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The effect of source and level of dietary fiber on growth performance, backfat thickness and blood profiles of Lanyu pigs [1]

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Abstract

The purpose of this experiment was to study the effect of source and level of dietary fiber on growth performance, backfat thickness and blood profiles of Lanyu pig. A total of 24 Lanyu pigs (initially 9 kg body weight and 11 weeks of age), half castrated and half female, were randomly assigned to three treatments and provided diets: 1) USDA 1160 diet referred to the United States miniature pig formula (USDA 1160) containing 5% alfalfa; 2) WB 10 diet containing 10% wheat bran (WB) and 3) WB 20 diet containing 20% wheat bran, for 12-week feeding trial. The trial incorporated protein and digestion design, with the three groups having the crude fiber content of USDA 1160, WB 10 and WB 20 as 3.56, 3.23 and 3.95%, respectively. All the pigs were weighed every three weeks for the measurement of growth performance. At the initiation, the sixth week and the 12th week -end of the experiment, backfat thickness and blood biochemical parameters were measured. Results showed that there was no difference on growth performance and increment of backfat thickness amongst treatments. For the blood profiles, pigs in the WB 20 group had higher ($P < 0.05$) creatinine and lower ($P < 0.05$) triglyceride (TG) than the USDA 1160 group at the end of the experiment. In addition, pigs in the WB 10 group also had lower ($P < 0.05$) TG than the USDA 1160 group at the end of the experiment. Total protein (TP), blood urine nitrogen (BUN), glucose and cholesterol were not different amongst treatments. In summary, Lanyu pigs fed diet with 10 or 20% wheat bran could maintain normal growth without over deposition of backfat, which indicated wheat bran could be a fiber source for Lanyu pigs.

Key words: Backfat thickness, Crude fiber, Growth performance, Lanyu pigs.

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Introduction

The selection of miniature pigs is mainly used for biomedical research. Such pigs should be smaller size, slower growth rate and less body fat. Lanyu pig is the native small-ear miniature pig, which has been bred and selected by Taitung Animal Propagation Station and accredited by the Association for Assessment and Accreditation of Laboratory Animal Care in 1999 and is available as biomedical research animals (Wu *et al.*, 2017). Lanyu pig, fed with commercial diet, was for meat production. That resulted in a fatty status in terms of thicker backfat (Lee *et al.*, 2003). Previous studies are shown that the more dietary crude protein level the Lanyu pigs fed, the higher growth performance (Chen *et al.*, 2017; Liu and Lin, 2019) and thicker backfat deposition (Lee *et al.*, 2003). Since the biomedical characteristic and nutrition requirement of miniature pigs are different from the commercial pigs which are for meat production. Therefore, the nutrient requirement for miniature pigs is necessary to be established.

Studies revealed that it is not necessary to supply a high concentrate of nutrients in terms of lysine, crude protein and metabolizable energy for Lanyu pigs between 8 and 25 kg live weight (Liao and Liu, 2016; Chen *et al.*, 2017; Liu and Lin, 2019). Fiber is used for the dilution of energy in pig diet (Jarrett and Ashworth, 2018). The utilization efficiency of dietary crude fiber varied between breed of pigs (Lee, 2006) and the type of fiber from cereal grain (Gunness *et al.*, 2016). The addition of fiber results in a decrease in total energy intake which might decrease the deposition of body fat (Gunness *et al.*, 2016). An early study carried out by Lee *et al.* (2003) found that fed Lanyu pigs between 30 and 50 kg live weight with 1 kg of feed and fresh Napiergrass (*Pennisetum purpureum*) *ad libitum* achieved the same growth and feed utilization efficiency compared with their counterparts fed the feed *ad libitum*. The finding indicated that the Lanyu pigs could utilize rough feed such as high fiber diet.

The USDA 1160 feed formula is used for miniature pigs and has been found suitable for Lanyu pigs (Liu and Lin, 2019). The formula of USDA 1160 feed contains 5% alfalfa meal (Bhathena *et al.*, 1996), in which the crude fiber, acid detergent fiber and neutral detergent fiber of alfalfa meal are 27.4, 30.6 and 37.1%, respectively. Besides, wheat bran is the by-product of wheat processing to make flour. The crude fiber, acid detergent fiber and neutral detergent fiber of wheat bran are 9.1, 12.0 and 38.4%, respectively (Livestock Research Institute, 2011). As the utilization of nutrient would be affected by either the source or the form of crude fiber (Shi and Noblet, 1993; Dégen *et al.*, 2007; Wilfart *et al.*, 2007), therefore, the purpose of this study was to study the effect of dietary fiber sources (i.e., alfalfa and wheat bran) and levels on growth performance, backfat thickness and blood profiles of Lanyu pigs.

Materials and Methods

Animals used in this study and the procedures were according to the Guide for Care and Use of Agricultural Animal of Livestock Research Institute, Council of Agriculture (Affidavit of Approval of Animal Use Protocol no. 107-34).

I. Experimental diet

The experimental diets were formulated with corn-soybean meal and two sources of crude fiber based on iso-crude protein (CP), lysine and iso-digestible energy (DE) basis. The USDA 1160 group was formulated and referred to the American miniature pig formula (USDA 1160), containing 5% alfalfa meal (Bhathena *et al.*, 1996). The other two diets contained 10 or 20% WB, which was represented by WB 10 and WB 20, respectively. Feed composition and the nutrient values were listed in Table 1.

II. Animals and experiment design

The BW of Lanyu pigs used in this study was approximately 9 kg and the age was approximately 11 weeks (WK-0) at the initiation of the study. The experiment was a completely randomized design. A total of 24 Lanyu pigs, half castrated male and half female, from Taitung Animal Propagation Station were assigned into three treatments with four replicates. Each replicate (pen) raised one castrated male and one female pig which were balanced for initial BW. The pigs were raised in wired-floor pens of 1.26 x 1.05 m at conventional open pig house.

The experiment was carried out when the pigs were from 11 to 23 weeks old of age and from 9 to 24 kg live weight.

All the pigs were weighed at the initiation, every three weeks, and the end of this experiment. Feed was provided daily according to the live weight of pigs by the recommendation of Lorentsen (2011). Each pig was provided diet 450, 500, 550, and 600 g daily at the start of experiment (WK-0) to WK-3, WK-4 to WK-6, WK-7 to WK-9 and WK-10 to WK-12, respectively. The water was provided *ad libitum* throughout the experiment. Feed intake of the pen was recorded every three weeks and the growth performance in terms of average daily weight gain, average feed intake and feed efficiency was calculated. At the initiation, sixth week (WK-6) and end of the experiment (WK-12), the backfat thickness of pigs were taken at the first rib, last rib and last lumbar by A-mode ultrasonic instrument (The PREG-ALERT PRO®, USA). Besides, the blood samples were collected from jugular vein for blood profiles analysis including total protein (TP), blood urea nitrogen (BUN), creatinine, glucose, triglyceride (TG) and cholesterol, and immunoglobulin (Ig) contents including Ig A, Ig G and Ig M.

Table 1. The compositions of experimental diets

Ingredients, %	Treatment[§]		
	USDA 1160	WB 10	WB 20
Yellow corn, ground	73.90	68.80	58.80
Soybean meal, 43% CP	17.90	17.50	15.20
Alfalfa meal	5.00	—	—
Wheat bran	—	10.00	20.00
Limestone, pulverized	0.35	0.35	0.35
Dicalcium phosphate	2.10	2.10	2.10
Salt	0.50	0.50	0.50
Soybean oil	—	0.50	2.80
Vitamin premix[a]	0.10	0.10	0.10
Mineral premix[b]	0.15	0.15	0.15
Total	100.00	100.00	100.00
Calculated values			
Crude protein, %	14.58	14.51	14.50
Lysine, %	0.74	0.74	0.71
Crude fiber, %	3.53	3.16	3.76
ADF[c], %	4.19	3.73	4.58
NDF[c], %	9.27	10.84	13.69
DE, kcal/kg	3,218	3,214	3,206
Analyzed values			
Crude protein, %	14.28	14.43	14.50
Lysine, %	0.75	0.73	0.76
Crude fiber, %	3.56	3.23	3.95

[§] USDA 1160 referred to the American miniature pig formula (USDA 1160); WB 10 and WB 20 contained 10 and 20% wheat bran, respectively.

[a] Vitamin premix provided per kilogram of diet: Vitamin A, 6,000 IU; Vitamin D_3, 400 IU; Vitamin E, 40 IU; Vitamin K, 2 mg; Vitamin B_1, 2 mg; Vitamin B_2, 6 mg; Vitamin B_6, 3 mg; Vitamin B_{12}, 0.03 mg; Niacin, 30 mg; Pantothenic acid, 30 mg; Folic acid, 0.6 mg; and Biotin, 0.2 mg.

[b] Mineral premix provided per kilogram of diet: Fe, 80 ppm; Cu, 5 ppm; Mn, 6 ppm; Zn, 45 ppm; I, 0.2 ppm; Se, 0.1 ppm; and Co, 0.35 ppm.

[c] ADF: acid detergent fiber; NDF: neutral detergent fiber.

III. Statistical analysis

Data were subjected to statistical analysis in a randomized complete block design using the General Linear Model procedures (SAS, 2008) and the significant differences among treatments were detected by Tukey's Multiple Range

Test. Variability in the data is expressed as the standard error (SE) and probability level of $p < 0.05$ was considered to be statistically significant.

Results and Discussions

I. Growth performance and the change of backfat thickness

There were no difference on growth performance and the change of backfat thickness of Lanyu pigs amongst treatments (Table 2). From the growth curve of Lanyu pigs in present study, it indicated that Lanyu pigs fed 10 or 20% dietary wheat bran performed similar growth to those fed 5% dietary alfalfa (USDA 1160) (Fig. 1).

Growth of pigs is influenced by genotype, environment and feeds (Bastianelli and Sauvant, 1997). Previous study showed that Lanyu pigs fed diet with 16% crude protein had higher weight gain and feed efficiency than pigs fed diet with 13% crude protein (Chen *et al.*, 2017). Liu and Lin (2019) also found that Lanyu pigs fed with USDA 1160 feed (14.4% CP, 0.77% lysine) and increased 10% nutrient concentration of USDA 1160 feed (15.7% CP, 0.87% lysine) had higher weight gain than the pigs fed with diet decreased 10% nutrient concentration of USDA 1160 feed (13.1% CP, 0.67% lysine). However, regarding biomedical purpose, the feeding of laboratory pigs needs to maintain the health and physical condition and avoids rapid growth and excessive accumulation of body fat. Indeed, Liu and Lin (2019) found that Lanyu pigs for biomedical use between 8 and 25 kg live weight, could be fed with USDA 1160 diet or even decreased 10% nutrient concentration of USDA 1160 feed. That would meet the nutrients requirement for normal growth. The dietary crude protein and lysine were 14.4 and 0.77%, respectively (Liu and Lin, 2019). The dietary crude protein and lysine in present study were around 14.4 and 0.75%, respectively, which is close to the level of USDA 1160 feed (Liu and Lin, 2019).

Table 2. Effects of dietary crude fiber on growth performance and backfat thickness of Lanyu pigs

Items	Treatment[§]		
	USDA 1160	WB 10	WB 20
No. of pigs	8	8	8
Initial BW, kg	9.13 ± 0.43	9.19 ± 0.40	9.19 ± 0.40
BW at WK-12, kg	24.55 ± 1.15	23.69 ± 1.08	23.60 ± 1.08
Daily WG, kg	0.184 ± 0.012	0.173 ± 0.011	0.172 ± 0.011
Daily feed intake, kg	0.520 ± 0.004	0.517 ± 0.004	0.515 ± 0.004
Feed efficiency, G/F	0.349 ± 0.006	0.334 ± 0.005	0.333 ± 0.005
Backfat thickness (three point average), mm			
Initial	7.57 ± 0.36	7.29 ± 0.34	7.25 ± 0.34
WK-12	13.24 ± 0.63	13.50 ± 0.59	13.46 ± 0.59
Increment	5.67 ± 0.50	0.21 ± 0.47	6.21 ± 0.47

[§] USDA 1160 referred to the American miniature pig formula (USDA 1160); WB 10 and WB 20 contained 10 and 20% wheat bran in diet, respectively. No significant difference was found amongst treatments ($P > 0.05$).
BW, body weight; WG, weight gain.

In present study, the increment of the backfat thickness ranged from 5.67 to 6.21 mm, and the changes in the three groups were similar. The backfat thickness in present study was dramatically lower than the finding of 33.4 mm by Lee *et al.* (2003), in which the Lanyu pigs fed with commercial diet containing 17.5% crude protein that is 20.7% higher than the dietary protein in present study. The different results of backfat parameters between Lee *et al.* (2003) and the present study might be due to the dietary protein level. One of the functions of fiber is dilution of energy in pig diet (Jarrett and Ashworth, 2018). The addition of fiber results in a decrease in total energy intake. Though the crude fiber content of WB 20 and WB 10 was 11% higher and 9% lower than that of USDA 1160, respectively in present study, the DE content was equal amongst treatments. The energy intake would not be different amongst treatments due to the daily intake was not

different significantly. In addition, the main fiber source of USDA 1160 came from alfalfa while the main crude fiber of WB 10 and WB 20 came from wheat bran. Fiber from different cereal grain could affect the nutrient digestibility and metabolism (Dégen *et al.*, 2007) and hence affect the body composition of pigs. The backfat parameters in the present study showed that the backfat thickness was neither affected by the content nor the source of crude fiber mainly due to the equal DE level amongst treatments. Therefore, the Lanyu pigs could consume about 4% crude fiber and the dietary fiber from either alfalfa or wheat bran did not increase backfat accumulation.

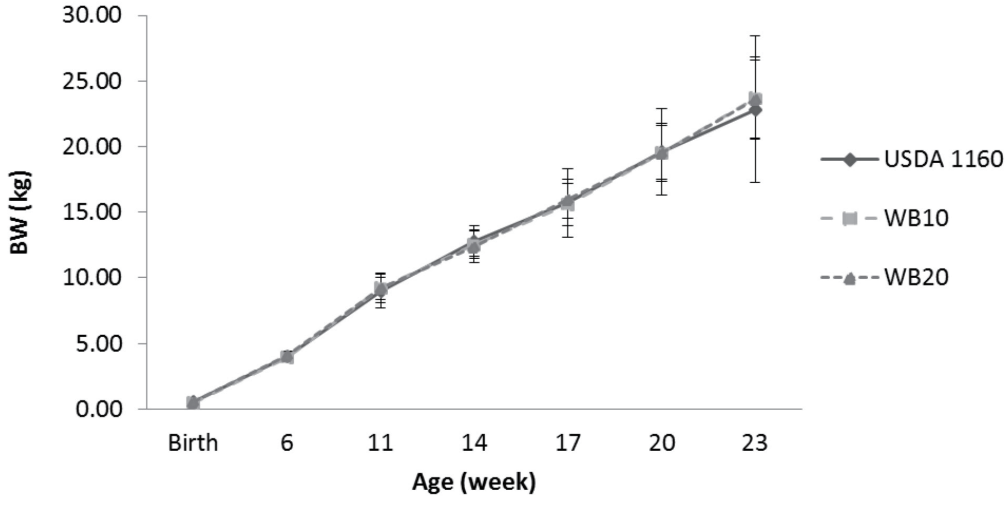

Fig. 1. Growth curve of Lanyu pigs from birth to 23 weeks of age.
Experiment started at 11 weeks old for 12 weeks. Data was shown as mean ± sd. USDA 1160 referred to the American miniature pig formula (USDA 1160); WB 10 and WB 20 contained 10 and 20% wheat bran in diet, respectively. No significant difference was found amongst treatments ($P > 0.05$).

From the result of growth and backfat thickness, Lanyu pigs fed 10 or 20% dietary wheat bran were able to grow slower compared with the pigs fed the high nutrient commercial feed (Lee *et al.*, 2003). Fortin and Elliot (1985) demonstrated that there is a strong correlation between backfat thickness and the fatty status of pigs. A reduction in backfat thickness was accompanied by a decrease in the fat content of the subcutaneous fat depot and to a lesser extent of the perinephric-retroperitoneal fat depot (Fortin and Elliot, 1985). Furthermore, Lanyu pigs fed diet with 10 or 20% wheat bran would not accelerate the accumulation of backfat, which implied the body condition might not be too fatty. This finding is important, from biomedical application point of view; un-fatty pigs would be beneficial to the manipulation of experiment, particularly for the surgical operation. Based on the finding of Chen *et al.* (2017), Liu and Lin (2019) and the present study, 14% dietary crude protein and 0.7% lysine can meet the requirement and 10 or 20% dietary wheat bran could be suitable for Lanyu pigs under 25 kg of live weight.

II. Blood biochemical parameters

The effects of fiber on blood biochemical parameters of Lanyu pigs are shown in Table 3. The pigs in WB 20 group had significantly ($P < 0.05$) higher creatinine than USDA 1160 group at WK-12. The WB 20 group had significantly lower triglyceride than USDA 1160 group ($P < 0.05$) at WK-6 and WK-12, while WB 10 group also had significantly lower triglyceride than USDA 1160 group ($P < 0.05$) at WK-12 of the experiment.

Previous reports have provided the hematological and blood biochemical parameters of Lanyu pig (Wu and Chang, 2018a, b; Liu and Lin, 2019). Such parameters are important references for biomedical research. However, the blood biochemical parameters might be affected by diet and age of animals. The blood biochemical values in present study were similar to the finding by Liu and Lin (2019) with the exception of TG. The averaged triglyceride in present study was lower than the finding by Liu and Lin (2019). There was no extra addition of oil to diet in Liu and Lin (2019). By contrast, soybean oil was added to WB 10 and WB 20 diets in present study. The different result of blood triglyceride between present study and Liu and Lin (2019) might be due to the reduction of fat digestibility by wheat bran. Consequently the lower fat digestibility resulted in lower blood TG. Reduction in lipid digestibility has been reported to be dependent on the type of fiber (Shi and Noblet, 1993; Dégen *et al.*, 2007; Wilfart *et al.*, 2007). Wilfart *et al.* (2007)

also found that growing pigs fed cereal-based diets containing 20% or 40% wheat bran decreased lipid digestibility. The WB 10 and WB 20 groups kept similar TG level during the 12 weeks feeding trial and had lower plasma triglyceride implied wheat bran affected the fat metabolism. The lower blood triglyceride concentration indicated the reduced/delayed digestion and absorption of fat and hence caused less backfat thickness accumulation as a result.

Table 3. Effects of dietary crude fiber on blood biochemical parameters of Lanyu pigs

Items	Treatment[§]			P-value
	USDA 1160	WB 10	WB 20	
No. of pigs	8	8	8	
Total protein, g/dL				
Initial	6.08 ± 0.24	6.28 ± 0.24	6.23 ± 0.24	NS
WK-6	6.81 ± 0.17	6.88 ± 0.16	6.95 ± 0.16	NS
WK-12	7.47 ± 0.26	7.20 ± 0.24	7.45 ± 0.24	NS
BUN, mg/dL				
Initial	9.50 ± 0.55	9.71 ± 0.55	9.38 ± 0.55	NS
WK-6	8.89 ± 0.99	8.74 ± 0.93	8.71 ± 0.93	NS
WK-12	9.89 ± 1.00	8.73 ± 0.94	11.44 ± 0.94	NS
Creatinine, mg/dL				
Initial	1.23 ± 0.05	1.29 ± 0.05	1.35 ± 0.05	NS
WK-6	1.47 ± 0.06	1.55 ± 0.06	1.54 ± 0.06	NS
WK- 12	1.49 ± 0.07^{b}	1.61 ± 0.07^{ab}	1.70 ± 0.07^{a}	*
Glucose, mg /dL				
Initial	102.5 ± 5.7	107.5 ± 5.7	94.0 ± 0.7	NS
WK-6	124.7 ± 11.8	150.8 ± 11.0	126.3 ± 11.0	NS
WK- 12	125.7 ± 10.7	122.9 ± 10.0	132.9 ± 10.0	NS
Triglyceride, mg/dL				
Initial	28.13 ± 2.97	27.25 ± 2.97	25.00 ± 2.97	NS
WK-6	28.86 ± 2.08^{a}	26.25 ± 1.95^{ab}	20.63 ± 1.95^{b}	*
WK-12	48.86 ± 6.52^{a}	28.75 ± 6.10^{b}	28.25 ± 6.10^{b}	*
Cholesterol, mg/dL				
Initial	86.50 ± 3.37	90.25 ± 3.37	90.38 ± 3.37	NS
WK-6	93.57 ± 3.05	97.38 ± 2.86	93.13 ± 2.86	NS
WK-12	86.57 ± 4.12	96.13 ± 3.86	89.25 ± 3.86	NS

[§] USDA 1160 referred to the American miniature pig formula (USDA 1160); WB 10 and WB 20 contained 10% and 20% wheat bran in diet, respectively.

[a, b] Means in the same row with the different superscripts differ ($P < 0.05$).

The significant higher creatinine in both wheat bran groups indicated that the metabolism of protein affected by wheat bran might be different from the effect of alfalfa. In terms of energy metabolism, growth-finishing pigs fed a lower-energy diet caused higher levels of creatinine in the blood due to decomposition of muscle protein (Hong *et al.*, 2016). Though the DE level in present study was equal amongst treatments, the dietary NDF level in WB 20 was higher than USDA 1160 (Table 1). Schulze *et al.* (1994) demonstrated that an increase in the dietary fiber content in terms of NDF leads to a decreased apparent ileal protein digestibility. As the protein digestibility might be decreased by wheat bran in present study that lead to the decomposition of muscle protein then caused higher blood creatinine.

Wu and Chang (2018b) investigated the blood biochemical parameters at three and six months old of Lanyu pigs. The content of TP, BUN and creatinine in both ages were similar to the results of present study. However, the blood glucose of Lanyu pigs at 3 months old was lower than the value at WK-6, which aged about 17 weeks old of the pigs in

present study, but similar to the ones at WK-12, which aged about 23 weeks old. The blood glucose of Lanyu pigs at 6 months old in the study of Wu and Chang (2018b) was also lower than the value of the pigs in present study. In addition, the TG and cholesterol of Lanyu pigs at 3 months old in the study of Wu and Chang (2018b) was similar to the pigs in present study, while both were higher at the age of 6 months old than those in present study. Compared with the blood biochemical parameters of Göttingen minipigs investigated by Ellegaard Göttingen Minipigs (2020), Lanyu pigs in present study had higher blood glucose, TP, BUN and creatinine and lower TG and cholesterol than Göttingen minipigs. The difference of blood biochemical parameters amongst Wu and Chang (2018b), Ellegaard Göttingen Minipigs (2020) and the results in present study indicated that the blood biochemical parameters are affected by age (Humann-Ziehank and Ganter, 2012).

III. Blood immunoglobulins

The blood IgG, IgM and IgA of Lanyu pigs ranged 7.2 ~ 16.0, 2.5 ~ 5.3 and 0.7 ~ 1.3 mg/mL, respectively and no significant difference was observed amongst treatments (Table 4). Immunoglobulins are the antibody formed when white blood cells are exposed to an antigen and could be the indicator of health status (Le Dividich and Herpin, 2005). Immunoglobulins might be affected by diet, feeding condition, seasons and stressor in environment (Chu and Song, 2013). Chu and Song (2013) demonstrated that IgM was the first antibody formed when white blood cells were initially exposed to an antigen. When exposed to an antigen for a second time, the pigs build very high levels of antibodies, mostly in the class of IgG. White blood cells switch from synthesizing IgM to IgG after continued antigen exposure. Serum IgG is the major constituent of blood immunoglobulin and plays a major role in defending against antigens. Bode *et al.* (2010) reviewed the serum IgG, IgM and IgA of minipigs ranged 17 ~ 29, 1.0 ~ 5.0 and 0.5 ~ 5.0 mg/mL, respectively while the serum IgG, IgM and IgA of man ranged 8 ~ 16, 0.5 ~ 2.0 and 1.5 ~ 4.0 mg/mL, respectively. The blood IgG, IgM and IgA of Lanyu pigs in present study were similar to the investigation of minipigs by Bode *et al.* (2010) which indicated that the health status of both studies was similar. In addition, concentration of serum IgG increased over time as the immune system matures (Chu and Song, 2013). The IgG level of Lanyu pigs across the three treatments in present study also consistently increased over time from 11 to 23 weeks old of age.

Table 4. Effects of dietary crude fiber on blood immunoglobulin of Lanyu pigs

Items	Treatment[§]		
	USDA 1160	WB 10	WB 20
No. of pigs	8	8	8
IgG, mg/mL			
Initial	7.32 ± 0.84	7.39 ± 0.84	7.15 ± 0.84
WK-6	11.44 ± 0.93	12.54 ± 0.87	11.92 ± 0.87
WK-12	14.05 ± 1.65	13.88 ± 1.54	16.04 ± 1.54
IgM, mg/mL			
Initial	2.50 ± 0.15	2.50 ± 0.15	2.57 ± 0.15
WK-6	2.85 ± 0.42	3.17 ± 0.39	3.82 ± 0.39
WK-12	5.26 ± 0.91	2.94 ± 0.85	3.63 ± 0.85
IgA, mg/mL			
Initial	0.75 ± 0.15	0.80 ± 0.15	0.74 ± 0.15
WK-6	1.17 ± 0.16	1.23 ± 0.15	1.29 ± 0.15
WK-12	1.28 ± 0.18	1.00 ± 0.14	0.99 ± 0.14

[§] USDA 1160 referred to the American miniature pig formula (USDA 1160); WB 10 and WB 20 contained 10 and 20% wheat bran in diet, respectively. No significant difference was found amongst treatments ($P > 0.05$).

Regarding of the effect of diet on immunoglobulin, the concentration of blood IgA, IgG and IgM in gestating and lactating sows was not affected by the amount of dietary protein intake (Haye *et al.*, 1981). Cuaron *et al.* (1984) demonstrated that the amount of blood immunoglobulin might be derived from the dietary limiting amino acids rather

than the amount of dietary protein intake. The first-limiting amino acid is the essential amino acid that first becomes deficient in the diet. Lysine is typically the first-limiting amino acid in pig diets. In previous studies, Chen *et al.* (2017), and Liu and Lin (2019) demonstrated that 14% dietary crude protein and 0.7% dietary lysine would meet the requirement of Lanyu pigs under 25 kg of live weight. In present study, the dietary crude protein and lysine level was 14% and 0.75%, respectively across the three treatment diets. As no differences were observed in feed intake amongst treatments, which meant the intake of lysine was not different.

Beside the effect of dietary protein, the main effect of dietary fiber is on the intestinal microbiota, intestinal health, digestive tract and nutrient digestibility (Jarrett and Ashworth, 2018), but not on blood immunoglobulins (Yan *et al.*, 2017; Fan *et al.*, 2020). Yan *et al.* (2017) found that the blood IgA and IgG in weaning pigs were not affected by dietary fiber in terms of sugar beet pulp. Fan *et al.* (2020) also found that serum immunoglobulins did not change with increasing levels of dietary crude fiber in terms of defatted rice bran. The results in present study also showed that neither sources nor levels of dietary fiber had effects on blood immunoglobulins.

Conclusions

The results in present experiment showed that the USDA 1160 diet is suitable for Lanyu pigs and diet containing 10 or 20% wheat bran could maintain normal growth and less accumulation of backfat of Lanyu pigs between 9 and 24 kg live weight. In conclusion, wheat bran could be a fiber source of ingredient for Lanyu pigs.

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飼糧中粗纖維來源及含量對蘭嶼豬生長性能、背脂厚度及血液生化值之影響 (1)

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摘　要

本試驗旨在探討飼糧中粗纖維來源及含量對蘭嶼豬生長、背脂厚度堆積及血液生化值之影響。試驗採用 24 頭公母各半之平均 11 週齡、體重 9 公斤蘭嶼豬，逢機分至 3 組進行 12 週飼養試驗，第一組為 USDA 1160, 其飼糧參照美國小型豬配方組成 (USDA 1160)，含 5% 苜蓿；第 2 組及第 3 組分別含 10% 麩皮之 WB 10 組飼糧及含 20% 麩皮之 WB 20 組飼糧。試驗飼糧均採等蛋白質及等消化能設計，三組飼糧粗纖維含量分別為 3.56、3.23 及 3.95%。試驗期間每三週測定豬隻生長性能，於試驗開始日、試驗第 6 週及第 12 週結束時測定背脂厚度及血液生化值。試驗結果顯示，蘭嶼豬於體重 9 至 24 公斤之間之生長性能及背脂厚度變化量，三組間差異不顯著。血液生化值方面，WB 20 組於試驗結束日之肌酸酐高於 USDA 1160 組 ($P < 0.05$)，但三酸甘油酯低於 USDA 1160 組 ($P < 0.05$)，而 WB 10 組於試驗結束時之三酸甘油酯亦低於 USDA 1160 組 ($P < 0.05$)。總蛋白質、尿素氮、葡萄糖及膽固醇，各組間差異不顯著。綜合上述，飼糧中含 10 或 20% 麩皮可維持蘭嶼豬的生長，且不會過度累積背脂，因此麩皮可作為蘭嶼豬飼糧纖維來源之原料選擇。

關鍵詞：背脂厚度、粗纖維、生長性能、蘭嶼豬。

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