Page 116 to 122

Volume 1 • Issue 3 • 2017

Research Article

Multidisciplinary Advances in Veterinary Science

ISSN: 2573-3435

Effect of Supplementation of Prebiotic and Probiotic on Growth Performance and Nutrient Digestibility of Finishing Pigs

Amphonephet Sisouvong[1], Wiriya Loongyai[2], Theerawit Poeikhampa[2] and Sornthep Tumwasorn[2]*

[1]Department of Tropical Agriculture, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand

[2]Department of Animal Science, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand

***Corresponding Author:** Sornthep Tumwasorn, Department of Animal Science, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand.

Received: September 20, 2017; **Published:** September 27, 2017

Abstract

This study was conducted to compare the effect of supplementation of prebiotic and probiotic on growth performance and nutrient digestibility in finishing pigs. One hundred and forty female pigs (75 ± 0.5 kg) were divided into 6 treatments with 3 replicates of twenty pigs each treatment. The experimental were analyzed by completely randomized design (CRD). The diets were composed by Treatment I) basal diet, Treatment II) basal diet mixture with 1.5 percentage of SuperYea, Treatment III) basal diet mixture with 0.2% of bacillus subtilis (1 x 10^{12} CFU), Treatment IV) basal diet mixture with 0.2% of Saccharomyces cerivisae (5 x 10^{9} CFU), Treatment V) basal diet mixture with 0.2% of *bacillus subtilis* (1 x 10^{12} CFU) plus l*actobacillus lactic* (1 x 10^{11} CFU) and Treatment VI) basal diet mixture with 0.2% of *bacillus subtilis* (1 x 10^{12} CFU) plus *Saccharomyces cerivisae* (5 x 10^{9} CFU) and *lactobacillus lactic* (1 x 10^{11} CFU).

The result of the experiment showed that pigs fed multi-strain microbial mixture with SuperYea of diet showed heavier final body weight than basal diet (96.4, 98.8, 98.1, 96.9, 99.2 and 99.6 kg/pig), body weight gain (20.9, 23.4, 22.5, 21.4, 23.8 and 24.2 kg/pig), average daily gain (698, 780, 766, 713, 793 and 806 g/d) and feed conversion ratio of supplementation multi-strain mixture with SuperYea of diet were lower than another treatments ($p < 0.05$). The dry matter digestibilities of multi-strain microbes higher ($p < 0.05$) than another treatments (86.4, 88.3, 87.4, 86.7, 86.53 and 89.13%), the crude protein digestibilities were better ($p < 0.05$) with supplementation of multi-strain microbial in diet than another treatments (73.4, 75.3, 74.1, 74.8, 75.6 and 76.5%). In conclusion, dietary inclusion of multi-strain microbes can be improved growth performance and nutrient digestibility in finishing pigs.

Keywords: *Prebiotic; Probiotic; Growth Performance; Nutrient Digestibility; Finishing Pigs*

Volume 1 Issue 3 September 2017

Introduction

The use of antibiotic in disease prevention and growth performance can be bring about emergence of drug-resistant microorganisms and leave antibiotic residues in animal feed (Weston, 1996, Esiobu., *et al.* 2002, Azza., et al. 2009). So a lot of researcher try to studied on prebiotic or probiotic as new feed additive and can be improved growth performance and healthy for animal production.

Citation: Sornthep Tumwasorn., *et al*. "Effect of Supplementation of Prebiotic and Probiotic on Growth Performance and Nutrient Digestibility of Finishing Pigs". *Multidisciplinary Advances in Veterinary Science* 1.3 (2017): 116-122.

Prebiotics are indigestible carbohydrates, which pass through small intestines and are broken down in the colon (Olsen and Maribo, 1999; Houdijk., *et al.* 1998). A macroorganism does not produce enzymes for breaking down of prebiotics. They are digested by bacteria of the digestive tract living in the colon. This action results formation of short-chain fatty acids, which in turn reduce pH in the colon, create unfavorable conditions for development of pathogenic bacteria (Poeikhampa., *et al.* 2011; Hinton., *et al*.1990).

Probiotics are live bacteria or yeast preparations containing microorganisms of one or several kinds, which have an antagonistic effect on pathogenic bacteria in intestines as well as a positive effect on microflora in intestines and the macro organism itself (Xuan., *et al*. 2001; Chang., *et al.* 2000; Vanbella., *et al.*1990).

The purpose of the present study is to investigate the effects of prebiotic and probiotic on growth performance and nutrient digestibility of finishing pigs.

Material and Methods

This study was conducted at Nongbua Farm & Country Home Village Co., Ltd at Ratchaburi Province, Thailand, and experimental animals were kept, maintained and treated in adherence to accept standards for the humane treatment of animals.

SuperYea

The SuperYea is a one part of by-product from ethanol factory by molasses and yeast as substrate and the SuperYea has composes high concentration of minerals, low fiber and 15% of β-glucan and prebiotic source for animal (Tumwasorn, 2012).

Animal and Managements

Two hundred and forty male commercial crossbred piglets (Duroc x Large White x Landrace; 75.00 ± 0.50 kg body weight) were used in this trail. The pigs were divided into 6 treatments and each treatment consisted of 3 replications (twenty pigs per replication). The pigs were raised in naturally ventilated houses consisting of 18 pens (4 x 6m^2), 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 designed in this experiment. Three Experimental diets were provided to pigs for 3 weeks as follow; Treatment I) basal diet(Control), Treatment II) basal diet+1.5% of SuperYea, Treatment III) basal diet + 0.2% of *Bacillus Subtilis* (1 x 10^{12} cfu), Treatment IV) basal diet + 0.2% of *Saccharomyces cerivisae* (5 x 10^9 cfu), Treatment V) basal diet + 0.2% of *Bacillus Subtilis* (1 x 10^{12} cfu) + *Lactobacillus Lactic* (1 x 10^{11} cfu) and Treatment VI) basal diet + 0.2% of Bacillus Subtilis (1 x 10^{12} cfu) + *Lactobacillus Lactic* (1 x 10^{11} cfu) + *Saccharomyces cerivisae* (5 x 10^9 cfu). The basal diets were formulated to provide the same amount of nutrients and net the requirement by National Research Council (NRC, 1998) as shown in Table 1. Feed and water were provided *ad libitum*. Body weight and feed intake were recorded one week interval.

Item	T1	T2	T3	T4	T5	T6
Rice Extruded	21.0	21.0	21.0	21.0	21.0	21.0
Corn Extruded	17.0	17.0	17.0	17.0	17.0	17.
Cassava Chip Meal	18.0	17.9	18.0	18.0	18.0	18.0
Soybean Meal	15.5	14.0	15.4	15.4	15.4	15.4
Soybean Extruded	16.3	16.4	16.2	16.2	16.2	16.2
Vinasses	4.5	4.5	4.5	4.5	4.5	4.5

SuperYea	-	1.5	-	-	-	-
Single-strain of microbial	-	-	0.2	-	-	-
Single-strain of microbial	-	-	-	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	1.5
DL-methionine	0.3	0.3	0.3	0.3	0.3	0.3
Coconut Oil	5.0	5.0	5.0	5.0	5.0	5.0
Milk Powder	0.01	0.01	0.01	0.01	0.01	0.01
Mono-dicalciumphosphate	0.01	0.01	0.01	0.01	0.01	0.01
Calcium carbonate	0.02	0.02	0.02	0.02	0.02	0.02
Salt	0.23	0.23	0.23	0.23	0.23	0.23
Premix	0.23	0.23	0.23	0.23	0.23	0.23
Anti-fungi	0.40	0.39	0.39	0.39	0.39	0.39
Total	100	100	100	100	100	100
Chemical Composition						
• Swine ME (Kcal/kg)	3,278	3,275	3,2756	3,277	3,277	3,275
• Crude Protein (%)	16.0	16.0	16.0	16.0	16.0	16.0
• Calcium (%)	0.65	0.65	0.65	0.65	0.65	0.65
• Available Phosphorus (%)	0.55	0.55	0.55	0.55	0.55	0.55
• Methionine (%)	0.65	0.65	0.65	0.65	0.65	0.65
• Lysine (%)	1.51	1.51	1.51	1.51	1.51	1.51

Table 1: *Calculation of feed ingredient and composition of finishing pigs in diet.*

Premix content; Vitamin A 4MIU, D 0.65 MIU, E 24,000 IU, $K_3$1.4g, B_1 0.6g, B_2 0.3g, B_6 0.75g, B_{12} 14 mg, Nicotinic 20g, Pantothenic acid 10g, Folic acid 0.44g, Biotin 0.04g, Choline 60g, Fe 45g, Cu 40g, Mn 15g, Zn 40g, Co 0.2g, I 0.4g, Se 0.06g, Carrier Added to 1 kg.

Parameters

Growth Performance: The initial body weight of each pigs was recorded and at the end of feeding trail (9 weeks) the body weight, body weight gain and feed intake were recorded one week interval in order to calculation of average daily gain, average daily feed intake and feed to gain ratio.

Nutrient Digestibility: One week before the end of experiment, Chromium oxide (Cr_20_3) was added at 0.2 percentages 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 -20oc until analysis take place. Before determination of dry matter (DM), crude protein (CP), crude fiber (CF) and ether extracts (EE) analyzed according to AOAC (AOAC, 1994) and chromium will be analyzed by UV absorption spectrophotometry (Shimadzu, UV1201, Japan).

Statistical analysis

All Data were statistically analyzed using analysis of covariance (ANOCOVA) of SAS (SAS, 1996). The differences between the means of groups were separated by Ducan's New Multiple Range Test according to the following model:

$Y_{ij} = \mu + A_i + \beta (Wt_j - Wt_j) + \epsilon_{ij}$

Where;

Y_{ij} = observation of dependent variables from treatment i and replication j.
μ = the overall mean.
A_i = effect of treatment ith (i = 1, 2, 3).
B = coefficient regression of initial of body weight for experimental.
Wt_j = initial body weight of animals experimental j.
Wt_j = average of initial body weight of animals experimental j.
ϵ_{ij} = experimental error.

Statements of statistical significance were based on $p < 0.05$ and all data statistical analyses were done in accordance with the method of Steel and Torrie (1980).

Results and Discussion

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 feeding trail, supplementation of prebiotic and probiotic are increase final body weight (FBW), body weight gain (BWG), average daily gain (ADG) and feed conversion ratio (FCR) than control treatments ($p < 0.05$).

Item	T1	T2	T3	T4	T5	T6
IBW (Kg)	75.5±0.14	75.4 ± 0.14	75.6 ± 0.14	75.5 ± 0.14	75.4 ± 0.14	75.4 ± 0.14
FBW (Kg)	96.4 ± 0.30^{b}	98.8 ± 0.30^{ab}	98.1 ± 0.30^{b}	96.9 ± 0.30^{b}	99.2 ± 0.30^{ab}	99.6 ± 0.30^{a}
BWG(Kg)	20.9 ± 0.21^{b}	23.4 ± 0.21^{ab}	22.5 ± 0.21^{ab}	21.4 ± 0.21^{b}	23.8 ± 0.21^{ab}	24.2 ± 0.21^{a}
ADG (g/d)	698.4 ± 14.7^{b}	780 ± 14.7^{ab}	766 ± 14.7^{ab}	713 ± 14.7^{b}	793.l ± 14.7^{ab}	806.6 ± 14.7^{a}
ADFI (kg/d)	1.54 ± 0.15	1.53 ± 0.15	1.54 ± 0.15	1.55 ± 0.15	1.54 ± 0.15	1.53 ± 0.15
FCR	2.21 ± 1.26^{b}	1.96 ± 1.26^{ab}	2.05 ± 1.26^{ab}	2.17 ± 1.26^{b}	1.94 ± 1.26^{ab}	1.89 ± 1.26^{a}

Table 2: *LS mean and standard errors of growth performance of pigs in all treatments imposed in this study.*

Note:

T1: Control diet.
T2: add 1.50 percentage of SuperYea in the diet.
T3: add 0.20 percentage of *bacillus Subtilis* (1×10^{12} CFU) in the diet.
T4: add 0.20 percentage of *saccharomyces cerivisae* (5×10^{9} CFU) in the diet.
T5: add 0.20 percentage of *bacillus subtilis* (1×10^{12} CFU) mixture with *lactobacillus lactic* (1×10^{11} CFU) in diet.
T6: add 0.20 percentage of *bacillus subtilis* (1×10^{12} CFU) mixture with *Lactobacillus lactic* (1×10^{11} CFU) and plus *saccharomyces cerivisae* (5×10^{9} CFU) in diet.
IBW: Initial Body Weight
FBW: Final Body Weight
BWG: Body Weight Gain
ADG: Average Daily Gain.
ADFI: Average Daily Feed Intake.

FCR: Feed Conversion Ratio

[abc]Means in the same row with different superscripts differ (P < 0.05).

Improvement of growth rate by feed additives supplementation confirms positive effect of this prebiotic that has previously reported by Chen., *et al*. (2006), also observed an improvement when growing pig fed diets supplemented complex probiotic (*Lactobacillus acidophilus, Saccharomyces cerevisiae and Bacillus subtilis*). Alexopoulos., *et al.* (2004) observed significant improvement when finishing pigs fed diet included probiotic (*Bacillus licheniformis* and *Bacillus subtilis*). Huang., *et al.* (2004) using a complex *Lactobacilli* preparation also observed improvements in growth performance of nursery pigs. When probiotics are added to growing or finishing pig diets, Jonsson and Conway (1992), who reported dietary addition of bacillus species improved growth performance and health of pigs and Cho., *et al*. (1992) reported that supplementation of *Lactobacillus casei* in diets improved growth performance of piglets and appeared to be more effective than sub-therapeutic antibiotics. However, Kornegay., *et al.* (1990) reported that there was no effect on growth performance by the supplementation of *Lactobacillus acidophilus* in finishing pigs. Unlike the diverse results obtained from growing and finishing pig experiments, many studies of probiotics conducted in nursery pigs found positive effects when diets added probiotic preparations (Lessard and Brissom, 1987; Park., *et al.* 2001).

Nutrient digestibility

The nutrient digestibilities of animals are shown in Table 3. The crude fiber, ether extract and crude ash were significantly difference on supplementation of prebiotic and probiotic in diets than control diet (p < 0.05).

Item	T1	T2	T3	T4	T5	T6
Dry matter	86.4 ± 0.26[b]	88.3 ± 0.26[b]	87.4 ± 0.26[b]	86.7 ± 0.26[ab]	86.53 ± 0.26[a]	89.13 ± 0.26[a]
Crude Protein	73.3 ± 0.38[b]	75.3 ± 0.38[b]	74.1 ± 0.38[b]	74.9 ± 038[ab]	75.6 ± 0.38[a]	76.5 ± 0.38[a]
Crude Fiber	2.73 ± 0.45	2.70 ± 0.45	2.72 ± 0.45	2.74 ± 0.45	2.75 ± 0.45	2.75 ± 0.45
Ether Extract	3.56 ± 0.14	3.56 ± 0.14	3.58 ± 0.14	3.60 ± 0.14	3.63 ± 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	2.24 ± 0.56

Table 3: *LS mean and standard errors of nutrient digestibility of pigs in all treatments imposed in this study.*

Note:

T1: basal diet.

T2: add 1.50 percentage of SuperYea in the diet.

T3: add 0.20 percentage of *bacillus Subtilis* (1×10^{12} CFU) in the diet.

T4: add 0.20 percentage of *saccharomyces cerivisae* (5×10^{9} CFU) in the diet.

T5: add 0.20 percentage of *bacillus subtilis* (1×10^{12} CFU) mixture with *lactobacillus lactic* (1×10^{11} CFU) in diet.

T6: add 0.20 percentage of bacillus subtilis (1×10^{12} CFU) mixture with Lactobacillus lactic (1×10^{11} CFU) and plus *saccharomyces cerivisae* (5×10^{9} CFU) in diet.

[abc]Means in the same row with different superscripts differ (P < 0.05).

Nutrient digestibility of various feed mixed with prebiotic and probiotic in this study showed the positive prebiotic mixed with probiotic effect as reported by Shen., *et al*. (2014) was reported dry matter and crude protein (P < 0.05) was increased digestibility's by dietary supplementation of yeast culture and antibiotic growth promoter than control diet. This study *Bacillus*-based feed additive on nutrient digestibility was increased diegestibilities for dry matter and crude protein when supplementation than control (p < 0.05). Zhao and Kim (2013) reported of study by direct-fed 0.1% *L. reuteri* and L. plantarum complex (1 × 109 cfu/kg in diets can be improved digestibilities of dry matter and crude protein than control (p < 0.05).

For nutrient digestibility and absorption capacity of the small intestine was affected by villus: crypt ratio (Montagne., *et al*. 2003). This study demonstrated that dietary supplementation of yeast culture improved the digestibility of dry matter and crude protein which may be due to increased villus height and villus: crypt ratio in the jejunum. However, these results are not consistent with other studies. Kornegay., *et al*. (1995) observed that the digestibility of protein and energy was not affected by yeast culture supplementation.

Conclusion

The result of this study suggested that supplementation of multri-strain probiotic mixture with SuperYea as based feed additives in finishing pigs significantly improved final weight gain, body weight gain, average daily gain, feed conversion ratio, dry matter digestibility, and crude protein digestibility.

Acknowledgement

The authors gratefully acknowledge funding from the Rich and Green Co., Ltd, Thailand. The supporting from Nongbua Farm & Country Home Village Co., Ltd, Ratchaburi Province, Thailand for suggestion, guidance, throughout this trail was graceful. We thank the Thailand International Development Cooperation Agency (TICA) under program "Ayeyawady-Chao Praya-Mekong Economic Cooperation Strategy (ACMECS)", Ministry of Foreign Affair, Bangkok, Thailand.

References

1. AOAC. Official Method of the Association of Official Analytical Chemists, 16th edition.
2. Washington, DC, USA. 1994.
3. Alexopoulos C., *et al.* "Field evaluation of the efficacy of a probiotic containing *Bacillus licheniformis* and *Bacillus subtilis* spores, on the health status and performance of sows and their litters". *Journal of Animal Physiology and Animal Nutrition* 88.11.12 (2004): 281-292.
4. Azza M Abd El-Rhman., *et al.* "Micrococcus luteus and Pseudomonas species as probiotics for promoting the growth performance and health of Nile tilapia, Oreochromis niloticus". *Fish & Shellfish Immunology* 27.2 (2009): 175-180.
5. Chang Y., *et al*. "Probiotics effects of Lactobacillus reuteri BSA-131 on piglets". *Korean Journal of Microbiology and Biotechnology* 28.1 (2000): 8-13.
6. Chen YJ., *et al*. "Effects of dietary Enterococcus faecium SF88 on growth performance, nutrient digestibility, blood characteristics and fecal noxious gas content in finishing pigs". *Asian-Australasian Journal of Animal Sciences* 19.3 (2006): 406-411.
7. Cho JH., *et al.* "Effects of anti-diarrheal herbs on growth performance, nutrient digestibility and meat quality in pigs". *Asian-Australasian Journal of Animal Sciences* 25.11: 1959 -1604.
8. Esiobu N*., et al*. "Antibiotic resistance in soil and water environments". *International Journal of Environmental Health Research* 12.2 (2002): 133-44.
9. Hinton A JR., *et al.* "Biological control of Salmonella typhimurium in young chikens". *Avian Diseases* 34.3 (1990): 626-633.
10. Houdijk JGM., *et al.* "Effects of dietary olilosaccharides on the growth performance and fecal characteristics of young growing pigs". *Animal Feed Science and Technology* 71.1.2 (1998): 35-48.
11. Huang MK., *et al*. "Effects of Lactobacilli and an acidophilic fungus on the production performance and immune responses in broiler chickens". *Poultry Science* 83.5 (2004): 788-795.
12. Jonsson, E and P Conway. Probiotics for pigs (in Probiotics: The scientific basis. Ed. by R. Fuller) Chapman and Hall, London. 1992: 259-316.
13. Kornegay ET., *et al*. "Effectiveness and safety of fructo-oligosaccharides for pigs". *Animal Reproduction Science* 10 (1992): 19-20.
14. Lessard M and GJ Brisson. "Effect of a lactobacillus fermentation product on growth, immune response and fecal enzyme activity in weaned pigs". *Canadian Journal of Animal Science* 67: 509.
15. Montagne L., *et al.* "A review of interactions between dietary fibre and the intestinal mucosa and their consequences on digestive health in young nonruminant animals". *Animal Feed Science and Technology* 103.1.4 (2003): 95-117.

16. NRC. Nutrient Requirements of Swine, 10th edition. Natl. Acad. Press, Washington, DC, USA. 1998.
17. Olsen LE and H Maribo. Company products for feed for piglets-Igalac, FUT and Bokashi F. In: Danish Slaughterhouse Reported #443. Natimal Committee for Pig Breeding, Health and Production, DemarkPark, 1999.
18. Park DY., *et al*. "Effects of supplementary enzymes or probiotics on the performance and ammonia gas production in weanling pigs". *Korean Journal of Animal Science and Technology* 43.4 (2001): 485-496.
19. Poeikhampa T and C Bunchasak. "Comparative effect of sodium gluconate, Manam oligosaccharide and potassium diformate on growth performance and small intestinal morphology of nursery pigs". *Asian-Australasian Journal of Animal Sciences* 24.6 (2011): 844-850.
20. SAS. SAS User's Guide: Statistics 6.06 Edition, SAS Institute Inc., Cary, NC. 1996.
21. Shen S., *et al*. "Effects of lactobacillus plantarumon production performance, immune characteristics, antioxidant status, and intestinal microflora of bursin-immunized broilers". *Canadian Journal of Microbiology* 60.4: 193-202.
22. Steel RGD and JH Torrie. Principles and procedures of statistics-A, Biometrical Approach (2nd Ed). 1980.
23. McGraw-Hill., *et al*. "Annual Report on Special Fermented Defatted Rice Bran for Pigs Feed". Thai Ruam Jai Vegetable Oil Company Limited. Bangkok, Thailand.
24. Vanbella N., *et al*. "Probiotics in animal nutrition: A review". *Archives of Animal Nutrition* 40.7 (1990): 543-567.
25. Weston DP. Environmental considerations in the use of antibacterial drugs in aquaculture. In: Baird D, Beveridge MVM, Kelly LA, Muir JF, editors. Aquaculture and water Resource management. Oxford: Blackwell. 1996.
26. Xuan ZN., et al. "Study on the Development of a Probiotics Complex for Weaned Pigs". *Asian-Australasian Journal of Animal Sciences* 14.10 (2001): 1425-1428.
27. Zhao PY and IH Kim. "Effect of direct-fed microbial on growth performance, nutrient digestibility, fecal noxious gas emission, fecal microbial flora and diarrhea score in weanling pigs". *Animal Feed Science and Technology* 200 (2013): 86-92.