

Effect of SuperYea and Mixture of SuperYea with Single, Double and Multi of Microbes on Growth Performance and Nutrient Digestibility in Growing Pigs

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Abstract

This study was conducted to compare the effect of dietary supplementation of SuperYea, SuperYea mixture with single, double and multi-strain microbes on growth performance, nutrient digestibility and fecal noxious gas content in growing pigs. One hundred and forty female pigs (24.00 ± 0.50 kg) were divided into 5 treatments with 6 replicates of eighteen pigs each and analyzed by completely randomized design (CRD). The diets were composed by Treatment I) basal diet+SuperYea, Treatment II) basal diet+SuperYea+*Bacillus subtilis* (1 × 10¹² CFU), Treatment III) basal diet+SuperYea+*Saccharomyces cerevisiae* (5 × 10⁹ CFU), Treatment IV) basal diet+SuperYea+*Bacillus subtilis* (1 × 10¹² CFU)+*Lactobacillus lactis* (1 × 10¹¹ CFU) and Treatment V) basal diet+SuperYea+*Bacillus subtilis* (1 × 10¹² CFU)+*Lactobacillus lactis* (1 × 10¹¹ CFU)+*Saccharomyces cerevisiae* (5 × 10⁹ CFU). The results of the experiment showed that pigs fed with mixture of SuperYea and multi-strain microbes in diets showed heavier final body weights (67.20, 66.85, 65.44, 65.42, 65.47), body weight gain (42.80, 41.60, 40.99, 40.97, 40.97) and average daily gain (668.49, 660.32, 650.63, 650.32, 650.32) than another diets (P<0.05). The dry matter digestibilities of SuperYea mixed with multi-strain microbes were higher (P<0.05) than single strain treatments (86.53, 85.79, 84.40, 84.37, 84.44). The crude protein digestibilities were increased (P<0.05) with supplementation of multi-strain microbial in diet than another treatments (4.56, 4.46, 4.32, 4.30, 4.35). In conclusion, dietary inclusion of multi-strain microbes could be improve growth performance and nutrient digestibility and the decrease of ammonia in faecal.

Keywords: Synbiotic; Performance; Digestibility; Grower pigs; Multi-strain microbes; Pathogenic organism

Introduction

Normally, the intensive farming system had antibiotic on pig's diet especially during the post weaning period (4-5 weeks of age) where piglets are weakened by pathogenic microorganism and other factors. Major losses of piglets are a result of diarrhea and found in most of the pig farms. Using antibiotic clearly prevents diarrhea during post weaning period [1]. However, the use of antibiotics was banned around the world since the year 2006. Consequently, feed additives are alternative substitution of antibiotics and are intensively focused around the world.

Using feed additive is one of the strategies on feed management. The synbiotic approach is a part in using feed additives through the combination of prebiotic and probiotic. The synbiotic can be useful in stimulating beneficial bacteria and improving performance, digestibility and health [2-4]. Several studies showed that multi-strain probiotics had more effect on growth of the host animal when compared to one-strain probiotics [5-8]. Non-digestible oligosaccharides (NDO) can be regarded as prebiotics because there are available as substrates for the gastrointestinal microflora [9-11] and probiotics can be characterized as live microbial feed supplements which beneficially affect the host by improving its intestinal microbial balance [12,13].

This study was conducted to compare the effect of SuperYea, a domestic prebiotic from Rich and Green Co., Ltd., together with imported probiotic being used in most pig farms in Thailand. SuperYea alone and mixture of SuperYea with single, double and multi-strain of microbial as synbiotic source are studied on growth performance, nutrient digestibility and fecal noxious gas content of growing pigs.

Materials and Methods

This study was conducted at Nongbua Farm and Country Home Village Co., Ltd at Ratchaburi Province, Thailand. Experimental

animals were kept, maintained and treated in adherence to accept standards for the humane Ct of animals in large commercial farm with high standard of feeding and management.

SuperYea

The SuperYea is manufactured using by-product from ethanol factory having molasses as initial substrate mixing with yeast culture. The SuperYea contains high levels of minerals and protein but low in fiber. The additional ingredient in SuperYea is β-glucan which is good sources of feed additive [13].

Animal and managements

Three hundred and twenty four commercial crossbred female piglets (Duroc × Large White × Landrace; 24.00 ± 0.50 kg body weight) were used in this trail. The pigs were divided into 5 treatments and each treatment consisted of six pens (eighteen pigs/pen). The piglets were raised in naturally ventilated houses consisting of 18 pens (4 × 5 m²), and each pen was assigned a crib and two of water nipples. During the feed trail, the piglets were bathed and the house was cleaned two days interval, while the face of piglets was removed every day.

Experimental design and diets

The Completely Randomized Design (CRD) was used as an

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experimental design. Three Experimental diets were provided to pigs for 3 weeks as follow; Treatment I) basal diet+SuperYea, Treatment II) basal diet+SuperYea+*Bacillus subtilis* (1×10^{12} CFU), Treatment III) basal diet+SuperYea+*Saccharomyces cerevisiae* (5×10^9 CFU), Treatment IV) basal diet+SuperYea+*Bacillus subtilis* (1×10^{12} CFU)+*Lactobacillus lactis* (1×10^{11} CFU) and Treatment V) basal diet+SuperYea+*Bacillus subtilis* (1×10^{12} CFU)+*Lactobacillus lactis* (1×10^{11} CFU) +*Saccharomyces cerevisiae* (5×10^9 CFU). The basal diets were formulated to provide the same amount of nutrients and met the requirement by National Research Council [14] as show in Table 1. Feed and water were provided *ad libitum*.

Parameters

Growth Performance: The initial and final body weight of each pig was recorded during 9 weeks feeding trial. Meanwhile the body weight gain and feed intake were recorded one week interval in order to calculate average daily gain, average daily feed intake, and feed to gain ratio.

Nutrient Digestibility: One week before the end of experiment, chromium oxide (Cr_2O_3) was added at 0.2% of the diet as an indigestible marker to calculate digestibility coefficient. Fecal samples were randomly drawn from each treatment around 30%. After collection, samples will be frozen and stored in refrigerator at $-20^\circ C$ until analysis take place. Before determination of dry matter (DM), crude protein (CP), crude fiber (CF) and ether extracts (EE) analyzed according to AOAC and chromium will be analyzed by UV absorption spectrophotometry.

Statistical analysis

All Data were statistically analyzed using analysis of covariance (ANOCOVA) of SAS [15]. The differences between the means of groups were compared by Duncan's New Multiple Range Test according to the following model:

$$Y_{ij} = \mu + t_i + \beta(x_{ij} - \bar{x}) + E_{ij}$$

Where;

Y_{ij} = observation of dependent variables from treatment i and replication j , μ = the overall mean,

t_i = effect of treatment i ($i=1,2,\dots,5$),

β = regression coefficient of final weight on initial weight,

x_{ij} = observation of covariance from treatment i in replication j , \bar{x} = mean of x , and

E_{ij} = residual error distributed as NID with mean 0 and a common variance. Statements of statistical significance were based on p less than or equal to 0.05 and all data statistical analyses were employed in accordance with the method of Steel and Torrie [16].

Results

Growth performance

The growth performances of animals are shown in Table 2. The initial body weights of pigs were not significantly difference. At the end

Item	T 1	T 2	T 3	T4	T5
Rice Extruded	21	21	21	21	21
Corn Extruded	17	17	17	17	17
Cassava Chip Meal	18	17.91	17.91	17.91	17.91
Soybean Meal	14	14	14	14	14
Soybean Extruded	16.3	16.2	16.2	16.2	16.2
Vinasses	4.5	4.5	4.5	4.5	4.5
SuperYea	1.5	1.5	1.5	1.5	1.5
<i>Bacillus subtilis</i>	-	0.2	-	-	-
<i>Saccharomyces cerevisiae</i>	-	-	0.2	-	-
Double-strain of microbial	-	-	-	0.2	-
Multi-strain of microbial	-	-	-	-	0.2
L-lysine	1.5	1.5	1.5	1.5	1.5
DL-methionine	0.3	0.3	0.3	0.3	0.3
Coconut Oil	5	5	5	5	5
Mono dicalcium phosphate	0.01	0.01	0.01	0.01	0.01
Calcium carbonate	0.01	0.01	0.01	0.01	0.01
Salt	0.02	0.02	0.02	0.02	0.02
Vitamin Premix	0.23	0.23	0.23	0.23	0.23
Mineral Premix	0.23	0.23	0.23	0.23	0.23
Anti-fungi	0.4	0.39	0.39	0.39	0.39
Total	100	100	100	100	100
Nutrients Calculated, %					
Swine ME (Kcal/kg)	3.278	3.275	3.274	3.277	3.276
Crude Protein (%)	18	18	18	18	18
Calcium (%)	0.67	0.67	0.67	0.67	0.67
Available Phosphorus (%)	0.55	0.55	0.55	0.55	0.55
Methionine (%)	0.65	0.65	0.65	0.65	0.65
Lysine (%)	1.51	1.51	1.51	1.51	1.51

Premix content; Vitamin A 4MIU, D 0.65 MIU, E 24,000 IU, K_3 1.4 g, B₁ 0.6 g, B₂ 0.3 g, B₆ 0.75 g, B₁₂ 14 mg, Nicotinic 20 g, Pantothenic acid 10 g, Folic acid 0.44 g, Biotin 0.04 g, Choline 60 g, Fe45 g, Cu 40 g, Mn 15 g, Zn 40 g, Co 0.2 g, I 0.4 g, Se 0.06 g, Carrier add to 1 kg

Table 1: Calculation of experimental feed ingredient and composition of growing pigs diet.

Item	T1	T2	T3	T4	T5
IBW (Kg)	24.5 ± 0.14	24.5 ± 0.14	24.5 ± 0.14	24.4 ± 0.14	24.4 ± 0.14
FBW (Kg)	64.8 ± 0.30 ^a	65.3 ± 0.30 ^a	65.3 ± 0.30 ^a	66.4 ± 0.30 ^{ab}	67.4 ± 0.30 ^b
BWG(Kg)	40.3 ± 0.21 ^a	40.9 ± 0.21 ^a	40.9 ± 0.21 ^a	42 ± 0.21 ^{ab}	43 ± 0.21 ^b
ADG (g/d)	750.3 ± 14.7 ^{ab}	735.2 ± 14.7 ^b	730.3 ± 14.7 ^b	760.3 ± 14.7 ^{ab}	770.4 ± 14.7 ^b
ADFI (g/d)	1.62 ± 2.15	1.63 ± 2.15	1.64 ± 2.15	1.65 ± 2.15	1.66 ± 2.15
FCR	2.09 ± 0.26	2.09 ± 0.26	2.08 ± 0.26	2.06 ± 0.26	2.05 ± 0.26

T1: add 1.50 percentage of SuperYea in the diet

T2: add 0.20 percentage of *Bacillus Subtilis* (1×10^{12} CFU) in the diet.

T3: add 0.20 percentage of *Saccharomyces cerevisiae* (5×10^9 CFU) in the diet. T4: add 0.20 percentage of *Bacillus subtilis* (1×10^{12} CFU) mixture with *Lactobacillus lactis* (1×10^{11} CFU) in diet.

T5: add 0.20 percentage of *Bacillus subtilis* (1×10^{12} CFU) mixture with *Lactobacillus lactis* (1×10^{11} CFU) and plus *Saccharomyces cerevisiae* (5×10^9 CFU) in diet.

BUN: Blood Urea Nitrogen WBC: White Blood Cell RBC: Red Blood Cell

^{ab}Means in the same row with different superscripts differ ($P < 0.05$).

Table 2: LS means and standard errors of growth performance of piglets in all treatments imposed in the study.

Item	T1	T2	T3	T4	T5
DM	84.4 ± 0.26 ^{ab}	84.1 ± 0.26 ^a	84.2 ± 0.26 ^a	85.8 ± 0.26 ^{ab}	86.5 ± 0.26 ^b
CP	4.43 ± 0.38 ^{ab}	4.30 ± 0.38 ^a	4.32 ± 0.38 ^{ab}	4.46 ± 0.38 ^{ab}	4.56 ± 0.38 ^b
CF	2.73 ± 0.45	2.70 ± 0.45	2.72 ± 0.45	2.74 ± 0.45	2.75 ± 0.45
EE	3.56 ± 0.14	3.56 ± 0.14	3.58 ± 0.14	3.60 ± 0.14	3.63 ± 0.14
Ash	2.23 ± 0.56	2.22 ± 0.56	2.22 ± 0.56	2.22 ± 0.56	2.24 ± 0.56

T1: add 1.50 percentage of SuperYea in the diet

T2: add 0.20 percentage of *Bacillus Subtilis* (1×10^{12} CFU) in the diet.

T3: add 0.20 percentage of *Saccharomyces cerevisiae* (5×10^9 CFU) in the diet.

T4: add 0.20 percentage of *Bacillus subtilis* (1×10^{12} CFU) mixture with *Lactobacillus lactis* (1×10^{11} CFU) in diet.

T5: add 0.20 percentage of *Bacillus subtilis* (1×10^{12} CFU) mixture with *Lactobacillus lactis* (1×10^{11} CFU) and plus *saccharomyces cerevisiae* (5×10^9 CFU) in diet.

DM: Dry matter CP: Crude Protein CF: Crude Fiber EE: Ether Extract

^{ab}Means in the same row with different superscripts differ ($P < 0.05$).

Table 3: LS means and standard errors of nutrient digestibility of piglets in all treatments imposed in the study (in percentage).

feeding trail, supplementation of mixture of SuperYea and multi-strain of microbes found to be heavier final body weight, body weight gain and average daily gain than other treatments ($p < 0.05$).

Nutrient digestibility

The nutrient digestibility of animals is shown in Table 3. The crude fiber, ether extract and crude ash were not significantly difference between supplementation prebiotic mixtures with probiotic. At the end feeding trail, the SuperYea mixed with multi-strain microbes yielded higher dry matter nutrient digestibility than another treatments ($p < 0.05$).

Discussion

Growth Performance of various feed mixed with different prebiotic and probiotic showed that the dietary of supplementation of prebiotic mixture probiotics helped the beneficial microflora in animals. Adding prebiotics will stimulate the good microflora population by adding beneficial microbes in the intestine which might improve intestinal in that aspect indirectly and eventually increase feed intake. As result animals may have increased growth performance because they eat more. We also investigated whether a specific synbiotic, a combination of SuperYea and multi-strain probiotic have a higher effect on body final weight gain, body weight gain and average daily gain compared to other treatments for growing pigs ($p < 0.05$) but average daily feed intake had not significant ($p > 0.05$) as similarly with [5,17-19] were studied of supplementation of yeast culture (YC) and modified yeast culture [YC+cell wall product (CWP) containing mannan-oligosaccharide] were increased body weight gain (BW) compared to control ($p < 0.05$) but the average dairy feed intake (ADFI) had not significant among treatments ($p > 0.05$). The supplementation of a prebiotics did not significantly affect growth. This result was similar to other studies [8,20,21]. But many studies in literature reported that prebiotic has clear stimulating effect [10,22,23] on weight gain and average daily gain.

The difference may be associated with the different chemical structure (degree of polymerization) of prebiotic used in the different studies and length of oligosaccharides and the presence of other fermentable sources especially non-starch polysaccharides in the diets and the experiment was investigated whether feeding a multi-strain microbes to growing pigs would yield higher performances as compared to a double-strain microbes. The supplementation of multi-strain microbes in diet has shown higher body final weight gain, body weight gain and average daily gain compared to the two-strain microbial. Some studies reported that feeding probiotics improved average daily gain, average daily feed intake and feed conversion in young pigs [11,12,24-28]. Other studies, however, did not find positive effects of probiotics in weanling piglets [29,30].

Nutrient digestibility of various feed mixed with different prebiotic and probiotic in this study showed the positive synbiotic effect as reported by Shim et al. [28]. The supplementation of 0.1 % oligofructose (OF) mixed with multi-strain probiotic have higher percent of dry matter (DM) and crude protein (CP) than the rest of all treatments ($p < 0.05$). The supplementation of prebiotic, probiotic and combined between prebiotic and probiotic may lead to improved digestion and absorption of nutrients in gut. The apparent fecal digestibility of dry matter and crude protein are not known whether the digestibility in ileum or fecal digestibility would be less with prebiotics or probiotic because there is more fecal biomass. Similar results of Li and Kim [23] showed significant improvement in digestibility of dry matter when weanling pigs were fed a corn-soybean meal diet supplemented with *Aspergillus oryzae*. Hu et al. [23] reported that piglets fed a diet supplemented with complex probiotic had increased nutrient digestibility. Burr et al. [31] demonstrated that supplementation of prebiotic had significantly increased crude protein digestibility compared with the control diet in fish. Lee et al. [21] also demonstrated that supplemental synbiotic effects from anaerobic microflora (probiotic from yeast, mold and bacteria) was increased ($p < 0.05$) digestibility of dry matter and protein

in early-weaning pigs. Zhao et al. [32] and Zhao et al. [33] proposed that dietary FOS supplementation at 0.1% has a substantial positive effect on nutrient digestibility. Rodrigues et al. [34] was reported that supplementation 0.25% of prebiotic mixed with 0.3% of probiotic was higher digestibility of dry matter than control ($p < 0.05$). Limited reports are available to compare the effects of lactulose on nutrient digestibility with other; thus, we could only compare our results with those reported in FOS studies. Mountzouris et al. [35] demonstrated that FOS did not affect nutrient digestibility in growing pigs at level of 0.6%, 1.35% or 1%.

Conclusion

The result of this study suggest that supplementation with prebiotic mixed with probiotic as based feed additives (synbiotic) in diet of growing pigs significantly improved final weight gain, body weight gain, average daily gain, dry matter digestibility, crude protein digestibility [36].

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