Original Article

Effect of Sumac (*Rhus Coriaria* L.) Fruit Powder as an Antibiotic Growth Promoter Substitution on Growth Performance, Immune Responses and Serum Lipid Profile of Broiler Chicks

Majid Toghyani*, Nahal Faghan

Department of Animal Science, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, IRAN

ABSTRACT

Objective: The experiment was conducted to evaluate effect of different levels of sumac (*Rhus coriaria* L.) fruit powder as an antibiotic growth promoter (AGP) substitution on performance, immune responses and serum lipid profile of broiler chicks. **Materials and Methods:** A totally of 260 one-day-old broiler chicks (Ross 308) were used in a completely randomized design with four treatments. The treatments consisted of basal diet (control) and basal diet with AGP (flavophospholipol), 3 or 7 g/kg sumac powder. **Results:** Feed consumption in broilers fed 3 and 7 g/kg sumac powder significantly decreased ($P < 0.05$) but weight gain were not affected by dietary treatments ($P > 0.05$). Feed conversion ratio was significantly improved in broilers fed 7 g/kg sumac powder compared to AGP and control ($P < 0.05$). Antibody titres against sheep red blood cell (SRBC), New castle diseases virus (NDV) and Avian Influenza virus (AIV) were not affected by dietary treatments ($P > 0.05$). Improvement in heterophile to lymphocyte ratio were observed in broilers fed 7 g/kg sumac powder and AGP ($P < 0.05$). Serum triglyceride, cholesterol, HDL and LDL cholesterol were not affected by treatments ($P > 0.05$). **Conclusion:** The results suggested that dietary inclusion of 7 g/kg sumac powder can be applied as alternatives to in-feed antibiotics for broiler chick diets.

Key words: Broiler chick, Sumac, Performance, Immunity, Serum lipid.

INTRODUCTION

Antibiotic growth promoters have been successfully used at sub therapeutic doses in poultry production to promote growth and protect health of the birds. The growing concerns about antibiotic residues in final poultry products and the risk of bacteria acquiring resistance to these specific antibiotics has arisen into a controversial issue around the world. Consequently, there has been a considerable interest in finding alternatives for in-feed antibiotics of plant origin. Phytogenic and herbal products have received increased attention in recent years because they have been accepted by consumers as natural additives.[1] Beneficial effects of bioactive plant substances in animal nutrition may include the stimulation of appetite and feed intake, the improvement of endogenous digestive enzyme secretion, activation of immune responses and antibacterial, antiviral and antioxidant actions.[2] Sumac (*Rhus coriaria* L.) belongs to Anacardiaceous family and it grows widely in Asian countries. The fruits of sumac contain flavonols such as myricetin, quercetin and kaempferol,[3] phenolic acids, hydrolysable tannins, anthocyanins, and organic acids such as malic, citric and tartaric acids.[4,5] Sumac is used as an herbal remedy in traditional medicine because of its assumed analgesic, antidiarrheal, antiseptic, anorectic, and antihyperglycemic properties.[6] Beneficial

DOI: 10.5530/ijper.51.3s.33
Correspondence:
Majid Toghyani,
Department of Animal Science, Isfahan (Khorasgan) Branch, Islamic Azad University, Isfahan, IRAN
Contact: 983135354001
E-mail: toghiani@hotmail.com

www.ijper.org

effects of sumac application in poultry diets have been reported by some researchers.[7-9]

The significant biological properties of sumac powder make it a potential substitute for in-feed antibiotics in poultry diets. Therefore, this study was conducted to evaluate in-feed antibiotics potential of sumac (Rhus coriaria L.) fruit powder and its effect on performance, immune responses and serum lipid profile in broiler chicks.

MATERIALS AND METHODS

Birds and dietary treatments

Two hundred sixty, one-day-old broiler chicks of mixed sexes (Ross-308) were weighted and randomly assigned to each of the 4 treatment groups, each with 5 replicate pens of 13 chicks. Flavophospholipol as a commercial antibiotic growth promoter (AGP) was used. The dietary treatments consisted of basal diet (control), control +4.5 mg AGP/ kg, and control +3 or 7 g sumac fruit powder/kg diet. Broiler chicks were fed a corn-soybean meal basal diet in three phases: starter 0 to 14 d (ME: 2860 Kcal/kg, CP: 21.5%), grower 14 to 28 d (ME: 2850 Kcal/kg, CP: 20%), and finisher 28 to 42 d (ME: 3040 Kcal/kg, CP: 19%). All the dietary treatments were added to the basal diets at the expense of corn. Chicks were raised on floor pens (110×110×80 cm) for 42 d and had free access to feed and water.

Growth performance

Body weights of broilers were determined at 1, 14, 28, and 42 d of age. Daily body weight gain and daily feed consumption were recorded in different periods and feed conversion ratio (feed consumption/weight gain) was calculated. Mortality was recorded as it occurred.

Immune responses

Antibody titres against Newcastle disease virus (NDV), Avian Influenza virus (AIV), and sheep red blood cells (SRBC), and heterophile to lymphocyte (H:L) were measured as immune responses. At 28 days of age two birds per replicate were randomly chosen and blood samples were collected from brachial vein and centrifuged to obtain serum. Antibody titres against NDV and AIV were measured using Hemagglutination Inhibition Test and antibody titres against SRBC were measured by the microtiter procedure described by Wegmann and Smithies.[10] At 42 days of age two birds per replicate were selected and blood samples were collected by syringes containing heparin to avoid blood clot formation. Blood samples were prepared on slides and painted by Gimsa methods for determination heterophil to lymphocyte ratio.[11]

Serum lipid profile

Serum concentration of triglyceride, cholesterol, HDL and LDL cholesterol were determined as serum lipid profile. In order to determine serum lipid profile blood samples (2 samples per replicate) were collected at 42 d and its concentrations were determined in serum using spectrophotometer and the kit package manufactured by Pars Azmoon Company, Tehran, Iran.

Statistical analysis

The data were subjected to analysis of variance procedures appropriate for a completely randomized design using the General Linear Model procedures of SAS Institute.[12] Means were compared using LSD test. Statements of statistical significance are based on $P<0.05$.

RESULTS AND DISCUSSION

Effect of dietary treatments on growth performance of broiler chicks are shown in Table 1. Body weight and weight gain of birds tended to increase in 7 g/kg sumac powder. Feed intake were decreased in broilers fed sumac powder ($P< 0.05$). The most efficient feed conversion ratio was observed in broilers fed 7 g/kg sumac powder ($P< 0.05$). Improvement in growth performance of broiler chicks by sumac powder or extract reported by some researchers.[9, 13,14] The improvement may be due to the active substances such as cinnamaldehyde and eugenol found in sumac, causing greater efficiency in the utilization of feed, resulting in enhanced growth. Rayne and Mazza[6] showed that sumac extracts have been found to have antimicrobial, antioxidant activities and has led to better growth and performance for broilers.

Effect of dietary treatments on immune related parameters are presented in Table 2. Antibody titres against AIV, NDV and SRBC as humoral immune responses were not affected by dietary treatments ($P> 0.05$). Heterophile to lymphocyte ratio decreased and improved in AGP and both levels of supplemented sumac powder particularly in 7 g/kg of inclusion ($P< 0.05$). The heterophile to lymphocyte ratio is the indicator of the physiological stress as the numbers of heterophiles increase during moderately stressful conditions.[15] Due to the fact that there is no disease challenge in this trial, the ratio of heterophile to lymphocyte has not been expected to increase. Therefore, decreased ratio might show that sumac powder did not impose any stress. Same findings by other phytogenic additives were reported by Landy et al,[1] who showed the marginal decrease of this ratio. In

Table 1: Effect of dietary treatments on broiler performance at 1 to 42 d.

Performance Parameters	Treatments				SEM
	Control	AGP	3g/kg SP	7g/kg SP	
Body weight (g)	2331.0^{ab}	2323.2^{b}	2304.4^{b}	2374.4^{ab}	18.94
Weight gain (g/d)	54.4^{ab}	54.3^{b}	53.8^{b}	55.5^{ab}	0.69
Feed intake (g/d)	96.6^{a}	92.3^{abc}	87.8^{c}	89.5^{bc}	1.62
FCR (g:g)	1.72^{a}	1.72^{a}	1.68^{a}	1.61^{b}	0.03

^{a,b,c} Values in the same row not sharing a common superscript differ significantly (P<0.05).
AGP: Antibiotic growth promoter, SP: Sumac powder, FCR: Feed conversion ratio.

Table 2: Effect of dietary treatments on immune responses of broiler chicks.

Immunity parameters	Treatments				SEM
	Control	AGP	3g/kg SP	7g/kg SP	
AIV (log2)	5.00^{a}	5.30^{a}	5.20^{a}	5.40^{a}	0.39
NDV(log2)	5.00^{a}	5.20^{a}	4.40^{a}	4.70^{a}	0.39
SRBC(log2)	9.10^{a}	9.10^{a}	8.50^{a}	9.20^{a}	0.51
H:L	0.65^{a}	0.43^{c}	0.55^{b}	0.51^{b}	0.03

^{a,b,c} Values in the same row not sharing a common superscript differ significantly (P<0.05).
AGP: Antibiotic growth promoter; SP: Sumac powder; AIV: *Avian Influenza virus*; NDV: *Newcastle disease virus*; SRBC: *sheep red blood cells*; H:L: *heterophile to lymphocyte* ratio

Table 3: Effect of dietary treatments on serum lipid profile of broiler chicks at 42 d.

Serum lipid (mg/100 ml)	Treatments				SEM
	Control	AGP	3g/kg SP	7g/kg SP	
Triglyceride	168 ^{a}	174 ^{a}	167 ^{a}	156 ^{a}	12.77
Cholesterol	184 ^{a}	185 ^{a}	177 ^{a}	178 ^{a}	8.59
HDL Cholesterol	88 ^{a}	85 ^{a}	88 ^{a}	85 ^{a}	3.41
LDL Cholesterol	63 ^{a}	64 ^{a}	58 ^{a}	61 ^{a}	4.92

^{a,b} Values in the same row not sharing a common superscript differ significantly (P<0.05).
AGP: Antibiotic growth promoter; SP: Sumac powder.

the present study, because of some active substances in sumac as immune modulator we anticipated that sumac powder improves humoral immunity of broilers but it did not occur. According to our observation, Mansoub[13] reported sumac powder had not significant effect on humoral immunity of broiler chicks.

As shown in Table 3, serum HDL and LDL cholesterol were not affected by dietary treatments (P> 0.05). Serum cholesterol and triglyceride were not significantly affected by treatments but it tended to be lower in broilers fed both levels of supplemented sumac powder. In agreement to our results, Valiollahi *et al*,[14] reported the lower serum concentration of triglyceride and cholesterol in broilers fed sumac powder. The hypocholesterolemic action of sumac may be related to its polyphenolic components. Phenolic compounds founded in sumac can inhibit lipid peroxidation, scavenge the superoxide anion and hydroxyl radical, and enhance the activities of detoxifying enzymes such as glutathione-S-transferase.[16] D-limonene is a monocyclic monoterpene component of sumac that has hypocholesterolemic effects.[17] Polyphonols have been shown to depress the reverse cholesterol transport, reduce the intestinal cholesterol absorption and even increase bile acid excretion.[13]

CONCLUSION

According to current results, it could be concluded that dietary inclusion of 7 g/kg sumac fruit powder can be applied as an antibiotic growth promoter alternatives without any adverse effects on immune responses in broiler chick diets.

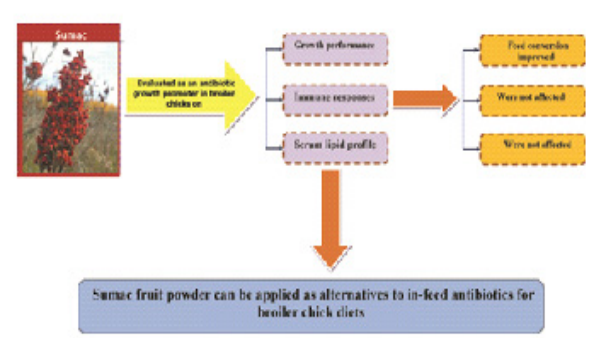
CONFLICT OF INTEREST

The authors contributing to this study and manuscript have no conflict of interests.

REFERENCES

1. Landy N, Ghalamkari G, Toghyani M. Performance, carcass characteristics and immunity in broiler chicks fed dietary neem (Melia azadirachta) as alternative for an antibiotic growth promoter. Livest Sci. 2011;142(1):305-9.
2. Nouzarian R, Tabeidian SA, Toghyani M, Ghalamkari G, Toghyani M. Effect of turmeric powder on performance, carcass traits, humoral immune responses, and serum metabolites in broiler chickens. J Anim Feed Sci. 2011;20:389-400.
3. Mehrdad M. Validated high throughput HPLC method for the analysis of flavonol aglyconesmyricetin, quercetin, and kaempferol in Rhus coriaria L. using a monolithic column. J AOAC Int. 2009;92(4):1035-43.
4. Özcan M, Haciseferogullari H. A condiment sumac (Rhus coriaria L.) fruits: Properties. Bulg J Plant Physiol. 2004;30(3-4):74-84.
5. Jung NC. Biological activity of urushiol and flavanoid from Lac tree (Rhus verniciflua Stokes). Ph.D. Thesis Chonnam National University, Kwang-Ju, South Korea. 1998.
6. Rayne S, Mazza G. Biological activities of extracts from sumac (Rhus spp.): a review. Plant Food Human Nutr. 2007;62(4):165-75.
7. Kheiri F, Rahimian Y, Nasr J. Application of sumac and dried whey in female broiler feed. Arch Anim Breed. 2015;58:205-10.
8. Alishah AS, Daneshyar M, Aghazadeh A. The effect of dietary sumac fruit powder (Rhus coriaria L.) on performance and blood antioxidant status of broiler chickens under continuous heat stress condition. Ital J Anim Sci. 2013;12(1):e6.
9. Gulmez, M, Oral N, Vatanever L. The effect of water extract of sumac (Rhus coriaria L.) and lactic acid on decontamination and shelf life of raw broiler wing. Poult Sci. 2006;85(8):1466-71.
10. Wegmann TG, Smithies O. A simple hemagglutination system requiring small amounts of red blood cells and antibodies. Transfusion. 1966;6(1):67-73.
11. Gross WB, Siegel PS. Evaluation of heterophil to lymphocyte ratio as a measure of stress in chickens. Avian Dis. 1983;27:972-9.
12. SAS Institute, SAS User's Guide: Version 9.2 Review Edition. SAS Institute Inc, Cary, NC. 2008.
13. Mansoub HN. Effect of different levels of sumac powder (Rhus Coriaria L.) on performance, carcass and blood parameters of broiler chickens. Ann Biol Res. 2012;25:647-52.
14. Valiollahi MR, Gholami M, Namjoo AR, Rahimian Y, Rafiee A. Effect of using Sumac (Rhus coriaria L.) and Ajwain (Trachyspermum copticum) powders on performance and intestinal microbial population in broiler chicks. Res Opin Anim Vet Sci. 2014;4(10):545-9.
15. Maxwell MH, Robertson GW. The avian basophilic leukocyte: a review. World Poult Sci J. 1995;51(3):307-25.
16. Piper TJ, Singhal SS, Salameh MS, Torman RT, Awasthi YC, Awasthi S. Mechanisms of anticarcinogenic properties of curcumin: the effect of curcumin on glutathione linked detoxification enzymes in rat liver. Int J Biochem Cell Biol. 1998;30(4):445-56.
17. Kurucu S, Koyuncu M, Guvenc A, Baser KHC, Ozek T. The essential oil of Rhus coriaria L. (sumac). J Essential Oil Res. 1993;5(5):481-6.

PICTORIAL ABSTRACT



SUMMARY

- Our objective was to evaluate effect of different levels of sumac (*Rhus coriaria* L.) fruit powder as an antibiotic growth promoter (AGP) substitution on performance, immune responses and serum lipid profile of broiler chicks.
- 260 one-day-old broiler chicks were used in four dietary treatments: basal diet (control) and basal diet with AGP (flavophospholipol), 3 or 7 g/kg sumac powder.
- Feed conversion improved in broilers fed 7 g/kg sumac powder compared to AGP and control ($P < 0.05$).
- Immunity and serum lipid profile of broilers were not affected by dietary treatments.
- Dietary inclusion of 7 g/kg sumac powder can be applied as alternatives to in-feed antibiotics for broiler chick diets.

ABOUT AUTHORS

Majid Toghyani: He is working as a full professor in the Department of Animal Science at Islamic Azad University of Isfahan, IRAN. Dr. Majid Toghyani has research experience in the field of poultry nutrition.

Nahal Faghan: She is a M.Sc student at Department of Animal Science at Islamic Azad University of Isfahan, IRAN.

Cite this article: Toghyani M, Faghan N. Effect of Sumac (*Rhus Coriaria* L.) Fruit Powder as an Antibiotic Growth Promoter Substitution on Growth Performance, Immune Responses and Serum Lipid Profile of Broiler Chicks. Indian J of Pharmaceutical Education and Research. 2017;51(3)Suppl:S295-98.