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The Effects of Three Different Feeding Methods on the Reproductive Performances of Gestating Sows

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Abstract:- This study compared the effects of three different feeding methods on reproductive performances of gestating sows. A total of nine DYL breed sows and nine Myanmar local breed sows were allotted to three dietary treatments in a completely randomized design (CRD) comprised as 2x3 factorial arrangements. During the gestating period, sows were treated with Flat feeding (Diet 1), Three-phase feeding (Diet 2), and Four- phase feeding (Diet 3). Body weight gain of gestating sow from day 0 to 110 was affected by feeding method. Sows fed Diet 2 and Diet 3 treatments had higher ($p<0.001$) in gestation weight gain than those fed Diet 1 treatment. Gestation backfat gain tended to be lower and total lactation feed intake of sow tended to be higher ($p>0.05$) in Diet 1 treatment compared with other treatments. When sows were provided with constant feeding (Flat feeding), body weight loss and backfat loss were lowered ($p<0.05$) during lactation. Feeding methods for gestating sows had no effect ($p>0.05$) on the number of piglets born and litter weight. These results suggested that higher feed intake in gestating sows had no effect on their reproductive performances. Local breed sows were found to be lower ($p<0.001$) in lactation feed intake, total feed intake and lactation weight loss, but greater ($P<0.001$) in piglet's weight and total backfat gain compared to those of DYL breed. In addition, local breeds were smaller ($P<0.001$) in litter size and litter weight than the DYL. No interactions between diets and breeds were observed regarding the feed intake, body weight, backfat gain and piglet's performances. These results showed that flat feeding was more suitable for breeding purpose in Myanmar.

Keywords:- *Sow; Gestation; Lactation; Breeds, Feeding; Piglet; Litter.*

I. INTRODUCTION

In commercial pig production, diet formulation and feeding strategy is important for maximal animal performance. Supplying the most appropriate nutrients to the gestating sows is of great advantages. Overall growth, productivity and reproductive performances of gestating sows can become enhanced when the optimum amount of nutrients is provided to satisfy their needs. In other words, offering the diets that contain mere amount of nutrients to meet the needs of pigs would have a significant impact on the profitability and success of the pig enterprise **[1]**. Poor quality feeds and inadequate feeding seem to be the major factors limiting pig productivity **[2]**.

As stated, providing adequate nutrition for livestock is one of the long-lasting problems for pig productivity these days [3]. Higher productivity expected for sows have not been achieved on most farms [4], which could be related to excessive body weight and body reserve losses during lactation [5]. Since high producing sows require sufficient amount of nutrients for better reproductive and growth performance of their progeny [6], an appropriate feeding method is essential for breeding sows to achieve optimum performance, including the increased number and weight of piglets, short weaning to conception interval, and high lifetime productivity [7].

Thus, it has been well-recognized that implementing efficient feeding strategies for gestating sows is crucial in management practice to give higher production rate in terms of their reproductive performance [8]. Accordingly, many feeding strategies for gestating sow, including constant feeding method and phase feeding methods, have been developed. Although, the constant feeding methods has been widely accepted as an efficient way for pregnant sows, a multi-phase feeding method has also been recommended for enhancing fetal growth and maternal protein accretion [6]. Therefore, it is necessary to review existing feeding strategies and make them adapted to specific breeds and geographical location so that the feeding requirements of sows can be met [9].

For Myanmar, it was reported that local breed pigs were two times smaller in litter size compared to those of the improved pigs [3], such as DYL which is the combination of Duroc, Landrace and Yorkshire [10]. In this regards, productivity and efficiency of indigenous pigs remain major constraint among pig farmers in Myanmar. Besides, there is a little information available on reproductive performances of local breed sow in Myanmar. It is therefore necessary to evaluate the reproductive performances of Myanmar indigenous sows to those of exotic cross breeds by comparing their performances with the same diet provided. It will fill the gap with research data covering the feeding strategy to improve performances in gestating sows. Therefore, this study was carried out to observe the effects of three different feeding methods on the reproductive performances of gestating sows.

II. MATERIAL AND METHODS

A. Experimental animals

Second parity nine DYL (Duroc x Yorkshire) x (Landrace x Yorkshire) sows and nine local breed sows were used in this experiment. They were randomly divided into three groups. Each group had 3 replicates. Sows were allocated to individual pen during gestation period and dewormed two weeks before parturition. The farrowing unit was thoroughly cleaned. At 107 day of postcoitum, gestating sows were moved from gestation stall to farrowing crates. Within 24 h postpartum, iron injection, needle teeth clipping and tail docking were carried out to each piglets. Male piglets were castrated at 7 day of age. Nursing pigs were weaned at 28 day of age.

B. Experimental Diets

Formulation of experimental diet and the nutrient requirement of sows were based on [11]. Compositions of the experimental diet and nutrient levels for gestating and lactating sows are shown in Table 1. Different amounts of feed were provided for each treatment group by (1) Flat (Constant), (2) Three phases of gestation (0-21days, 22-90days and 91days to farrowing) and (3) Four phases of gestation (0-21days, 22-75days, 76-90days and 91days to farrowing) feeding methods. Feeding level during lactation period was increased gradually at a rate of 1.0kg/d from the day of farrowing to a maximum of 7kg/d on day 7 of lactation. Each diet was provided as dry form and two times per day at 9:00 and 15:00 hours. Water was given free access via nipple drinkers. Feeders were checked daily and feed residue was weighed in the early morning before fresh feed was given.

Ingredients %	**Experimental Diets (kilogram)**	
	Gestation diet	***Lactation diet***
Broken rice	27.00	22.00
Maize	53.00	49.80
Rice bran	2.40	2.40
Groundnut meal	6.00	12.00
Soybean meal	6.30	10.00
Fish meal	3.00	1.50
Snail	1.00	1.00
Lysine	0.20	0.20
Methionine	0.20	0.20
Premix	0.40	0.40
Vitagrow	0.30	0.30
DCP	0.20	0.20
Total	100	100
Crude protein %	12.90	16.00
Energy (Kcal)	3261	3256

Table 1:- Formulation of Experimental Diets

C. Experimental Design

Completely randomized design (CRD) was used for this experiment. There were six treatments comprising of 2×3 factorial arrangement on two different pig breeds and three diets with different level of feeding methods. Three replicate for each treatment was used. All sows were randomly allocated in each pen.

D. Breed Treatments

- Breed 1 – Local breed sow
- Breed 2 – DYL breed sow

E. Dietary Treatments

- Diet 1 –2 kg of gestation diet on flat feeding
- Diet 2 – 2, 2.5, 3 kg of gestation diet on three phases of gestation
- Diet 3 - 2, 2.2, 2.4 and 3.2 kg of diet on four phases of gestation

F. Measurements

Feed intake (FI) was measured by the differences between residual and feed given. It was recorded daily. Body weight (BW) and back fat (BF) thickness were measured at breeding, at day 110 postcoitum, day 1 postpartum and day 28 postpartum [6]. Back fat thickness was measured by Renco Lean-Meter® SERIES 12, USA. Measurement of the back fat thickness was made at P2 position; 6.5cm (2.5 inches) from the edge of dorsal midline, at the level of 10th rib of the pig. Reproductive performances such as litter weight, litter size, number of piglets born alive, number of stillborn, piglet weight and number of weaned pigs were recorded.

G. Statistical Analyses

Data were analyzed by analysis of variance using General Linear Model (GLM) [12] as a Completely Randomized Design (CRD) experiment. The significant differences among the treatments were determined at $p<0.05$ by Duncan's Multiple Range Test (DMRT). The significant interaction between breed and dietary treatment was determined at $p<0.05$ in factorial analysis.

III. RESULTS

A. The Effect of Gestating Feeding Levels on Body Weight, Backfat Thickness and Feed Intake of Two Breeds of Sow

The effects of gestating feeding levels on BW, BF thickness and FI of two breeds of sow are shown in table II, III and IV. BW of sow at breeding, day 110 of postcoitum, day 1 postpartum, day 28 of postpartum and average BW gain were not significantly different ($p>0.05$) among the dietary treatments. The sows treated with Diet 1 treatment were significantly lowered ($p<0.001$) in gestation weight gain and lactation loss than that of Diet 2 and Diet 3 treatments. Sows fed Diet 3 were significantly higher ($p<0.05$) in lactation loss than the sows fed other treatments. Except gestation BW gain, there were significantly different ($p<0.001$) in BW between DYL and Local breed sow. BW and lactation loss of DYL breed were significantly ($p<0.001$) higher than the Local breed. Local breed was significantly higher ($p<0.001$) in total BW gain than the DYL. There were no interaction ($p>0.05$) between diets and breed in BW of sows on the whole experiment.

Sows fed Diet 2 were lose more BF ($p<0.001$) than that of Diet 1 and Diet 3 on the lactation. There were no significantly differences ($p<0.05$) in BF thickness at the day of breeding, 110 day of gestation, day 1 postpartum and day 28 postpartum. Significantly higher ($p<0.001$) in BF were observed in local breed than DYL at the day of breeding, at 110 day of gestation, at day 1 postpartum, day 28 of lactation and total BF gain. Gestation Bf gain and lactation Bf loss were not significantly different ($p<0.05$) between DYL and Local breed sow. There were significantly interaction ($P<0.05$) on BF thickness at breeding, day 110 postcoitum and day 1 postpartum, ($p<0.001$) at 28 day postpartum between diet and breed treatment. But, Gestation gain, lactation loss were not significantly interact ($p>0.05$) between diet and breed.

The sows treated with Diet 2 were significantly higher ($p<0.001$) in total gestation FI than Diet 1 and Diet 3. The sows fed Diet 1 was lower in total gestation FI than that of Diet 3. Total lactation FI were tended to be higher in the sows fed diet 1 but there was no significantly different in total lactation FI among the dietary treatments. The sows fed Diet 2 were higher significant ($p<0.001$) in total FI than Diet 1 and Diet 3 and the sows fed Diet 1 were significantly lower ($p<0.001$) in total FI than Diet 2 and Diet 3. Total gestation FI were not different significantly ($p<0.001$) between DYL and Local breed. Total lactation FI and total feed intake was higher significantly ($p<0.001$) in DYL than Local breed. No interaction ($p>0.05$) between Diet and Breed were observed in total gestation FI, total lactation FI and total FI.

Body weight (kg)	**Diet (Means ± SEM)**			**Sig. Level**	**Breed (Means ± SEM)**		**Sig. Level**
	Diet 1	***Diet 2***	***Diet 3***		***Local***	***DYL***	
Breeding	141.64±12.18	142.16±12.22	145.01±12.46	NS	170.19±1.36b	115.68±1.33a	**
Day 110 postcoitum	174.51±12.72	183.47±13.15	187.42±13.62	NS	211.07±2.50b	152.52±1.92a	**
Day 1 postpartum	149.45±11.76	156.22±12.55	162.29±13.33	NS	183.85±2.60b	128.13±1.86a	**
Day 28 postpartum	144.51±10.89	148.35±11.27	151.93±11.93	NS	173.37±1.92b	123.16±1.68a	**
Gestation gain	32.86± 10.62a	41.31± 1.42b	42.41± 1.39b	**	40.88± 1.83	36.84± 1.39	NS
Lactation loss	4.93± 1.03a	7.87± 1.40b	10.36± 1.66b	*	10.47± 1.12b	4.97± 0.71a	**

[a]a,b The means with different superscripts within the same row are significantly different at ($p<0.001$)** and ($p<0.05$)*. NS= no significant

Table 2:- Effects of Gestating Feeding Levels on Body Weight of Two Breeds of Sow

Backfat Thickness (mm)	**Diet (Means ± SEM)**			**Sig. Level**	**Breed (Means ± SEM)**		**Sig. Level**
	Diet 1	***Diet 2***	***Diet 3***		***Local***	***DYL***	
Breeding	18.84± 0.30	18.59± 0.40	18.30± 0.73	NS	17.44± 0.22a	19.35± 0.23b	**
Day 110 postcoitum	21.4± 0.48	21.93± 0.31	21.50± 0.68	NS	20.60± 0.25a	22.64± 0.14b	**
Day 1 postpartum	21.37± 0.48	21.91± 0.30	21.45± 0.67	NS	20.56± 0.25a	22.59± 0.14b	**
Day 28 postpartum	19.08± 0.48	18.56± 0.40	18.42 ±0.82	NS	17.45± 0.23a	19.93± 0.16b	**
Gestation gain	3.04± 0.20	3.43± 0.15	3.20± 0.11	NS	3.15± 0.16	3.28± 0.11	NS
Lactation loss	2.28± 0.18a	3.34± 0.19c	3.03± 0.16b	**	3.11± 0.23	2.66± 0.15	NS

[b]a,b.c The means with different superscripts within the same row are significantly different at ($p<0.001$)** and ($p<0.05$)*. NS= no significant

Table 3:- Effects of Gestating Feeding Levels on Backfat Thickness of Two Breeds of Sow

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Feed Intake (kg)	Diet (Means ± SEM)			Sig. Level	Breed (Means ± SEM)		Sig. Level
	Diet 1	*Diet 2*	*Diet 3*		*Local*	*DYL*	
Total GFI	218.58±1.73a	277.77±1.28c	264.25±2.19b	**	255.37±9.26	251.69±8.80	NS
Total LFI	125.74±5.72	109.66±5.59	110.90±5.13	NS	127.40±2.90b	103.46±2.60a	**
Total FI	344.33±6.12a	387.43±6.42c	375.15±6.88b	**	382.78±6.77b	355.16±6.41a	**

[c]a,b.c The means with different superscripts within the same row are significantly different at (p<0.001)**. NS= no significant

Table 4:- Effects of Gestating Feeding Levels on Feed Intake of Two Breeds of Sow

Litter Weight (kg)	Diet (Means ± SEM)			Sig. Level	Breed (Means ± SEM)		Sig. Level
	Diet 1	*Diet 2*	*Diet 3*		*Local*	*DYL*	
At birth	13.78± 1.01	13.61± 1.24	14.41± 1.16	NS	16.34± 0.38b	11.53± 0.29a	**
Day 28	80.83± 8.36	73.76±8.38	79.10± 8.37	NS	95.83± 2.43b	59.97± 1.91a	**

[d]a,b The means with different superscripts within the same row are significantly different at (p<0.001)**. NS= no significant

Table 5:- Effects of Gestating Feeding Levels on Litter Weight of Two Breeds of Sow

Piglet Weight (kg)	Diet (Means ± SEM)			Sig. Level	Breed (Means ± SEM)		Sig. Level
	Diet 1	*Diet 2*	*Diet 3*		*Local*	*DYL*	
At birth	1.46.± 0.06	1.51± 0.05	1.51± 0.04	NS	1.37± 0.01a	1.62± 0.01b	**
Day 28	8.40± 0.08	8.22± 0.05	8.22± 0.22	NS	8.13± 0.04a	8.42± 0.05b	**

[e]a,b The means with different superscripts within the same row are significantly different at (p<0.001)**. NS= no significant

Table 6:- Effects of Gestating Feeding Levels on Piglet Weight of Two Breeds of Sow

No. of Piglet	Diet (Means ± SEM)			Sig. Level	Breed (Means ± SEM)		Sig. Level
	Diet 1	*Diet 2*	*Diet 3*		*Local*	*DYL*	
Total born	9.83± 1.13	9..83± 1.30	10.00± 1.23	NS	12.56± 0.17b	7.22± 0.27a	**
Still born	0.00± 0.00	0.33± 0.21	0.17± 0.16	NS	0.33± 0.16	0.00± 0.00	NS
Mummies	0.17± 0.16	0.33± 0.21	1.67± 1.28	NS	0.33± 0.16	1.11± 0.87	NS
Born alive	9.67± 1.08	9.17± 1.13	9.50± 1.14	NS	11.89± 0.20b	7.00± 0.23a	**
Weaning	9.67± 0.08	9.00± 1.06	9.33± 0.58	NS	11.67± 0.23b	7.00± 0.23a	**

[f]a,b The means with different superscripts within the same row are significantly different at (p<0.001)**. NS= no significant

Table 7:- Effects of Gestating Feeding Levels on Litter Size of Two Breeds of Sow

B. The Effect of Gestating Feeding Levels on Litter Weight, Piglet Weight and Littrt Size of Two Breeds of Sow

The effects of gestating feeding levels on litter weight, piglet weight and number of piglet of two breeds of sow are shown in table V, VI and VII. Litter weight, piglets weight and number of piglet were not significantly different (p<0.001) among the sows treated with Diet 1, Diet 2 and Diet 3 throughout the experiment. DYL breed was significantly greater (p<0.001) in litter weight than the local breed at birth and day 28 postpartum. Piglets weight of local breed was significantly greater (p<0.001) than DYL at birth and day 28 postpartum. DYL was significantly higher (p<0.001) in total born, born alive and weaning piglet than local breed. Stillborn and mummies piglets were not significantly different (p<0.001) in DYL and local breed. No significant interaction (p>0.05) was observed between Diet and Breed.

IV. DISCUSSION

A. The Effect of Gestating Feeding Levels on Body Weight, Backfat Thickness and Feed Intake of Two Breeds of Sow

The experiment showed that the sows fed Diet 1 treatment (Flat feeding) had lower gestation weight gain and lactation weight loss than the sows fed other treatment (Diet 2 and Diet 3). The gestation BF gain was tended to be lower in sows fed Flat feeding treatment and significantly lower in lactation BF loss.

The agreements of [13], the sows on the higher levels of FI gained more BW and BF during gestation compared with sows on the lower levels of FI. [14] also stated that increasing levels of FI during 4 short periods of gestation increased BW and BF gain during gestation and led to less BW gain and more BF loss during lactation. When sows were fed constant feed ration (Flat feeding), less BW loss was observed during lactation. Increasing FI during gestation caused the increment of BF thickness as well as BW gain of gestating sow. At the end of gestation, BW and

BF thickness of sows in Flat feeding treatment were lower than those of other feeding methods [6].

According to the gestation feeding, the sows fed Diet 2 and Diet 3 was higher in total gestation FI than the sow fed Flat feeding treatments. However, there were no differences in total lactation FI among the sow fed experimental diets. Sows fed Flat feeding treatment were tended to be higher in total lactation FI.

It was similar with [13] that the levels of FI during gestation had no effect on lactation feed intake. [14] also described the lactation FI was similar for sows fed restrictedly or ad libitum during gestation. This result was in agreement with [6] who reported that FI of lactating sows tended to be greater when they were in flat feeding treatment. Moreover, the negative relationship between levels of feed intake during gestation and lactation feed intake has been observed by [15], [16]. However, [8] described that increasing feeding level in late gestation also increased lactation FI and increased feed cost with no benefit in sow performance.

Since higher FI during gestation generally resulted in a higher BW and body fatness of sows at farrowing [15], voluntary FI during lactation may be affected by BW and BF of sows during gestation. Moreover, lower fatness maybe reduced circulating concentration of leptin hormones, which lead to increased feed intake [17]. Therefore, high FI of lactating sows in Flat feeding treatment could be pronounced by their lower body fatness. One possible reason was that lower feeding level had relatively lower energy reserve at farrowing than sows fed higher feeding level, which resulted in increasing feed intake of lactating sows in order to meet their increased energy requirements during lactation [6].

Although BW of Myanmar local breed sows were lower and higher in BF than the DYL throughout the experiment, no differences were seen in gestation weight gain, gestation BF gain and lactation BF loss between them. DYL breed sows were higher in lactation weight loss than local breed sows. BW and BF differences may be due to breed different. The growth of Myanmar local pigs is slow (weights 114-140 kg in adult) and the proportion of fat in carcass is high [18]. In the study of [19], DYL cross breed reached the 100kg body weight within 164.8days. Agreement with [20], growth performances of DYL were superior over that of local breed. BF thicknesses of DYL were also thinner than that of local breed. So, DYL sows were greater in BW and lower in BF than local breed sows.

The study showed that no significant differences in gestation FI between two breed and higher in lactation FI was observed in DYL than local breed. It might be due to the different in BF thickness and litter size of sows during lactation. Gestation gain and lactation loss of BW and BF were not observed in the interaction of Diet and breed.

B. The Effect of Gestating Feeding Levels on Litter Weight, Piglet Weight and Litter Size of Two Breeds of Sow

There was no agreement with [9] who described that the total number of pigs born alive was decreased in sows fed increased amount of diet from day 30 to 50 of gestation. [21] also indicated that high feed intake during the first month of gestation decreases embryo survival. [22] reported that sows with higher feed intake from day 30 to 50 of gestation reduced number of piglets born alive compared to the sows with normal feed intake.

Similar to the findings of [23], no differences in the total number of pigs born were observed following the changes in maternal feed intake. The findings that the total number of piglets born, live-born piglets, and piglets at weaning were not different among different levels of feed intake throughout the 4 periods of gestation supported the findings of [14]. [7] also expressed that the increased feed intake during gestation was not related to a higher number of piglets born alive.

Although high feed intake had been shown to be detrimental to embryo survival, the detrimental effects were most obvious only in the first 72h after breeding [24], and therefore the increased feed intake in this study was not related to a higher number of piglets born alive [6] since it was provided only after 21 days of gestation. Another reason was that the amounts of feed provided in this study were not big enough to produce any differences in litter size among the treatments.

[23] observed no significant differences in litter weight with increased feed intake from days 25 to 50 of gestation. [6] observed increased BW and BF did not increase in litter weight or individual pig weight and increased in gestation feeding was found to have little effect on piglet BW [16]. Agreements with their study, the flat feeding treatment had similar piglet BW compared to other treatment groups. However, in some others, higher levels of feeding lead to heavier piglets at birth [25], [26]. These differences among studies might be due to differences on the amount of energy and nutrients, the length of time and the period of gestation in which the feed supplementation was provided.

Litter size and litter weight of DYL breed were greater and lower in piglets weight than local breed. It is agreement with [18] who stated that Myanmar local breed sow had litter size of 6-8. Hence lower in litter size and lactation FI, the litter weight of Myanmar local pigs might be lower than the DYL breed.

In conclusion, increasing the feed intake during gestation did not significantly reduce the feed intake of sows in lactation period, but reduced the lactation body weight and backfat thickness significantly. In addition, piglet's birth weight and weaning weight were not affected by feeding levels in gestation. Thus, flat feeding will be an appropriate and economical feeding plan to exploit reproductive performance and body condition of breeding

sows without any detrimental effects on the growth of offspring.

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REFERENCES

[1]. I.L. Chiba, Swine production handbook. 13th revision, Department of Animal and Dairy Sciences, Auburn University, Alabama, USA. 2010.
[2]. J.M. Mbuthia, T.O. Rewe, and A.K. Alexander Kigunzu Kahi, Evaluation of pig production practices, constraints and opportunities for improvement in smallholder production systems in Kenya. Trop. Anim. Heal. Prod. Kenya, vol. 47, pp. 369-376, December 2015.
[3]. Food and Agriculture Organization, Swine industry profile of Myanmar. In: Swine Industry Profile of Selected South East Asian Countries, Bangkok. 2011, pp. 22-53.
[4]. J.J. Eissen, E. Kanis, and B. Kemp, Sow factors affecting voluntary feed intake during lactation. Lives. Prod. Sci. Netharlands, vol. 64, pp. 147-165, 2000.
[5]. E.J. Clowes, F.X. Aherne, A.L. Schaefer, G.R. Foxcroft, and V.E. Barocos, Selective protein loss in lactating sows is associated with reduced litter growth and ovarian function. J. Anim. Sci. Edmonton, vol. 81, pp. 753-764. March 2003.
[6]. L.G. Piao, W.S. Ju, H.F. Long, and Y.Y. Kim, Effects of various feeding methods for gestating gilts on reproductive performance and growth of their progeny. Asian-Aust. J. Anim. Sci. Korea, vol. **23**, pp. 1354 – 1363. May 2010.
[7]. I. Kyriazakis, and C.T. Whittemore, In: Whittemore's Science and Practice of Pig production. 3rd (Eds.), Reproduction, Oxford, UK, 2006, pp. 104-146.
[8]. N.W. Shelton, J.M. DeRouchey, C.R. Neill, M.D., Dritz, S.S, Tokach, R.D. Goodband, and J.L. Nelssen, Effects of increasing feeding level during late gestation on sow and litter performance. Sow Herd Nutrition and Management. Kansas, pp. 38-50, January 2009.
[9]. A. Cerisuelo, R. Sala, J. Gasa, N. Chapinal, D. Carrión, J. Coma, and M.D. Baucells, Effects of extra feeding during mid-pregnancy on gilts productive and reproductive performance. Spanish J. Agri. Res. Spain, vol. 6, pp. 219-229, February 2008.
[10]. K.S. Kim, J.S. Yeo, and J.W. Kim, Assessment of genetic diversity of Korean native pigs (Sus Scrofa) using AFLP markers. Genes and Genetic System. Korea, vol. 77, pp. 361-368, October 2002.
[11]. National Research Council, Nutrient requirements of swine. 10th ed. National academy press, Washington, DC, 1998.
[12]. Statistical for the Social Science, IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp, 2015.
[13]. D.C. Mahan, Relationship of gestation protein and feed intake levels over a five-parity period using a high-producing sow genotype. J. Anim. Sci. Columbus, vol. 76, pp. 533–541, 1998.
[14]. P. Ren, X.J. Yang, R. Railton, J. Jendza, and S.K. Baido, Effects of different levels of feed intake during four short periods of gestation and housing systems on sows and litter performance. Anim. Repro. Sci. United States, vol. 188, pp. 21–34, 2018.
[15]. W.C. Weldon, A.J. Lewis, J.F. Louis, J.L. Kovar, M.A. Giesemann, and P.S. Miller, Postpartum feeding hypophagia in primiparous sows: I. Effects of gestation level on feed Intake, feeding Behavior, and plasma metabolite concentrations during lactation. J. Anim. Sci. Lincoln, vol. **72**, pp. 387-394, December 1994.
[16]. P.G. Lawlor, P.B. Lynch, M.K. O'Connell, , L. Mcnamara, P. Reid, and N.C. Strickland, The influence of over feeding sows during gestation on reproductive performance and pig growth to slaughter. Arch Tierz Dummerstorf. Ireland, vol. 50, pp. 82-91, January 2007.
[17]. C.R. Barb, X. Yan, M.J. Azain, R.R. Kraeling, G.B. Rampacek, and T.G. Ramsay, Recombinant pocrine leptin reduces feed intake and stimulates growth hormone secretion in swine. *Domes. Anim. Endocri*. Athens, Vol. 15(1), pp. 77–86, August 1998.
[18]. V. Porter, A. Alderson, J.G. Stephen, D. Hall, and P. Sponenberg, Mason's world encyclopedia of livestock breeds and breeding, 2 Volume Pack. CABI, UK, pp. 567, 2016.
[19]. D.L. Kuhlers, S.B. Jungst, and J.A. Little, An Experimental Comparison of Equivalent Terminal and Rotational Crossbreeding Systems in Swine: Pig Performance. Department of Animal and Dairy Sciences, Auburn University, 2014.
[20]. Sai Koung Ngeun, The effect of lysine supplementation on the performance of two different pig breeds. M.V.Sc Thesis. University of Veterinary Science, Nay Pyi Taw, Myanmar, 2018.
[21]. R. Jindal, J.R. Cosgrove, F.X. Aherne, and G.R. Foxcroft, Effect of nutrition on embryonal mortality in gilts: association with progesterone. J. Anim. Sci. Canada. vol, 74, pp. 620-624, April 1996.
[22]. R.E. Musser, D.L. Davis, M.D. Tokach, J.L. Nelssen, S.S. Dritz, and R.D. Goodband, Effects of high feed intake during early gestation on sow performance and offspring growth and carcass characteristics. Anim. Feed Sci. Tech. USA, vol. 127, pp. 187–199, 2006.
[23]. C.M. Dwyer, N.C. Stickland, and J.M. Fletcher, The influence of maternal nutrition on muscle fiber number development in the porcine foetus and on subsequent postnatal growth. J. Anim. Sci. London, vol. 72, pp. 911-917, 1994.

[24]. R. Jindal, J.R. Cosgrove, and G.R. Foxcroft, Progesterone mediates nutritionally induce effects on embryonic survival in gilts. J. Anim. Sci. Canada, vol. 75, pp. 1063-1070, April 1997.
[25]. F.X. Aherne, and R.N. Kirkwood, Nutrition and sow prolificacy. J. Repro. Ferti. Supple. USA, vol. 33, pp. 169-183, February 1985.
[26]. M.T. Coffey, B.G. Diggs, D.L. Handlin, D.A. Knabe, J.C.V. Maxwell, P.R. Noland, T.J. Prince, and G.L. Gromwell, Effect of dietary energy during gestation and lactation on reproductive performance of sows: a cooperative study. J. Anim. Sci. Lexington, vol. 67, pp. 3-14, January 1994.