Received: 12 March 2020 | Revised: 21 June 2020 | Accepted: 19 September 2020

MJVAS Myanmar Journal of Veterinary and Animal Sciences

DOI: 10.1002/0000.12345 ISSN:0000-000X

RESEARCH ARTICLE

Effect of varying protein level and different physical forms of diet on the performance of weaned pigs

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Abstract

An experiment was conducted to investigate the effect of dietary crude protein level and physical form of diet on performance of newly weaned pigs. A total of 24, 45 days old pigs (DYL) were randomly allotted into 6 treatments with 4 replicates in a randomized complete block design with 3 x 2 factorial arrangements. The six treatments provided were 1) diet containing crude protein 20%, fed in dry form, 2) diet containing crude protein 20% fed in wet form, 3) diet containing crude protein 18% fed in dry form, 4) diet containing crude protein 18% fed in wet form, 5) diet containing crude protein 16% fed in dry form, and 6) diet containing crude protein 16% fed in wet form. Wet forms of diet were prepared by steaming the complete diet at 140℉ for 15 minutes. Experimental period was 12 weeks. Results from experiment showed that pigs fed wet form of diet had significantly ($P < 0.001$) increase average daily feed intake (ADFI), average daily gain (ADG) and gain: feed ratio (G/F ratio) during the first two weeks and this improved performance with wet feed maintained throughout experiment. The dietary protein level had no significant ($P > 0.05$) effect on performance during the first two weeks but as the animal aged significant difference was found ($P < 0.05$) among treatments. Treatment 4 had the highest ADFI and ADG compared to others and treatment 2 had the highest ratio (G/F). Therefore, these results suggested that feeding wet feed to newly weaned pigs is better than dry counterpart and a slight reduction in dietary crude protein level (3-4 units below NRC recommendation) had no detrimental effect on performance of newly weaned pigs. Either dietary crude protein level or physical form of diet had no significant effect on digestibility of DM, CP and CF.

Keywords:

wet form, dry form, crude protein, newly weaned pig

1. Introduction

During the last three decades, livestock production in Myanmar had been increased enormously and come to play as an important sector. Among them, swine production plays a major role because pigs convert low quality plants and animal products and by-products into food and is an efficient depot for fat, proteins, vitamins and minerals. The growth of swine under favourable conditions is more rapid in proportion to size than that of further farm animals unless it is poultry.

Swine grow rapidly, mature quickly and are prolific as judged by either the number of pigs they produced at one birth or by the fact that the same sow may be managed to raise litters of pig a year (Krider and Carrol, 1975). For improving herd health and enabling producers to customize feeding programs, segregated early weaning (SEW) of piglets at 10-14 days of age has become increasingly popular. It has been said that SEW limits diseases transfer from the sow herd to nursery (Kim et al., 2001). At the time of weaning young piglets are subjected to several stresses such as nutritional, environmental, social and microbial imbalance (Fraser et al., 1998).

Among the challenges of weaning management the provision of adequate nutritional support is important as the young pigs are abruptly switched from sow to dry feed (Nessmith et al., 1997). Similarly, nutritional stress when superimposed on health challenges (porcine reproductive and respiratory syndrome) can result in high morbidity and high mortality in the nursery. Physical form of diet had a large impact on growth performance of early weaned pigs (Kim et al., 2001). Proponent of wet feeding claimed that the procedure increases feed consumption, improve feed efficiency and speed growth (Kornegay et al., 1981). Prior to weaning piglets are normally being fed a liquid diet about every hour by their dam (Hartman et al., 1962). At weaning, it is a general practice to abruptly shift nursing piglets from their hourly liquid feeding to dry feed and water. Thus, Leece et al. (1997) suggested that management schemes to keep frequent liquid feeding seemed to be rational approach.

Wet feeding is becoming a popular feeding method for pig production. It's advantages include increased feed intake, improved growth rates (Payne, 1991), greater feed efficiency (Chae et al., 1997) and reduced wastage of feed and water (Chae, 2000). Canibe and Jensen (2003) also suggested that there are many advantages of using liquid feeding systems compared to dry feeding in swine production. These include improved nutrient utilization, flexibility and control of feeding programs, utilization of inexpensive liquid products, reduced environmental impact and improved animal performance. Liquid feeding may also enhance gut health, reduce the need for feed medications and improve animal well-being (Brooks et al., 2001). These benefits appear to be due to enhanced nutrient availability and reduce growth and shedding of pathogenic bacteria such as Yersinia, salmonella and *E.coli* due to low pH (Geary et al., 1996; Scholten et al., 1999).

Since consumers demand high quality lean pork product, it is producer interest to maximize or optimize the accretion of muscle, or lean body mass and minimize fat deposition. In nearly 20 years pork producers have made tremendous strides toward providing a leaner product to the packer and ultimately to the consumers (Chen et al., 2002). The lean content of pig carcasses is an economically important trait which can be manipulated by nutritional and genetic mean (McPhee et al., 1988). Pigs are much more efficient in producing lean tissue than fat. Pig requires about 4 times the amount of feed to produce one Kg of body fat compare to one Kg of body lean.

The protein level has a significant collective ef-

-fect on the intramuscular fat and nitrogen content of the muscle. Increasing protein level results in a slower rate of gain for pig marketed at 150 lbs, indicating that energy level may have been the limiting factor in the utilization of additional protein (Wagner et al., 1963). Boenker et al. (1960) stated that increasing protein level resulted in linear decrease in carcass back-fat thickness. Nyachoti et al. (2006) also indicated that the reduction of protein level in finisher pigs diet with appropriate feed ration balance and meeting real demand for amino acids digestible in the small intestine decreases nitrogen emission to the environment without lowering pig's performance.

It is interesting to investigate the merit of management system such as feeding dry or wet diet on growth performance and the relationship between protein level of diet and performance of weaned pigs.

2. Materials and Methods

Experimental animals were housed in a farrowing ward with movable rain coat curtain sided building and plastic floor. Feed were provided with individual metal feed trough and water was supplied with automatic drinker. Forty five days old, 24 weaned DYL female hybrid piglets were used in this experiment. They all were provided with creep feed from Myanmar CP Co. Ltd. during suckling. Piglets were randomly divided in to four groups. Each group has 6 piglets which were randomly allocated to individual pen. Before feeding the experimental diet, all piglets were dewormed by injecting Ivermectin and were weighed individually and recorded. Each group was provided with 6 treatments (3 x 2) and each treatment has 4 replicates.

Ration formulae for experiment are shown in Table 1. They were based on locally available feedstuff and compounded manually to contain 3 levels of protein % (20, 18, 16) respectively for each treatment. Each diet was provided at wet form and dry form. Wet form was prepared by steaming the diet at 140˚Ffor 15 minutes and extra water was added at the beginning of steam processing for rapid distribution of heat and the steamed diet contained 40-50% moisture.

A randomized complete block design with (3 x 2) factorial arrangement was used. Diets containing 3 levels of crude protein were given the weaning pigs as both wet and dry form.

2.1 Treatments:

Treatment 1 = Diet containing 20% crude protein fed in dry form

Treatment 2 = Diet containing 20% crude protein fed in wet form

Treatment 3 = Diet containing 18% crude protein fed in dry form

Treatment 4 = Diet containing 18% crude protein fed in wet form

Treatment 5 = Diet containing 16% crude protein fed in dry form

Treatment 6 = Diet containing 16% crude protein fed in wet form

Parameters measured –

Body weight (BW) – animals were weighed at the beginning and weekly throughout the experimental period.

Feed-intake – Feed were provided ad libitum and feed-intake was measured by weighing the feed given to individual pig and collecting and weighing the feed residue in the next morning.

Gain Feed Ratio – G/F ratio was calculated by dividing weight gain with feed intake for individual pig.

Digestibility – During the experiment when the animals were adapted to the feed, their feces were collected for three days and calculated the amount of feces per individual pigs per day. A sample of about 15 g was ta-

Table 1. Rational formula of diet

Sr. No.	Ingredients	Diet 1	Diet 2	Diet 3
1	Corn	29	32	32
2	Broken rice	26.5	28	32
3	Rice Bran	9.3	9	10
4	Groundnut Cake	12	11.8	11.8
5	Sesame cake	10	10	5
6	Fish meal	9	5	5
7	Lysine	0.8	0.8	0.8
8	DCP	0.5	0.5	0.5
9	Burger fat	2	2	2
10	ZnO	0.3	0.3	0.3
11	Premix	0.1	0.1	0.1
12	Provimin	0.5	0.5	0.5
	Total	100	100	100
	Crude protein (%)	19.65	17.85	15.75
	ME (kcal/kg)	3337.7	3340.48	3351.23

-ken from each feces sample and subjected to the laboratory to measure DM, CP and CF.

2.2 Statistical analysis

Data were subjected to analysis of variance using GLM procedure of SAS, according to 3 x 2 factorial arrangement of treatment. Treatment means were compared using Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1980).

3. Results

Overall performances of pigs fed experimental diets are shown in Table 2.

Final body weight of pigs fed diet containing 18% CP was the highest and that of pig fed 16% CP was the lowest. Pigs fed wet form of diet had the highest BW and those fed dry form of diet had lower BW.

There were significant differences of ADFI among different treatments. The highest ADFI was observed in pigs fed diet containing 18% CP and lowest ADFI in pigs fed diet containing 16% CP. In addition, ADFI of pigs fed wet form of diet was higher than those of pigs fed dry form of diet. Pigs fed diet containing 18% CP had the highest ADG and those fed diet containing 16% CP had the lowest. Similarly, pigs fed wet form of diet had the highest ADG than those fed dry form. The higher Gain Feed ratio was observed in the pigs fed 18% and 20% CP diets, when compared with that of pigs fed 16% CP diet.

There were no significant interaction between physical form and dietary protein levels for all parameter measured during experimental period.

3.1 Average Daily Feed Intake (ADFI)

As shown in table 3, there were significant ($P < 0.001$) differences among the treatments from the first week and throughout the experimental period. Treatment 4 had the highest ADFI throughout the experimental period. The differences among the treatments were more pronounced ($P < 0.001$) during the first month (0-35 days) and less pronounced ($P < 0.05$)

Table 2. Effect of dietary protein level and physical form of diet on performance of pigs

Parameters	Dietary Crude Protein Level (Means ±SE)			Physical Forms (Means ±SE)	
	20%	18%	16%	Dry	Wet
Final BW (Kg)	37.29± 2.32^{b}	42.05±1.56^{a}	28.73±0.71^{c}	32.83±1.38^{b}	39.23±2.29^{a}
ADFI (gm/day)	835.9±35.08^{b}	959.54±32.64^{a}	747.33±16.06c	787.01±27^{b}	908.17±32^{a}
ADG (gm/day)	333.79±25.39^{b}	377.75±16.42^{a}	234.34±7.64^{c}	280.77±14.7^{b}	349.82±25.2^{a}
G:F (gm/ 1 Kg feed)	395.94±16.85^{a}	393.75±11.66^{a}	314.14±10.57^{b}	355.08±9.64^{b}	380.8±19.12^{a}

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

Table 3. Effect of treatments on average daily feed intake of pigs (gm)

Duration (Days)	Treatment						
	1	2	3	4	5	6	SEM
Day 0-7	340.39^{abc}	382.41^{ab}	316.31^{c}	396.99^{a}	326.56^{bc}	379.44^{abc}	9.50
Day 0-14	369.83^{ab}	388.95^{ab}	356.7^{ab}	433.55^{a}	346.76^{c}	386.81^{ab}	10.69
Day 15-35	509.99^{bc}	582.13^{abc}	632.98^{ab}	666.25^{a}	469.64^{c}	548.36^{abc}	23.23
Day 0-35	453.92^{b}	504.86^{ab}	522.47^{b}	573.17^{a}	420.49^{b}	483.74^{ab}	17.52
Day 36-63	805.54^{cd}	938.98^{bc}	946.9^{b}	1057.46^{a}	749.17^{d}	875.57^{d}	35.37
Day 0-63	610.33^{cd}	697.8^{ab}	711.1^{ab}	788.41^{a}	566.57^{d}	657.88^{cd}	23.87
Day 63-91	1078.96^{b}	1411.09^{a}	1316.07^{a}	1547.05^{a}	1030.34^{b}	1072.28^{b}	43.61
Day 0-91	754.52^{c}	917.27^{b}	897.25^{b}	1021.84^{a}	709.27^{c}	785.39^{c}	27.59

^{a,b,c,d} means with different superscripts in the same row differ significantly ($P < 0.05$)

during the last month.

3.2 Average Daily Gain (ADG)

During the first two weeks, ADG showed no significant ($P < 0.05$) differences among the treatments (Table 4). But the treatment 4 showed the highest ADG ($P < 0.001$) from day 15 to the end of the experiment and treatment 5 and treatment 6 had the lowest ADG throughout the entire experiment.

3.3 Effect of physical form of diet on ADG

The effects of treatments on average daily gain (ADG) of pigs and the ADG of pigs fed different physical form of diet were given in Table 4. As shown in the table 4, there was no significant differences ($P < 0.05$) among the treatments and between physical form of diet in the first week. But significant differences ($P < 0.05$) was found among other weeks of experiment.

3.4 Feed efficiency (Gain: Feed Ratio)

Feed efficiency is described as weight gain (gram) per 1 Kg of feed (gain: feed ratio) and there was no significant ($P > 0.05$) differences among the treatments on feed efficiency (gain: feed ratio) during the first two weeks. However, in the overall experiment, treatment 2 had the best ($P < 0.001$) gain: feed ratio (G:F) and seconded by treatment 4, treatment 5 and treatment 6 being the lowest G: F ratio (Table 5).

3.5 Body Weight

The pig with treatment 4 had the highest initial body weight and maintained throughout the experimental period. Although the pigs with treatment 5 and treatment 6 had higher initial body weight than treatment 1, treatment 2 and treatment 3and they had the lowest weight at the end of experiment.

Table 4. Effects of treatments on Average Daily Gain of the pigs (gm per day)

Duration	Treatments						SEM
	1	2	3	4	5	6	
Day 0-7	142.86^{ns}	182.14^{ns}	150^{ns}	150^{ns}	125^{ns}	135^{ns}	8.33
Day 0-14	148.21^{ns}	201.79^{ns}	133.93^{ns}	216.07^{ns}	135.71^{ns}	151.79^{ns}	11.59
Day 15-35	203.57^{c}	298.81^{b}	296.43^{b}	389.28^{a}	133.33^{c}	178.57^{d}	20.11
Day 0-35	181.43^{dc}	260^{ab}	231.43^{bc}	320^{a}	134.29^{d}	167.86^{dc}	15.07
Day 36-63	278.57^{c}	377.68^{b}	350.89^{b}	402.68^{a}	241.96^{c}	244.64^{c}	15.05
Day 0-63	224.6^{c}	312.3^{b}	284.52^{b}	356.75^{a}	182.14^{c}	201.98^{c}	14.04
Day 64-91	373.21^{b}	588.39^{a}	458.93^{a}	553.57^{a}	350^{b}	308.93^{b}	26.61
Day 0-91	270.33^{c}	397.25^{a}	338.19^{b}	417.31^{a}	233.79^{d}	234.89^{d}	15.97

^{a,b,c,d} means with different superscripts in the same row differ significantly ($P < 0.05$)

Table 5. Effects of treatments on Gain Feed ratio of pigs (gram of gain per 1 Kg of feed)

Duration	Treatment						SEM
	1	2	3	4	5	6	
Day 0-7	420.84^{ns}	475.61^{ns}	475.33^{ns}	370.75^{ns}	384.95^{ns}	415.65^{ns}	19.47
Day 0-14	397.67^{ns}	515.77^{ns}	382.22^{ns}	488.67^{ns}	392.86^{ns}	393.94^{ns}	22.0
Day 15-35	409.04^{bc}	523.06^{ab}	461.17^{ab}	601.69^{a}	284.4^{c}	329.82^{c}	25.74
Day 0-35	404.49^{cd}	520.14^{ab}	429.59^{bc}	556.48^{a}	327.78^{d}	355.47^{dc}	21.41
Day 36-63	356.9^{ab}	410.53^{a}	380.72^{ab}	389.22^{ab}	337.84^{ab}	284.23^{c}	11.45
Day 0-63	383.34^{bcd}	471.42^{a}	407.87^{bc}	482.14^{a}	332.25^{cd}	323.81^{d}	11.80
Day 64-91	345.07^{ab}	421.91^{a}	356.04^{ab}	362.20^{ab}	339.57^{ab}	287.15^{b}	14.03
Day 0-91	358.63^{cd}	433.24^{a}	377.15^{bc}	410.35^{ab}	329.47^{de}	298.82^{e}	10.81

^{a,b,c,d} means with different superscripts in the same row differ significantly ($P < 0.05$)

Table 6. Effect of treatments on body weight of pigs (Kg)

Duration (days)	Treatment						SEM
	1	2	3	4	5	6	
				Weight – Kg			
Initial	6.95^{ab}	6.88^{b}	7.48^{ab}	7.88^{a}	7.43^{ab}	7.45^{ab}	0.13
Day 7	7.95^{b}	8.15^{ab}	8.53^{ab}	8.93^{a}	8.30^{ab}	8.55^{ab}	0.12
Day 14	9.03^{b}	9.70^{ab}	9.35^{b}	10.90^{a}	9.33^{b}	9.58^{b}	0.19
Day 35	13.3^{cd}	15.98^{b}	15.58^{bc}	19.08^{a}	12.13^{cd}	13.33^{cd}	0.56
Day 63	21.10^{c}	26.55^{b}	25.40^{b}	30.25^{a}	18.90^{c}	20.18^{c}	0.91
Day 91 (Final)	31.55^{c}	43.03^{a}	38.25^{b}	45.85^{a}	28.70^{c}	28.83^{c}	1.47

^{abcd} means with different superscripts in the same row differ significantly ($P < 0.05$)

As described in table 7, either dietary crude protein levels or physical form of diet had no significant ($P > 0.05$) effect on digestibility of DM, CP and CF.

Table 7. Digestibility of nutrients among different dietary treatments

	Dietary Crude Protein Level			Physical Form		SEM
	20%	18%	16%	Dry	Wet	
Dry Matter %	83.17	83.4	84.09	83.21	83.89	0.39
Crude Protein %	84.69	83.55	83.28	83.03	84.64	0.68
Crude Fibre %	70.73	73.6	76.17	73.41	73.58	1.78

All are non significance

4. Discussion

4.1 Physical form of diet and performances of pigs

In this study, the ADFI was increased significantly ($P < 0.001$) as a result of wet feeding up to 14 days (Table 3) after weaning. Increased ADFI has previously demonstrated to result from feeding wet, slurry, gruel and liquid feed to the newly weaned pigs (Kornagay et al., 1981; Kim et al., 2001; Lawlor et al., 2002). This increased ADFI might be behaviouraly based on the facts that pigs immediately after weaning do not have learn new and separate feeding and drinking. Another explanation of this result might be the physical character of the diet. Wet feed is smooth and easily chewed and less abrasive to the digestive tract of the piglets, hence, increase feed intake. Deprez et al. (1987) found that pigs fed the slurry had higher villi on 8 days and 11 days after weaning. The villous height may be maintained because the digesta from the slurry is less abrasive and thus cause less shedding of enterocytes (Pluske et al., 1996; Dong and Pluske, 2007). This could serve to maintain the digestive capacity of the pig and thus might prevent the 'growth lag' often experience at this time. Contrary to Lawlor et al. (2002) who documented that pigs offered fresh liquid feed had lower daily gain (ADG) during the period from 0-13 days after weaning than pigs offered dry feed. This result is consistent with Kim et al. (2001) who reported that liquid fed pigs gained almost four times faster than the dry-fed controls. This increase in ADG might be because of steam heating during the preparation of wet feed which resulted in increased ADFI.

As shown in Table 5, although there were no significant differences between physical form of diet during the first two weeks, there was a tendency to increase gain: feed ratio (G/F) with wet feed. This ADG and G: F might be the result of increase ADFI. But contrary to this, Hansein et al. (1992) reported that improvement in G: F ration in pigs was the result of decrease ADFI. Jensen and Mikkelsen (1998) also reported that regardless of the type of liquid feed provided to weaned pigs, a reduction in gain/feed ratio is found normally relative to pigs offered dry feed. Nevertheless the improvement in feed utilization in this study could be attributed to increased ADFI with a corresponding increase in ADG. An increase in feed intake will not only stimulate growth rate, but also improve feed efficiency because the extra nutrients can be used in growing animals almost exclusively for growth rather than for maintenance.

Any benefit from liquid, wet, slurry or gruel feeding to newly weaned pig is likely to arise from an increase in Average Daily Feed Intake (ADFI). This increased ADFI after weaning by liquid feeding had been found to help maintain gut integrity and, in particular, villous height (Deprez et al., 1987; Pluske et al., 1996). Dong and Pluske (2007) also stated that pigs fed the slurry may consume more feed than their counterparts fed the pellet diet, which may result in higher villi.

In overall experiment, a significant increase ($P < 0.001$) in ADFI, ($P < 0.05$) ADG and ($P < 0.05$) gain feed

ratio with wet feeding was found. The pigs that performed well during the first two weeks had superior performance through the experimental period. This result was in agreement with several researchers (Pollmann et al., 1992; Pluske et al., 1995; Azain et al., 1996; Kin et al., 2001) stating that performance in early life influences subsequences growth performances. The growth advantage achieved by wet feeding during the first two weeks after weaning was maintained through the growing period.

Moreover pigs fed wet diet through the growing period had better performance than those fed dry diet. This result is in lined with the finding of Barber et al. (1963); Braude and Rowel (1976) and Seigl (1962) also reported that pigs preferred wet diets to a dry one by 2:1. Although the crude protein levels of diet 2 and diet 3 in this experiment are much lower than NRC recommendation, there were no significant ($P < 0.05$) effects of CP level on pigs performance during the first two weeks (Table 4 and 5). Several researchers showed the level of crude protein per cent had no effect on average daily feed intake (ADFI), daily gain (ADG) and feed efficiency, if supplemented with essential erystalline amino acid (Anugwa and Okwori, 2008; Powers et al., 2008; Le Bellego et al., 2001; Guo et al., 2011 and Noblet et al., 2001).

But as the animal aged from third week to final week, the levels of crude protein affect significantly ($P < 0.05$) on ADG and gain: feed ratio. The pigs fed high dietary crude protein levels (20% and 18%) had better performance than the pigs fed diet containing 16% of crude protein. One possible explanation for the discrepancy in these results is because either these diets do not provide sufficient nitrogen to allow for synthesis of non-essential amino acids, or the supply of essential amino acids is inadequate when the body weight of the pig increased.

The result of this study is consistent with the previous reports (Chen et al., 1995; Crownwell et al., 1993) demonstrating that ADG and G: F had been shown to decrease in response to decreasing dietary crude protein. The results of Anugwa and Okwori (2008) also indicated that pigs fed diet containing 18% crude protein consumed more ($P < 0.05$) and gain more weight and had better feed conversion ratios ($P < 0.01$) than those fed the 14% crude protein diet even though crystalline amino acids was provided. Reduced growth performance in pig fed low protein diets has also been reported by Kerr et al. (1995).

The results of this experiment are contrary to Guo et al. (2011) who reported that the growth performance was not affected by dietary protein although there is a great difference of protein levels in the diets (11.2% versus 22.7%). Also in one experiment comparing 11%, 12%, 13%, 14, 15% and 16% crude protein in the diet by Figueroa et al. (2000), they found that there were no effect of the concentration of crude protein between 12% and 16% in the diet on ADFI, ADG and gain; feed ratio but pigs fed diet containing crude protein percent of 11 had significantly lower ADFI, ADG and gain: feed ratio.

4.2 Digestibility

Feed processing can change the physical and chemical properties of feedstuffs. In addition, it can also improve the nutritional values of the feed through various mechanisms (Chae et al., 1997). In this study, there was no significant ($P < 0.05$) difference on digestibility between diets with steamed processing and diets without steamed processing (Table 7). Therefore, steaming diets did not affect nutrient digestibility. Contrary to this results, many researchers reported that feed processing (steaming at 65˚C, steamed pelleting, extruding) increased nutrient digestibility (Seerly et al., 1962; Skoch et al., 1983). However, this result was consistent

with the findings of Rodhouse et al. (1992) and Ohh et al. (2002). In the research of Ohh et al. (2002) who studied with 108 pigs (average body weight 7.6 Kg) found that there was no significant effect ($P < 0.05$) of processing methods, processed diet and unprocessed diet (mash form) on faecal digestibility of dry matter and crude protein during nursery period. These inconsistent results might be due to different feed ingredients among researchers, temperature during processing, techniques of processing, particle size of ingredients and the moisture content during processing.

Conclusions

In this experiment, three levels of dietary crude protein per cents (20, 18, 16) were fed as wet and dry feed to newly weaned pigs for three months. According to the results, although the good performance is below NRC growth model, it can be concluded that pigs fed diet in wet form had superior performance during the first month after weaning and 18% dietary crude protein showed the satisfactory results for weaned pigs. Not only dietary protein level and physical form of diet but also dietary protein- to dietary energy ratio affect performance of piglets. Therefore, further research should be focused on protein to energy ratio of the diet provided.

Conflict of interest

Main author and Co-author have consensus agreement and approved the submission of this manuscript therefore do declare that there is no conflict of interest at all. This manuscript has not been published nor previously considered publication anywhere.

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