omega}$ -closed.

Proof. Let  $A \subseteq U$  where  $U$  is  $b\omega$ -open set. Since  $A^* = \Phi$  for every  $A \in I$ , then  $cl^*(A) = A \cup A^* = A \subseteq U$ . Therefore, by Theorem 2.5,  $A$  is  $I_{gb\omega}$ -closed.

**Theorem 2.10.** If  $(X, \tau, I)$  is an ideal space, then  $A^*$  is always  $I_{gb\omega}$ -closed for every subset  $A$  of  $X$ .

Proof. Let  $A^* \subseteq U$  where  $U$  is  $b\omega$ -open. Since  $(A^*)^* \subseteq A^*$  [8], we have  $(A^*)^* \subseteq U$  whenever  $A^* \subseteq U$  and  $U$  is  $b\omega$ -open. Hence  $A^*$  is  $I_{gb\omega}$ -closed.

**Theorem 2.11.** Let  $(X, \tau, I)$  be an ideal space. Then every  $I_{gb\omega}$ -closed,  $b\omega$ -open set is  $\star$ -closed set.

Proof. Since  $A$  is  $I_{gb\omega}$ -closed and  $b\omega$ -open. Then  $A^* \subseteq A$  whenever  $A \subseteq A$  and  $A$  is  $b\omega$ -open. Hence  $A$  is  $\star$ -closed.

**Theorem 2.12.** Let  $(X, \tau, I)$  be an ideal space and  $A$  be a  $I_{gb\omega}$ -closed set. Then the following are equivalent.

- a)  $A$  is a  $\star$ -closed set.
- b)  $cl^*(A) - A$  is a  $b\omega$ -closed set.
- c)  $A^* - A$  is a  $b\omega$ -closed set.

Proof.

(a)  $\Rightarrow$  (b) If  $A$  is  $\star$ -closed, then  $A^* \subseteq A$  and so  $cl^*(A) - A = (A \cup A^*) - A = \Phi$ . Hence  $cl^*(A) - A$  is  $b\omega$ -closed set.

(b)  $\Rightarrow$  (c) Since  $cl^*(A) - A = A^* - A$  and so  $A^* - A$  is  $b\omega$ -closed set.

(c)  $\Rightarrow$  (a) If  $A^* - A$  is a  $b\omega$ -closed set, since  $A$  is  $I_{gb\omega}$ -closed set, by Theorem 2.6,  $A^* - A = \Phi$  and so  $A$  is  $\star$ -closed.

**Example 2.13.** Let  $X=\{a,b,c\}$ ,  $\tau=\{\Phi,X,\{a\},\{b\},\{a,b\}\}$  and  $I=\{\Phi,\{b\}\}$ . Then g-closed sets are  $\Phi,X,\{c\},\{a,c\},\{b,c\}$  and  $I_{gb\omega}$ -closed sets are  $\Phi,X,\{b\},\{c\},\{a,c\},\{b,c\}$ . It is clear that  $\{b\}$  is  $I_{gb\omega}$ -closed set but it is not g-closed.

**Example 2.14.** Let  $X=\{a,b,c\}$ ,  $\tau=\{\Phi,X,\{a\}\}$  and  $I=\{\Phi\}$ . Then g-closed sets are  $\Phi,X,\{b\},\{c\},\{a,b\},\{a,c\},\{b,c\}$  and  $I_{gb\omega}$ -closed sets are  $\Phi,X,\{b,c\}$ . It is clear that  $\{b\},\{c\},\{a,b\},\{a,c\}$  are g-closed sets but are not  $I_{gb\omega}$ -closed.

**Remark 2.15.** By Example 2.13 and Example 2.14, g-closed sets and  $I_{gb\omega}$ -closed sets are independent.

**Remark 2.16.** We have the following implications for the subsets stated above.

**Theorem 2.17.** Let  $(X,\tau,I)$  be an ideal space and  $A \subseteq X$ . If  $A \subseteq B \subseteq A^*$ , then  $A^*=B^*$  and  $B$  is  $\star$ -dense in itself.

Proof. Since  $A \subseteq B$ , then  $A^* \subseteq B^*$  and since  $B \subseteq A^*$ , then  $B^* \subseteq (A^*)^* \subseteq A^*$ . Therefore  $A^*=B^*$  and  $B \subseteq A^* \subseteq B^*$ . Hence proved.

**Theorem 2.18.** Let  $(X,\tau,I)$  be an ideal space. If  $A$  and  $B$  are subsets of  $X$  such that  $A \subseteq B \subseteq A^*$  and  $A$  is  $I_{gb\omega}$ -closed, then  $B$  is  $I_{gb\omega}$ -closed.

Proof. Let  $U$  be any  $b\omega$ -open set of  $(X,\tau,I)$  such that  $B \subseteq U$ . Then  $A \subseteq U$ . Since  $A$  is  $I_{gb\omega}$ -closed, we have  $A^* \subseteq U$ . Now  $B^* \subseteq (A^*)^* \subseteq A^* \subseteq U$ . Therefore  $B$  is  $I_{gb\omega}$ -closed.

The following theorem gives a characterization of  $I_{gb\omega}$ -open sets.

**Theorem 2.19.** Let  $(X, \tau, I)$  be an ideal space and  $A \subseteq X$ . Then  $A$  is  $I_{gb\omega}$ -open if and only if  $F \subseteq \text{int}^*(A)$  whenever  $F$  is  $b\omega$ -closed and  $F \subseteq A$ .

Proof. Suppose  $A$  is  $I_{gb\omega}$ -open. If  $F$  is  $b\omega$ -closed and  $F \subseteq A$ , then  $X-A \subseteq X-F$  and so  $\text{cl}^*(X-A) \subseteq X-F$  by Theorem 2.5. Therefore  $F \subseteq X - \text{cl}^*(X-A) = \text{int}^*(A)$ . Hence  $F \subseteq \text{int}^*(A)$ .

Conversely, suppose the condition holds. Let  $U$  be a  $b\omega$ -open set such that  $X-A \subseteq U$ . Then  $X-U \subseteq A$  and so  $X-U \subseteq \text{int}^*(A)$ . Therefore  $\text{cl}^*(X-A) \subseteq U$ . By Theorem 2.5,  $X-A$  is  $I_{gb\omega}$ -closed. Hence  $A$  is  $I_{gb\omega}$ -open.

The following theorem gives a characterization of  $I_{gb\omega}$ -closed sets in terms of  $I_{gb\omega}$ -open sets.

**Theorem 2.20.** Let  $(X, \tau, I)$  be an ideal space and  $A \subseteq X$ . Consider the following statements.

1.  $A$  is  $I_{gb\omega}$ -closed,
2.  $A \cup (X-A^*)$  is  $I_{gb\omega}$ -closed,
3.  $A^* - A$  is  $I_{gb\omega}$ -open.

Then we have (1)  $\Rightarrow$  (2)  $\Leftrightarrow$  (3).

Proof.

(1) $\Rightarrow$ (2) Suppose  $A$  is  $I_{gb\omega}$ -closed. If  $U$  is any  $\omega$ -open set such that  $A \cup (X-A^*) \subseteq U$ , then  $X-U \subseteq X - (A \cup (X-A^*)) = X \cap (A \cup (A^*)^c)^c = A^* \cap A^c = A^* - A$ . Since  $A$  is  $I_{gb\omega}$ -closed, by Theorem 2.6, it follows that  $X-U = \Phi$  and so  $X=U$ . Therefore  $A \cup (X-A^*) \subseteq U$  which implies that  $A \cup (X-A^*) \subseteq X$  and so  $(A \cup (X-A^*))^* \subseteq X^* \subseteq X=U$ . Hence  $A \cup (X-A^*)$  is  $I_{gb\omega}$ -closed.

(2) $\Leftrightarrow$ (3) Since  $X - (A^* - A) = X \cap (A^* \cap A^c)^c = X \cap ((A^*)^c \cup A) = (X \cap (A^*)^c) \cup (X \cap A) = A \cup (X - A^*)$  is  $I_{gb\omega}$ -closed. Hence  $A^* - A$  is  $I_{gb\omega}$ -open.

**Theorem 2.21.** Let  $(X, \tau, I)$  be an ideal space. Then every subset of  $X$  is  $I_{gb\omega}$ -closed if and only if every  $b\omega$ -open set is  $\star$ -closed.

Proof. Suppose every subset of  $X$  is  $I_{gb\omega}$ -closed. If  $U \subseteq X$  is  $b\omega$ -open, then by hypothesis,  $U$  is  $I_{gb\omega}$ -closed and so  $U^* \subseteq U$ . Hence  $U$  is  $\star$ -closed.

Conversely, suppose that every  $b\omega$ -open set is  $\star$ -closed. Let  $A$  be a subset of  $X$ . If  $U$  is  $b\omega$ -open set such that  $A \subseteq U$ , then  $A^* \subseteq U^* \subseteq U$  and so  $A$  is  $I_{gb\omega}$ -closed.

**Theorem 2.22.** The union of two  $I_{gb\omega}$ -closed sets is again  $I_{gb\omega}$ -closed.

Proof. Suppose that  $(A \cup B) \subseteq U$  and  $U$  is  $b\omega$ -open in  $(X, \tau, I)$ , then  $A \subseteq U$  and  $B \subseteq U$ . Since  $A$  and  $B$  are  $I_{gb\omega}$ -closed sets,  $A^* \subseteq U$  and  $B^* \subseteq U$ .  $(A \cup B)^* = A^* \cup B^* \subseteq U$ . Thus,  $A \cup B$  is  $I_{gb\omega}$ -closed.

**Theorem 2.23.** For each  $x \in (X, \tau, I)$ , either  $\{x\}$  is  $b\omega$ -closed or  $\{x\}^c$  is  $I_{gb\omega}$ -closed in  $(X, \tau, I)$ .

Proof. Suppose that  $\{x\}$  is not  $b\omega$ -closed, then  $\{x\}^c$  is not  $b\omega$ -open and the only  $b\omega$ -open set containing  $\{x\}^c$  is the space  $(X, \tau, I)$  itself. Therefore  $cl^*(\{x\}^c) \subseteq X$  and so  $\{x\}^c$  is  $I_{gb\omega}$ -closed.

**Definition 2.24.** A subset  $A$  of an ideal topological space  $(X, \tau, I)$  is said to be

- 1) a  $b\omega$ - $X_I$ -set if  $A = U \cap V$ , where  $U$  is a  $b\omega$ -open set and  $V$  is a  $\star$ -perfect set.
- 2) a  $b\omega$ - $Y_I$ -set if  $A = U \cap V$ , where  $U$  is a  $b\omega$ -open set and  $V$  is a  $\star$ -closed set.

**Theorem 2.25.** A subset  $A$  of an ideal topological space  $(X, \tau, I)$  is a  $b\omega$ - $X_I$ -set and a  $I_{gb\omega}$ -closed set, then  $A$  is a  $\star$ -closed set.

Proof. Let  $A$  be a  $b\omega$ - $X_1$  -set and a  $I_{gb\omega}$ -closed set. Since  $A$  is a  $b\omega$ - $X_1$  -set,  $A = U \cap V$ , where  $U$  is a  $b\omega$ -open set and  $V$  is a  $\star$ -perfect set. Now,  $A = U \cap V \subseteq U$  and  $A$  is a  $I_{gb\omega}$ -closed set implies that  $A^* \subseteq U$ . Also,  $A = U \cap V \subseteq V$  and  $V$  is  $\star$ -perfect set implies that  $A^* \subseteq V$ . Thus,  $A^* \subseteq U \cap V = A$ . Hence,  $A$  is a  $\star$ -closed set.

**Theorem 2.26.** For a subset  $A$  of an ideal topological space  $(X, \tau, I)$ , the following are equivalent.

1.  $A$  is a  $\star$ -closed set.
2.  $A$  is a  $b\omega$ - $Y_1$  -set and a  $I_{gb\omega}$ -closed set.

Proof.

(1)  $\Rightarrow$  (2): Let  $A$  be a  $\star$ -closed set and  $A = X \cap A$ , where  $X$  is  $b\omega$ -open set and  $A$  is a  $\star$ -closed set. Hence,  $A$  is a  $b\omega$ - $Y_1$  -set. Assume that  $A$  be a  $\star$ -closed set and  $U$  be a  $b\omega$ -open set such that  $A \subseteq U$ . Then  $A^* \subseteq U$  and hence  $A$  is a  $I_{gb\omega}$ -closed set.

(2)  $\Rightarrow$  (1): Let  $A$  be a  $b\omega$ - $Y_1$  -set and a  $I_{gb\omega}$ -closed set. Since  $A$  is a  $b\omega$ - $Y_1$  -set,  $A = U \cap V$ , where  $U$  is a  $b\omega$ -open set and  $V$  is a  $\star$ -closed set. Now,  $A \subseteq U$  and  $A$  is a  $I_{gb\omega}$ -closed set implies that  $A^* \subseteq U$ . Also,  $A \subseteq V$  and  $V$  is a  $\star$ -closed set implies that  $A^* \subseteq V$ . Thus,  $A^* \subseteq U \cap V = A$ . Hence,  $A$  is a  $\star$ -closed set.

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