Effect and Benefit Analysis of Fishmeal on Weaning Baby Pigs

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1. Preface:

The pigs at an early age have less developed physical functions and tend to suffer diarrhea and a high death rate. The diets for weaning baby pigs change from original breast milk to the mixed feeds in solid or powdery form, and tends to create some problems like indigestion, diarrhea and even death, causing considerable losses of swine industry. This phenomenon is attributable to the fact that the baby pigs lack a fully developed digestive system and thus show poor digestion of plant protein. If the excessive plant protein (e.g. soybean meal) is involved in the feeds, some anti-nutritional factors will damage the intestinal mucosa of baby pigs and affect their digestion and health. An effective solution is to involve some animal protein in the feeds, like fishmeal as a partial substitute of soybean meal so as to alleviate baby pigs' diarrhea and improve their health. The use of fishmeal in diets of baby pigs creates a higher feed cost, but can win a higher economic benefit. This trial includes the use of fishmeal in feeds by 2%, 5% and 8% respectively and studies the effect of fishmeal on weaning baby pigs in health condition, growth performance and economic indicators to provide a scientific basis for the proper use of fishmeal by pig raisers and feed enterprises.

Notes: This study is supported by the International Fishmeal and Fish oil Organization (IFFO)

Introduction of author: Ji Haifeng (1963-), Ph.D., a researcher specialized in the swine nutrition and breading.

2. Materials and methods:

2.1 Trial time:

The trial lasted for 33 days from February 26, 2009 to March 30 2009.

2.2 Trial animals:

In the breading pig farm of considerable scale on the suburb of Beijing, China, 60 baby pigs (hybrid of Large White and Landrace) aging at 28 days were randomly divided into three groups, and each group included 20 pigs and each pigsty involved 6 to 7 test pigs. The test pigs which were bred on raised floor could freely eat and automatically drink, and the indoor temperature, moisture and air quality could meet the requirements of test pigs. Before the test pigs made an entry to pig pens, they were thoroughly sterilized and left unused for at least 7 days. During the test period, the pig excrement shall be removed without delay to keep the good sanitary conditions of pig pens. In addition, the swine herb should be closely observed and the pig pens should be regularly sterilized with pigs inside. In case any sick pigs with diarrhea are found, they should be treated in a timely manner according to the vet's instructions to minimize the loss of swine herb.

2.3 Feed formulation:

Three groups with varying levels of fishmeal at 2%、5% and 8%, but they are formulated to be the same levels of protein and energy within the same breeding environment. The feed formulation and nutrients of three diets are indicated in Table 1 and Table 2.

Table 1: Feed Formulation of Three Diets

Feed Material	Group Ⅰ（2% fishmeal）	Group Ⅱ（5% fishmeal）	GroupⅢ（8% fishmeal）
Corn,%	60.00	61.80	63.00
Wheat bran, %	4.00	5.00	6.00

Soybean meal, %	19.00	15.10	10.50
Fishmeal(imported)，%	2.00	5.00	8.00
Stone dust，%	1.30	1.20	1.10
Calcium hydrophosphate，%	1.00	0.70	0.50
Salt，%	0.35	0.30	0.20
Lysine，%	0.30	0.30	0.20
Methionine，%	0.10	0.10	0.05
Premix compound，%	0.50	0.50	0.50
Whey powder，%	5.00	5.00	5.00
Puffing compound Soybean powder，%	6.50	5.00	5.00

Table 2: Feed Nutrients of Three Diets

Nutrients	Group Ⅰ（2% fishmeal）	Group Ⅱ（5% fishmeal）	GroupⅢ（8% fishmeal）
Digestible energy value，MC/Kg	3.2509	3.2444	3.2508
Crude protein，%	18.0895	18.1226	18.1929
Crude fat，%	3.8312	3.8898	4.1753
Calcium，%	0.8979	0.8953	0.9165
Phosphorus，%	0.6073	0.6270	0.6639
Available phosphorus，%	0.3949	0.4249	0.4735
Salt，%	0.4108	0.4640	0.4678
Lysine，%	1.1516	1.1840	1.1507
Methionine，%	0.3827	0.4099	0.3908
Threonine，%	0.6855	0.6921	0.7052
Tryptophan，%	0.2159	0.2113	0.2085
Sodium，%	0.2709	0.2786	0.2667
Chlorine，%	0.2452	0.2314	0.1872

2.4 Test items:

Test the initial and final weights of test pigs on an empty stomach, record the feed consumption during the test, analyze the feed gain ratio, death rate, diarrhea rate, and quantity of lactic acid bacteria and colon bacillus in excrement, interleukin 1 level, acute phase protein level (porcine C-reactive protein), ω-fatty acid level and economic index.

2.5 Testing of blood index:

As the test is over, obtain blood sample of 2~3mL via jugular vein and keep the collected blood sample inside coagulation promoting tube, and inside the incubator at 37℃ for two hours, extract blood serum and subject to centrifugal processing at a rate of 5000 for 5 minutes, extract supernatant fluid and keep at -18℃ for future use.

The testing of ω-fatty acid is based on the method as stated in J. Agric.Food Chem., 1988，Vol.36, No.6. Interleukin 1 level and acute phase protein level (porcine C-reactive protein) shall be tested via Elisa kit. IL-1's Elisa kit is produced by U.S. RB Company and CRP's Elisa kit is produced by USCNLIFE.

The main instruments and devices include Agilent 6890 gas phase chromatography, ZHWY-2102 incubator at constant temperature (Shanghai Zhicheng Analytical Instrument Manufacturing Co., Ltd.), LX-B35L high-pressure sterilizer (Hefei Huatai Medical Instrument Co., Ltd.), 318-model ELIASA (Shanghai Sanco Instrument Co., Ltd.), 5415R centrifugal separator (Eppendorf Company), single and multi-channel liquid filler (Eppendorf Company), coagulation promoting tube (German Greiner bio-one Company) and 1.5mL centrifugal tube (Eppendorf Company).

3. Result and analysis

3.1 Growth performance of baby pigs in test

As indicated in Table 3, Group Ⅲ (8% fishmeal) grew fastest and enjoyed the highest feed use rate, and its daily weight gain and feed gain ratio is 20.76% and 20.73% higher than Group I (2% fishmeal). Group II (5% fishmeal) showed a less satisfactory result, but its daily weight gain and feed gain ratio is still 6.43% and 11.52% higher than Group I (2% fishmeal). The result indicates that the weaning baby pigs can have

a better growth rate and feed use rate with an increased use of fishmeal.

3.2 Intestinal canal health of baby pigs in test:

As indicated in Table 4, three diets' death rate was zero, suggesting that the inclusion of fishmeal by over 2% in feed can guarantee the lives of baby pigs. The diarrhea rate showed that the baby pigs in three diets wouldn't suffer diarrhea after a weaning period of 10 days, but face a high diarrhea rate within a weaning period of 10 days. The baby pigs in the diet with little fishmeal showed a high diarrhea rate while the baby pigs in the diet with much fishmeal showed a low diarrhea rate. The baby pigs in Group III (8% fishmeal) showed a diarrhea rate of 70% lower than that of the baby pigs in Group I (2% fishmeal) while those in Group II (5% fishmeal) showed a diarrhea rate of 60% lower than in Group I (2% fishmeal). The result indicates that the weaning baby pigs can have a lower diarrhea rate and healthy intestinal canal with an increased use of fishmeal.

Moreover, the lactic acid bacteria and colon bacillus in excrement showed no difference in three diets, suggesting that the quantity of fishmeal has no noticeable effect on main microorganisms in intestinal canal.

Table 3: Growth Performance of Baby Pigs in Test

Performance Index	Group Ⅰ（2% fishmeal）	Group Ⅱ（5% fishmeal）	GroupⅢ（8% fishmeal）
Test-beginning individual weight, kg	6.785±0.842	7.310±0.887	7.625±0.855
Test-end individual weight，kg	20.010±2.334	21.385±1.588	23.595±1.964
Feed consumption during test，kg/pig	26.275	24.750	25.150
Daily weight gain during test，g/d	400.76±46.16[a]	426.52±27.93[b]	483.94±35.27[c]
Daily feed gain ratio during test	1.987[a]	1.758[b]	1.575[c]

Notes: Horizontal comparison, those with noticeable difference (P<0.05) are marked with

different letters.

Table 4: Intestinal Canal Health of Baby Pigs in Test

Intestinal Canal Health Index	Group Ⅰ(2% fishmeal)	Group Ⅱ(5% fishmeal)	GroupⅢ(8% fishmeal)
Diarrhea rate from 1st to 10th day during test，%	75% (15/20) ^{A}	15% (3/20) ^{B}	5% (1/20) ^{C}
Diarrhea rate from 11th to 33rd day during test，%	0	0	0
Death rate during test，%	0	0	0
Quantity of lactic acid bacteria in manure，CFU/g	4.50×10^{8}	1.11×10^{8}	6.60×10^{7}
Quantity of colon bacillus in manure，CFU/g	4.30×10^{6}	1.27×10^{6}	2.83×10^{6}

Notes: Horizontal comparison, those with noticeable difference (P<0.01) are marked with different letters.

3.3 Contents of ω-fatty acid in blood

ω-fatty acid has a very important physiological function in terms of blood clots, epidemic prevention, anaphylactic reaction and physical health. Fishmeal is rich in ω-fatty acid, so the use of fishmeal in feed will increase the contents of ω-fatty acid in blood. As indicated in Table 5, the baby pigs in Group III (8% fishmeal) showed a higher contents of ω-fatty acid in blood than other groups, and 516.41% and 104.77% higher in EPA and DHA respectively than Group I (2% fishmeal). Group II (5% fishmeal) is 195.12% and 82.92% higher in EPA and DHA respectively than Group I (2% fishmeal). The result indicates that the weaning baby pigs can have a much higher content of ω-fatty acid in blood and a better physical condition with an increased use of fishmeal.

Table 5: Contents of ω-Fatty Acid in Blood of Baby Pigs in Test

ω-fatty acid	Group Ⅰ（2% fishmeal）	Group Ⅱ（5% fishmeal）	GroupⅢ（8% fishmeal）
EPA（C20:5），mg/100ml	0.841 ± 0.267^{a}	3.323 ± 0.681^{b}	5.184 ± 0.592^{c}

DHA（C22:6），mg/100ml	1.487±0.202[a]	2.720±0.297[b]	3.045±0.404[c]

Notes: Horizontal comparison, those with noticeable difference (P<0.05) are marked with different letters.

3.4 Contents of Interleukin 1 and porcine C-reactive protein in blood

Under the normal physiological condition, pigs have a quite low level of Interleukin 1（IL-1）and porcine C-reactive protein（CRP）in blood, and the level will be raised radically by any inflammation. As indicated in Table 6, the baby pigs in Group III (8% fishmeal) showed the lowest level of Interleukin 1（IL-1）and porcine C-reactive protein（CRP）and the smallest data variation, suggesting the best physiological condition of this group. The baby pigs in other two groups mostly showed a low level of Interleukin 1（IL-1）and porcine C-reactive protein（CRP）, but some pigs' high level may suggest the potential inflammation.

Table 6: Contents of Interleukin 1 and Porcine C-reactive Protein in Blood of Baby Pigs

Blood Index	Group Ⅰ（2% fishmeal）	Group Ⅱ（5% fishmeal）	GroupⅢ（8% fishmeal）
Interleukin 1（IL-1），pg/ml	77.308±9.150[a]	81.174±19.262[a]	31.108±3.633[b]
Porcine C-reactive protein（CRP），μg/ml	14.838±22.230[a]	27.498±33.288[b]	7.422±1.379[c]

Notes: Horizontal comparison, those with noticeable difference (P<0.05) are marked with different letters.

3.5 Economic analysis of baby pigs in fishmeal-feeding test:

As indicated in Table 7, the use of fishmeal in diets will increase the feed cost. The feed price in Group III (8% fishmeal) is 4.56% higher than Group I (2% fishmeal),

and 2.46% higher than Group II (5% fishmeal). However, the weight gains are very satisfactory. The baby pigs in Group III (8% fishmeal) showed a weight gain of 20.76% higher than Group I (2% fishmeal) and 13.46% higher than Group II (5% fishmeal). As regards the "weight gain benefits - feed consumption cost" of baby pigs during test, Group III (8% fishmeal) made profits of RMB 57.59 more than Group I (2% fishmeal) and RMB 37.30 more than Group II (5% fishmeal), and Group II (5% fishmeal) made profits of RMB 20.29 more than Group I (2% fishmeal).

Table 7: Economic Analysis of Weaning Baby Pigs in Fishmeal-feeding Test

Performance Index	Group Ⅰ(2% fishmeal)	Group Ⅱ(5% fishmeal)	GroupⅢ(8% fishmeal)
Mingled feed price，RMB/kg	2.41	2.46	2.52
Average price of baby pig，RMB/kg	21.0	21.0	21.0
Feed consumption during test，kg/pig	26.275	24.750	25.150
Weight gain during test，kg/pig	13.225	14.075	15.970
Weight gain benefits - feed consumption cost，RMB	214.40	234.69	271.99

4. Summary:

The inclusion of fishmeal in weaning baby pig feeds can increase the contents of ω-fatty acid in blood, lower the level of Interleukin 1（IL-1）and porcine C-reactive protein（CRP）, promote their health, reduce diarrhea rate, and increase the growth rate and feed use rate. Though the fishmeal raises the feed cost, the health condition and weight gain benefits are satisfactory. According to the test results, the feed price of Group III (8% fishmeal) was 4.56% higher than Group I (2% fishmeal) and 2.46% higher than Group II (5% fishmeal), but the baby pigs in Group III (8% fishmeal) enjoyed weight gain of 20.76% higher than Group I (2% fishmeal) and 13.46% higher

than Group II (5% fishmeal). When it comes to the economic index of weight gain benefits - feed consumption cost, Group III (8% fishmeal) made profits of RMB 57.59 more than Group I (2% fishmeal) and RMB 37.30 more than Group II (5% fishmeal), and Group II (5% fishmeal) made profits of RMB 20.29 more than Group I (2% fishmeal). To sum up, the use of fishmeal by 8% in feed of weaning baby pigs can create higher economic benefits. For a farm selling 10,000 pigs a year, by using 8% fishmeal in feeds of weaning baby pigs, the annual economic benefit will be RMB 575,900 higher than Group I (2% fishmeal) and RMB 373,000 higher than Group II (5% fishmeal).