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THE EFFECTS OF PROBIOTIC SUPPLEMENTATION ON GROWTH PERFORMANCE OF WEANING PIGS IN THE MEKONG DELTA OF VIETNAM

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ABSTRACT

The experiment was conducted at the farm in Cho Lach district, Ben Tre province to assess the supply of probiotic products on performance of [Duroc x (Yorkshire-Landrace) - DYL] 108 piglets (12 herds) after weaning. Piglets were weaned at 28 days of age and the experimental period was lasted for 5 weeks. The initial live weight of pigs was about 8 kg and final live weight of 26 kg. The experimental design was 3 treatments and 12 blocks (12 herds); each herd was divided into 3 groups randomly allocated into 3 treatments. It included 2 treatments supplied probiotic products (PRO: containing Bacillus subtilis, Lactobacillus spp; PRO-ANT: PRO + neomycine sulphate) vs to the CONTROL (none supply bioproduct). Results showed that live weight of pig and growth parameters (weight gain, average daily gain) of pigs which supplied bio-products were significantly ($P<0.05$) higher as compared to those of the control group at week number 4 and 5. Feed conversion ratio was also effective ($P<0.05$) for the PRO and PRO-ANT treatments. The diarrhea rate (%) of piglets in the treatments with additional products was lower than that in the CONTROL group. Quantitative results of E. coli (10^6 CFU/g) in feces samples of pig in the CONTROL (3.1) were higher than PRO (0.9) and PRO-ANT (0.6). Economic benefits of feed and veterinary for the CONTROL (100%) were lower than PRO (106%) and PRO-ANT (108%). The supplement of probiotic products may become effective for improving performance, pig health and also the environment in the Mekong Delta.

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1 INTRODUCTION

The Mekong Delta has been more and more development of livestock husbandry model, the progress of science and technology has been applied to produce livestock products with high productivity and quality; met the domestic market as well as exports. Besides the success, there are also diseases that lead to significant losses. In the treatment of livestock, the use of antibiotics has brought positive results; however, if we use antibiotic often, it is easy to produce resistant bacteria strains; as well as antibiotic can accumulate in the animal body due to negatively effect on consumer. And creating ability for livestock disease prevention at the beginning time is the interesting solution. Especial for the health of young animal, such as piglets in suckling and weaning periods are concerned because it has economical significance for farmers. At the early stage, the possibility of disease on piglets is very high due to the resistance is low; specially, piglets have diarrhea with various causes such as the digestive and enzyme systems are not fully developed completion, the beneficial organisms in intestine are unbalanced...; or pigs are in-

fected with the *Escherichia coli* due to slow growth, high loss rate leads to less economic efficiency (Phuoc, 1980; Giang, 2009, 2011).

To overcome the situation above, current trend is to limit antibiotics using in livestock because it is easy to disorder beneficial organisms in the intestinal tract of animal. Instead, the use of biological products referred to as probiotics which is useful microorganisms such as *Bifidobacterium*, *Lactobacillus*, *Streptococcus*... are taken directly into feed. Its activity is not harmful to body host, enhancing inhibition of harmful microorganisms to protect the gastrointestinal tract of livestock. In addition, these useful microorganisms also produce digestive enzymes such as protease or anaerobic fermentation of carbohydrate sources that undigested by the host into volatile fatty acid to reduce the pH in the large intestine, inhibit stinking fermentation, protect the gastrointestinal tract as well as provide energy for livestock. Probiotics also have a positive effect on antibody system; prevent diarrhea on piglet and more effective in stress inhibition (Fuller, 1989; NRC, 1998; Dan, 2005; Liem, 2008; Men, 2010; Giang, 2012). From actual requirement of production, we conducted the project "Effect of probiotic supplement on growth performance of weaning pigs in the Mekong Delta". The main objective of the project was concerned on effects of two probiotic products used as feed supplement for weaning pigs about growth performance, feed efficiency, diarrhea rate as well as economic benefit obtained in practical condition of the Mekong Delta.

2 MATERIALS AND METHODS

2.1 Materials

2.1.1 Time and location

The experiment was conducted in Cho Lach district, Ben Tre province and Center of research and development of Vemedim Co., Can Tho City, Vietnam, started in June 2013. The farm was covered an area of about 5,000 m^2, including main parts of the integrated farming such as animals, fruit garden and fish pond. Pig farm scale was equal 100 sows, target produced breeding piglets then to raise finishers. Farm had direction East - West, opening farm style, two roofs and corrugated roofing. Weaning pigs raised in groups (9-10 heads) in the cage - 0.8 m from the floor and the size of 2.8 m x 2.2 m; 0.8 m high, plastic floor, drinking button and automatic feeders.

2.1.2 Experimental animals and feed

Experimental animals were 12 herds (108 pigs), DYL of piglets in post-weaning period. The average initial live weight of weaning pig was about 8.0 kg and continued increasing in 5 weeks period (Fig.1).

Fig. 1: Experimental weaning piglets

Table 1: Analyzed chemical composition of the basal diet for weaning pigs

Items	Content
DM (%)	87
ME (Kcal/kg)	3,200
CP (%)	20
CF (%)	4
Ca (%)	0.8
P (%)	0.5
NaCl (%)	0.3

The experimental diet (basal feed) for weaning pigs was the power compound feed. The chemical composition and metabolisable energy of basal feed was presented in Table 1.

Experimental supplement included two products (1) PRO: containing mostly beneficial bacteria *Bacillus subtilis* (10^9 CFU/kg of product) and *Lactobacillus acidophilus* (10^8 CFU/kg). Usage: mix bio- product into feed with doses of 5 g/kg of feed for weaning pigs. Product (2) PRO-ANT with

ingredient in 1 kg of product: *Bacillus subtilis* (10^9 CFU), *Lactobacillus acidophilus* (10^8 CFU) and neomycin sulfate 10%. Usage: mix bio-product into feed with doses of 4 g/kg feed for weaning pigs. The basal feed was formulated adding bio-products weekly, then fed to weaning pigs 5 times per day in the treatments supplied probiotic during 5 weeks in period.

2.2 Methods

2.2.1 Experimental design

The experimental design was arranged in a completely randomized block with 3 treatments and 12 blocks corresponding to the 12 herds (108 pigs), DYL piglets in post-weaning period. Each herd was divided into 3 lots (3 pigs/lot) randomly allocated into 3 treatments. It included 2 treatments supplied probiotic products such as (1) PRO: containing *Bacillus subtilis*, *Lactobacillus* spp (2) PRO-ANT: PRO + neomycin sulphate) vs to the CONTROL (none addition bio-product).

2.2.2 Measurement

Performance of pigs was the live weight (kg/head), live weight gain (kg/head) and average daily gain (g/head/day) in the weeks during experimental stage; feed intake, feed conversion ratio; the cost of feed/kg weight gain of pigs and economic benefit (feed+veterinary): the total cost of feed and veterinary medicine compared to the total weight gain of pigs during the experimental stage. The diarrhea rate of piglets was also evaluated (Thang *et al*., 2010). Quantity of *E.coli* (CFU/g) in pigs' feces samples collected in the late stage was determined by colony counting method. Principle: Homogenous samples were implanted in appropriate agar environment containing lactose, and then incubated at 44^0C for 24 hours. The number of characteristic colonies having the shape of coliforms is counted and then confirmed *E.coli* by IMViC (Indol, Methyl Red, Voges Proskauer and Citrate) trials (Thuoc, 2006). The formula of quantity of *E.coli* (CFU/g) is presented below.

$(CFU/g) = N/(n_1vf_1 + \ldots + n_ivf_i) * R$

N: the total number of colonies counted

f_1: dilution at each plates

n_i: the number of plates in each dilution

R: the positive rate

v: the volume (ml) of dilution to grow in each plate

2.2.3 Statistical analysis

The data was analyzed by ANOVA using the General Linear Model of Minitab Statistical Software version 16 (Ryan *et al*., 2012). Sources of variation were the treatments. The Tukey test for paired comparisons was used to separate means when the differences were significant at 5% level.

3 RESULTS AND DISSCUSION

3.1 Growth performance of pigs

Table 2 showed that live weights at the initial stage, at weeks 1, 2 and 3 of pigs in 3 different treatments were not statistical significance ($P>0.05$). However, the body weight of pigs in weeks 4 and 5 were significantly different ($P<0.05$). This result showed that in the experimental stage, fermentation of microorganisms has been promoted effective better on pigs' growth. Improvement of feed quality, better supply and absorption of nutrients; strongly resistance to infective diseases and less environmental contamination leads to increasing resistance and increasing growth in livestock (Tuan and Dan, 2000; Man and Lung, 2002).

Table 2: Live weight of weaning pigs in different point times (kg/head)

Items	CONTROL	PRO	PRO-ANT	SEM	P
Initial live weight	9.27	9.25	9.30	0.75	0.151
1st week live weight	11.6	11.5	11.6	0.09	0.140
2nd week live weight	14.6	14.8	15.2	0.18	0.097
3rd week live weight	18.6	19.0	19.3	0.19	0.064
4th week live weight	23.5^a	23.7^{ab}	24.1^b	0.17	0.036
5th week live weight	28.1^a	28.7^{ab}	29.1^b	0.02	0.021

$^{a, b}$: Means with different letters in the same row are significantly different ($P<0.05$)

Through Tables 3 and 4 showed that the live weight gain (kg/head) and average daily gain (g/day) of pigs from weaning stage to weeks 3 at different groups were not significant difference ($P>0.05$) among the treatments. However, at the last stages in weeks 4 and 5 these results were significantly higher ($P<0.05$) in the 2 groups that supplemented with probiotic products compared with control group. This result showed that in this period the pigs responded well to probiotic product and

feed, leading to higher growth. According to NRC (1998), Liem *et al*. (2002), Thien (2008) and Viet (2008) showed that the trains of beneficial micro-organisms (*Bacillus, Lactobacillus*) were supplied in feed to increase digestibility for compounds of glucid, lipid and protein to get more efficiencies in young livestock. Therefore, the improvement of animal growth achieved higher so easier absorbed digestive nutrients and reduced the amount of surplus excreted into the environment.

Table 3: Weight gain of weaning pigs in different periods (kg/head)

Items	CONTROL	PRO	PRO-ANT	SEM	P
Weight gain (post-weaning - 1st week)	2.22	2.30	2.31	0.07	0.095
Weight gain (post-weaning - 2nd week)	5.3	5.5	5.9	0.15	0.072
Weight gain (post-weaning - 3rd week)	9.3	9.7	9.9	0.17	0.056
Weight gain (post-weaning - 4th week)	14.3^{a}	14.4^{ab}	14.8^{b}	0.15	0.033
Weight gain (post-weaning - 5th week)	18.9^{a}	19.4^{ab}	19.8^{b}	0.14	0.019

$^{a, b}$: Means with different letters in the same row are significantly different (P<0.05)

Table 4: Average daily gain of piglet in different periods (g/head/day)

Items	CONTROL	PRO	PRO-ANT	SEM	P
Daily gain (post-weaning - 1st week)	320	329	329	9.47	0.100
Daily gain (post-weaning - 2nd week)	381	392	418	9.86	0.070
Daily gain (post-weaning - 3rd week)	444	463	473	7.93	0.060
Daily gain (post-weaning - 4th week)	508^{a}	514^{ab}	528^{b}	5.30	0.030
Daily gain (post-weaning - 5th week)	539^{a}	553^{ab}	565^{b}	5.14	0.020

$^{a, b}$: Mean with different letters in the same row are significantly different (P<0.05)

Table 5 showed that feed intake and feed consumption of piglets were not significant difference (P> 0.05). However, FCR of piglets was improved between the two groups that used probiotic products as compared to that in the control group (P<0.05); this meant the using probiotic for piglets improved digestion by organic resolution enzyme; so piglets used nutrients and energy better resulted in leads to higher weight gain (Man, 2006; Giang, 2009).

Table 5: Feed intake, feed conversion ratio and feed cost in the experiment

Item	CONTROL	PRO	PRO-ANT	SEM	P
Feed intake (g/head/day) (ADFI)	720	727	729	10.16	0.271
Feed intake (kg/lot/day)	2.16	2.18	2.19	0.01	0.545
Feed consumption of whole period (kg/lot)	76.6	76.8	76.8	0.60	0.690
Full-term weight gain (kg/lot)	56.7^{a}	58.1^{b}	59.4^{b}	0.27	0.033
FCR	1.36^{a}	1.31^{b}	1.29^{b}	0.01	0.016
Cost (basal feed + (bio-products)/kg weight gain (thousand VND)	21.3	21.4	20.8		
Comparison (%)	100	97	95		

$^{a, b}$: Mean with different letters in the same row are significantly different (P<0.05

3.2 The diarrhea rate of piglets and quantity of E. coli bacteria

Through Table 6, the rate of diarrhea (%) of piglets in the probiotic groups was significantly reduced as compared to that with control group. Quantification of *E. coli* in feces at final period was significant difference (P<0.01) between the two experimental groups. This meant that the production contained beneficial bacteria: *Lactobacillus acidophilis, Bacillus subtilis* – contained with high protein, digestive enzymes, could create B vitamins (folic acid, biotin, B_6, B_{12}, pantothenic acid, niacin); fermentation lactose into lactic acid that reduced intestinal pH level then could be able to inhibit harmful bacteria, as well as antibiotics such as avilamycine, neomycine so it could inhibit the activities of *E.coli* bacterium. Whereby piglet diarrhea as well as other intestinal infections were prevented effectively (Phuoc, 1980; Lang, 2003; Dan, 2005; Binh, 2008, Viet, 2008; Thang *et al*., 2010; Giang, 2011, 2012). It agrees to the ideas in role of probiotics affect the growth of other bacteria actively because they reduce pH levels and under typical conditions, they can produce hydrogen peroxide and bacteriocins

(nisin and pediocin) (Saavedra, 1995). They also fill an ecological niche by adhering to intestinal walls (Coconnier *et al*., 1997). Due to inhibition of the growth of pathogenic bacteria (Gibson and Fuller, 2000) the greater resistance of organisms to intestinal infections is one of benefits from using probiotics.

Table 6: The diarrhea rate of piglets and quantity of *E. coli* bacterium

Item	CONTROL	PRO	PRO-ANT	SEM	P
Diarrhea times	58	30	24		
Diarrhea rate (%)	9.2^a	4.8^b	3.8^b	0.05	0.018
Quantity of *E.coli* (x 10^6 CFU/g faece)	3.1^a	0.9^b	0.6^b	0.04	0.001

3.3 Economical benefit

Table 7 showed that cost of feed was not significantly different in whole of experiment. Feed costs for piglets which supplied probiotic was slightly higher; however, the veterinary cost was lower significance than control group. Thereby, it leaded to total cost of feed and veterinary medicine was lower significance compared to control group. It agrees with the research of Phuoc *et al*. (2010) reported that probiotic supplement in feed for weaning pigs resulted cost of medicine significantly decreased for treating diarrhea of pigs. Besides, due to the total weight gain of pigs was higher so that total from the probiotic groups was also higher than control. Balance between income and expenditure from piglets showed that probiotic groups were higher from 6-8% compared with control.

Table 7: Economical benefit based on feed and veterinary medicine of the experiment

Items	CONTROL	PRO	PRO-ANT
Total of weight gain (kg)	680	704	720
Total income of weight gain (thousand VND)	61,200	63,360	64,800
Feed consumption (kg)	915	920	922
Cost of feed (thousand VND)	14,730	14,818	14,844
Cost of bio-products (thousand VND)	0	224	348
Cost of veterinary medicines (thousand VND)	738	236	214
The total (feed+veterinary) (thousand VND)	15,468	15,278	15,406
Income (-) expenses (thousand VND)	45,732	48,082	49,394
Comparison (%)	100	106	108

Basal feed: 16,100 VND/kg; Bio-product (PRO): 66,000 VND/kg; Bio-product (PRO-.ANT): 72,500 VND/kg; Piglet price: 90,000 VND/kg

4 CONCLUSIONS

Supplementation of bio-products in the diet of weaning pigs was contributed to increase the piglet productivity and feed efficiency. In addition, they inhibited the development of *E.coli* harmful bacteria in the intestine excreted into the environment and reduced diarrhea rate of pigs. Economic benefit also achieved higher when supplying probiotic in diets of piglets, especially on current industrial breeding conditions in the Mekong Delta.

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