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RESEARCH ARTICLE

Effects of physical forms of diet (dry versus wet) on the performances of breeding sow

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Abstract

Six third-parity DYL (Duroc x Yorkshire) x (Landrace x Yorkshire) sows and six local breed sows were used in this experiment. They were randomly divided into two groups (dry feeding and wet feeding). Body weight (BW) and backfat thickness (BF) of sows fed wet and dry diets were not significantly different (P > 0.05) at breeding, 110 days of gestation, day 1 postpartum, day 28 postpartum and gestation BW gain. The sows treated with dry diet were higher (P < 0.05) in lactation BW losses than those on a wet diet and were not significantly different in lactation BF loss (P > 0.05). Average daily gestation feed intakes (ADGFI) and total gestation feed intake (TGFI) of sows during the gestation period were not different (P > 0.05) between wet and dry diet treatments. Wet feeding treatment had significantly higher (P < 0.05) in average daily lactation feed intakes (ADLFI), total lactation feed intake (TLFI) and total feed intake (TFI) than dry feeding treatments. Litter weight at birth, piglet weight at birth, litter size and weaning to oestrus interval of sow fed dry diet and wet diet were not significantly different (P > 0.05). At day 28, litter weights of wet feeding treatments were numerically greater and piglet weights of wet feeding treatments were significantly greater (P < 0.05) than dry feeding. Lactation BW loss was also higher (P < 0.001) in DYL sows than in local breed sows. DYL breed sows were numerically higher in lactation BF loss than local breeds. Litter size and litter weight of the DYL breed were significantly greater (P < 0.001) and lower (P < 0.05) in piglet weight than those in the local breed. Since DYL breed sows have higher litter sizes; they are more suitable for breeding purposes than Myanmar local breed sows. Furthermore, wet feeding is suitable for two breeds of sow.

Keywords:

DYL, Local, sow, feed intake, physical forms

1. Introduction

In Myanmar, swine production creates 27% of the total meat production. Pig populations of commercial pig farming are smaller than those of local pigs (NCCM, 2001). Myanmar local breed pigs are fed mainly with kitchen waste, rice bran and occasionally limited amounts of concentrates (FAO, 2011; Thin Thinzar et al., 2019). Pig feeds mainly depend on readily available feed rather than on nutritional requirements at different stages of the production cycle (Lemke et al., 2006). Due to this fact, their growth is slow and a well-fed pig weighs about 60 kg at 12 months of age (Porter et al., 2016) and they also require 8 to 12 months to reach marketable weight (FAO, 2011). Moreover, the success and efficiency of pig farming largely depends upon the reproductive performance of pigs (Joseph and Abolaji, 1997), and providing unbalanced nutrition to breeding sows causes low performance (Phan et al., 2005).

On the other hand, most of the farmers gave drinking water mixed with feed (Thin Thinzar et al., 2019). Its advantages include increased feed intake, improved growth rates and greater feed efficiency (Chae et al., 1997) and reduced wastage of feed and water (Maton and Daelemans, 1991). Due to these facts, wet feeding is becoming a popular feeding method for pig production (Chae, 2000). O'Grady and Lynch (1978) observed that the sows in the wet feeding group had higher feed intake than the sows in the dry feeding group. Sows fed with dry feed had greater body weight loss compared to the wet feeding group, but it led to high content and quality of milk production and good litter performance (Hong et al., 2016).

Moreover, gestation feeding management is important for the reduction of embryonic losses, to minimize fetal loss, and to enhance fetal growth and mammary development (Johnston, 2010). Furthermore, encouraging lactating sows to eat and drink as much as possible is critical for milk production, the conservation of body nutrient stores, and an efficient transition into the next reproductive cycle (Peng et al., 2007). Insufficient nutrient intake caused body composition loss to maintain milk production (NRC, 1987) and a low level of feed consumption during the lactation period is associated with low milk production and a decrease in fat muscular reserves (O'Grady et al., 1973), severe body weight loss, delayed WEI, reduced conception rate, ovulation rate, and fetus survival rate (Zak et al., 1997).

Although the use of wet feeding can increase feed intake and the reproductive performance of sows, the collected data of Myanmar local breed sows fed with commercial concentrate and wet feed was still inadequacy. So, it is necessary to investigate the reproductive performance of Myanmar local breed sows and DYL sows by feeding them with dry versus wet diets.

2. Materials and Methods

2.1 Experimental animals, diets and design

The experiment was carried out at the Fifty Acres Livestock Breeding Zone of the Myanmar Army Commander in Chief's Camp Office in Nay Pyi Taw, Myanmar. Six third-parity DYL (Duroc x Yorkshire) x (Landrace x Yorkshire) gestating sows and six local breed gestating sows were used in this experiment. They were randomly divided into two groups (dry feeding and wet feeding). Each group had 3 replicates. Sows were allocated to individual pens during the gestation period and dewormed two weeks before parturition.

At 107 days of postcoitum, gestating sows were moved from gestation stalls to farrowing crates. Within 24 h postpartum, iron injection, needle teeth clipping, and tail docking were carried out on each piglet. Male piglets were castrated at 7 days of age. The formulation of the experimental diet and the nutrient requirements of sows were based on NRC (1998). Chemical analysis of experimental diets was carried out according to the procedure of AOAC (2005) at the Department of Animal Science, Yezin, Nay Pyi Taw, Myanmar.

Compositions of the experimental diet and nutrient levels for gestating and lactating sows are shown in Table 1. The wet diet (1:3 with feed and water) was made in a large plastic box the day before. All of the experimental sows were given access to 2 kg of gestation diet during the gestation period. Feeding level during the 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 in dry form and two times per day, at 9:00 am and 3:00 pm. 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. A completely randomized design (CRD) was used for this experiment. There were four treatments comprising of 2×2 factorial arrangement on two different pig breeds and two types of physical form of diet.

2.2 Measurements and analysis of data

Feed intake was measured by the differences between residual and feed given. It was recorded daily. The residual feed was then carefully removed from the trough and weighed on the electronic balance. The residual wet feed was poured into metal trays and placed in a drying oven at 80°C for 24 h. The dried feed residue was then weighed and recorded. Intake of feed was calculated as the difference between feed provided minus the residual. BW and BF thickness were measured at breeding, at day 110 postcoitum, day 1 postpartum and day 28 postpartum (Piao et al., 2010).

BF was measured by Renco Lean-Meter® SERIES 12, USA. Measurement of the BF 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. Litter weight, litter size, piglet weight and weaning to estrus interval were recorded. The collected data was analyzed by analysis of variance using GLM procedure of SPSS (2015) as a 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 $P < 0.05$ factorial analysis.

3. Results and Discussion

In this experiment, sows fed wet and dry diets were not different ($P > 0.05$) in BW at breeding, 110 days of gestation, day 1 postpartum, day 28 postpartum, and gestation BW gain. But, lactation BW losses were higher ($P < 0.05$) in sows treated with dry diet than in those treated with wet diet (Table 2). The BF thicknesses of sows were not significantly different ($P > 0.05$) at breeding, 110 days of gestation, day 1 postpartum, day 28 postpartum. Gestation BF gains, and lactation loss between the sows fed dry and wet dietary treatments were also similar (Table 3).

Feed intakes of sows (Table 4) during the gestation period were not significantly different ($P > 0.05$) between wet and dry diet treatments. The sows treated with wet diet had more lactation feed intake ($P < 0.05$) than dry feeding treatments. Since the amounts of feed intake during the gestation period were not significantly different ($P > 0.05$), gestation BW gain and BF gain did not differ (Table 2 and 3). Moreover, ADLFI and TLFI were significantly higher ($P < 0.05$) in sows fed wet feeding. As, higher in TLFI in the sow fed wet diet, BF losses of sows fed dry diet were numerically higher in lactation than those of sows fed with wet diet.

Agreement with Eissen et al. (2003), who stated that sows with a greater lactation feed intake showed smaller BF and BW losses. Moreover, feed intake durin-

Table 1. Formulation of experimental diets

Ingredients %	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 2. Effects of physical forms of diet on body weight of two breeds of sow

Body weight (kg)	Physical form (Means ± SEM)		Sig. level	Breed (Means ± SEM)		Sig. level	Physical form* Breed
	Dry	Wet		DYL	Local		
Breeding	153.46±11.26	153.31±12.02	NS	179.27±1.03[b]	127.50 ±1.53[a]	P < 0.001	NS
110 day of gestation	186.91±11.40	186.90±12.29	NS	213.21±1.20[b]	160.60± 1.75[a]	P < 0.001	NS
Day 1 post-partum	164.83±10.75	165.64±11.19	NS	189.60±1.11[b]	140.87 ±1.48[a]	P < 0.001	NS
Day 28 post-partum	160.99±10.02	163.71±10.83	NS	185.50±1.43[b]	139.21 ±1.50[a]	P < 0.001	NS
Gestation BW gain	33.45±0.73	33.58±0.77	NS	33.93±0.92	33.10± 0.46	NS	NS
Lactation BW loss	3.84±0.72[b]	1.92±0.36[a]	P < 0.05	4.10±0.61[b]	1.66± 0.24[a]	P < 0.01	P<0.001

[a,b] The means with different superscripts within the same row are significantly different at (P <0.05)*.
NS= non-significant

-g the lactation period was only influenced by wet feeding (Genest and Allaire, 1995). Sows fed with wet feeding were not only greater feed intake but also lower body weight loss than those fed with dry feeding during lactation (Peng et al., 2007). In addition, O'Grady and Lynch (1978) described that lactating sow had higher feed intake when the feed was wet or watery. Hong et al. (2016) also found that lactating sows fed with dry feed had greater body weight loss compared with the wet feeding group. Furthermore, the use of wet feeding reduced the weight loss and backfat loss (Genest and Allaire, 1995). According to the study, sows fed wet diet were significantly higher (P < 0.05) in lactation feed intake than those fed dry diet. The higher the FI of sow, the lower the BW loss and BF loss during lactation.

BW of DYL breed sows were significantly greater (p<0.001) than those of local breed sows throughout the experiment. Lactation BW loss was also higher (P < 0.01) in DYL sows than in local breed sows. The gestation BW gains were not different (P > 0.05) between two breeds. Gestation BW gain may depend on gestation feed intake. On the other hand, litter size may also affect the lactation BW of sows. Local breed sows were higher (P < 0.001) in BF than DYL sows (Table 2 and 3). Although Gestation BF gains and lactation BF losses were not significantly different (P > 0.05) between two breeds, DYL breed sow were numerically higher in lactation BF loss than local breed.

In the finding of current study, litter size of DYL breed sows was greater (P < 0.001) than that of local breed sow. Because of litter size of DYL breed sow was greater than that of local breed sow, lactation BF loss of DYL breed sow was higher than that of local breed sow. Eissen et al. (2003) stated that lactation body weight loss and backfat loss of sow increased linearly with litter size. BW and BF differences between DYL and local breed sows 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 (Porter et al., 2016). In the study of Kuhlers et al. (2014), DYL cross breed reached the 100kg body weight within 164.8days and Sai koung Ngeun (2018) found that BW of fattening DYL were greater and thinner in BF thickness than those of fattening local breed.

Litter weight and piglet weight at birth of sow fed dry diet and wet diet were not significantly different (P > 0.05). At day 28, litter weights of wet feeding treat-

Table 3. Effects of physical forms of diet on backfat thickness of two breeds of sow

Backfat thickness (mm)	Physical form (Means ± SEM)		Sig. level	Breed (Means ± SEM)		Sig. level	Physical form* Breed
	Dry	Wet		DYL	Local		
Breeding	18.72±0.58	18.80±0.67	NS	17.44±0.29 ^{a}	20.08±0.12 ^{b}	P < 0.001	NS
110 day of gestation	21.91±0.55	22.30±0.58	NS	20.91±0.27 ^{a}	23.30±0.14 ^{b}	P < 0.001	NS
Day 1 postpartum	21.75±0.55	22.08±0.57	NS	20.72±0.25 ^{a}	23.11±0.12 ^{b}	P < 0.001	NS
Day 28 postpartum	19.64±0.62	20.24±0.58	NS	18.64±0.24 ^{a}	21.24±0.19 ^{b}	P < 0.001	NS
Gestation BF gain	3.19±0.10	3.50±0.10	NS	3.47±0.14	3.22±0.05	NS	NS
Lactation BF loss	2.11±0.08	1.83±0.10	NS	2.08±0.12	1.86±0.06	NS	NS

^{a,b} The means with different superscripts within the same row are significantly different at (P < 0.05)* .
NS= non-significant

-ments were numerically greater and piglet weights of wet feeding treatments were significantly greater ($P < 0.05$) than those of dry feeding. According to Lawlor et al. (2007), weaning weights were not affected by gestation feeding (Table 5 and 6). This finding was not in agreement with Genest and Allaire (1995) who stated that the reproductive performance of sows was not affected by different treatments (wet and dry diet). Sows with a greater lactation feed intake showed a higher litter weight gain (Eissen et al., 2003). Not differences in litter weight at birth may be due to the same gestation feed intake. Higher in weaning weight might be affected by higher feeding level of lactating sows those fed wet diet.

The physical forms of diet were not affected ($P > 0.05$) by litter size and weaning to oestrus interval (Table 7 and 8). Kyriazakis and Whittemore (2006) also expressed that a higher number of piglets born alive was not related to gestating feeding. Another reason was that the amounts of feed provided to gestating sows were not big enough to produce any differences in litter size among the treatments.

Table 4. Effects of physical forms of diet on feed intake of two breeds of sow

Feed intake (kg)	Physical forms (Means ± SEM)		Sig. level	Breed (Means ± SEM)		Sig. level	Physical form* Breed
	Dry	Wet		DYL	Local		
ADGFI	1.92±0.01	1.92±0.00	NS	1.92±0.01	1.92±0.01	NS	NS
ADLFI	4.28±0.11 [a]	4.79±0.12 [b]	P<0.05	4.73±0.14	4.33±0.13	NS	NS
TGFI	219.52±0.68	219.84±0.89	NS	219.79±1.03	219.57±0.43	NS	NS
TLFI	119.87±3.19 [a]	134.18±3.43 [b]	P<0.05	132.66±4.03	121.38±3.67	NS	NS
TFI	339.40±3.07 [a]	354.02±3.70 [b]	P<0.05	352.46±4.09	340.96±3.81	NS	NS

[a,b] The means with different superscripts within the same row are significantly different at ($P < 0.05$)*.

Table 5. Effects of physical forms of diet on litter weight of two breeds of sow

Litter weight (kg)	Physical forms (Means ± SEM)		Sig. level	Breed (Means ± SEM)		Sig. level	Physical form* Breed
	Dry	Wet		DYL	Local		
At birth	15.32±0.83	14.91±0.93	NS	16.77±0.37 [b]	13.47±0.58 [a]	P < 0.001	NS
Day 28	71.54±4.26	77.12±5.37	NS	84.69±2.11 [b]	63.97±1.67 [a]	P < 0.001	NS

[a,b] The means with different superscripts within the same row are significantly different at ($P < 0.05$)*.
NS= non-significant

Table 6. Effects of physical forms of diet on piglet weight of two breeds of sow

Piglet weight (kg)	Physical forms (Means ± SEM)		Sig. level	Breed (Means ± SEM)		Sig. level	Physical form* Breed
	Dry	Wet		DYL	Local		
At birth	1.43±0.04	1.43±0.04	NS	1.34±0.01 [a]	1.52±0.02 [b]	P < 0.001	NS
Day 28	6.88±0.16 [a]	7.37±0.08 [b]	P < 0.05	6.87±0.17 [a]	7.38±0.07 [b]	P < 0.05	P < 0.01

[a,b] The means with different superscripts within the same row are significantly different at ($P < 0.05$)*.
NS= non-significant

Table 7. Effects of physical forms of diet on litter size of two breeds of sow

Litter size	Physical forms (Means ± SEM)		Sig. level	Breed (Means ± SEM)		Sig. level	Physical form* Breed
	Dry	Wet		DYL	Local		
Total born	10.83±0.87	10.50±0.84	NS	12.50±0.22 [b]	8.83±0.30 [a]	P < 0.001	NS
Born alive	10.83±0.87	10.50±0.84	NS	12.50±0.22 [b]	8.83±0.30 [a]	P < 0.001	NS
Wean pigs	10.50±0.84	10.50±0.84	NS	12.33±0.21 [b]	8.66±0.21 [a]	P < 0.001	NS

[a,b] The means with different superscripts within the same row are significantly different at (P < 0.05)*.
NS= non-significant

Table 8. Effects of physical forms of diet on weaning to estrus interval of two breeds of sow

	Physical forms (Means ± SEM)		Sig. level	Breed (Means ± SEM)		Sig. level	Physical form* Breed
	Dry	Wet		DYL	Local		
Weaning to estrus interval	5.33±0.42	5.17±0.30	NS	5.17±0.40	5.33±0.33	NS	NS

NS= non-significant

Litter weight at birth and day 28 of DYL breed was significantly greater (P < 0.001) than those of the local breed (Table 5). But, piglet weights of the local breed were greater (P < 0.05) than those of the DYL breed sows throughout the experiment (Table 6). Gestation BW gains and BF gains did not influence litter weight and individual piglet weight at birth (Piao et al., 2010). Gestation feed intake does not affect litter weight (Dwyer et al., 1994) but it has little effect on piglet BW (Lawlor et al., 2007). Litter weight gain increased linearly with litter size (P < 0.001) and a large litter has negative effects on piglet weight gain (Eissen et al., 2003). The differences in litter weight and piglet weight between two breeds may be due to the differences in their litter sizes.

Litter size (Table 7) and litter weight (Table 5) of the DYL breed were greater and lower in piglet weight than those of the local breed. It is in agreement with (Porter et al., 2016) who stated that Myanmar local breed sows had litter sizes of 6-8, and Thin Thinzar et al. (2019) described that the average litter size was 10.08 ± 2.74, average number of live born piglets was 9.5± 2.57, and the average number of weaned piglets was 9.04 ± 2.97. Litter weight gain increased linearly with litter size (P < 0.001) and a large litter has negative effects on piglet weight gain (Eissen et al., 2003). The lower in litter weights of local breed sows than those of DYL breed might be due to their litter size that is lower than litter size of DYL breed sows.

WEI of DYL and local breed sows were not different (P > 0.05) (Table 8). It may be due to their similar lactation feed intake. Eissen et al. (2003) observed that sows with a greater lactation feed intake showed a reduced probability of a prolonged weaning-to-estrus interval. Moreover, the lactation body weight loss of DYL and local breed sows was lower than 10% of their body weight. The finding of current study is in line with the suggestion of Thaker and Bilkei, (2005) who stated that the weight loss during lactation should not be greater than 10% for multiparous sows to achieve an early return to estrus, high farrowing rate, and high subsequent litter size.

Conclusions

Wet feeding is the suitable feeding method for DYL and local breed sows without detrimental effects on their lactation BW loss and BF loss. Moreover, the DYL sow is more useful for breeding purposes, producing more piglets per sow per year than the local breed sow.

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Conflict of interest

The authors declare that they have no competing interests.

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