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Effect of Supplementation of Animal Fat on Growth and Feed Conversion Efficiency in Large White Yorkshire Pigs*

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Abstract

The experiment was conducted to study the effect of supplementation of animal fat in the diet of Large White Yorkshire (LWY) pigs on growth and feed conversion efficiency. Twenty weaned female Large White Yorkshire piglets were randomly divided into two groups and allotted to the two dietary treatments, T1-control ration as per NRC (1998) and T2-control ration supplemented with five per cent of animal fat and maintained for 70 days. The daily feed intake, fortnightly body weight were recorded and average daily gain and feed conversion efficiency were calculated. The average daily gain and feed conversion efficiency were 813.00, 828.14 and 2.80, 2.57 respectively for two dietary treatments. The pigs of T2 had higher ($P<0.05$) average daily gain and feed conversion efficiency than that of T1 treatment. The supplementation of energy by animal fat at five per cent level over and above the energy requirement, improves the average daily gain and feed conversion efficiency in large White Yorkshire pigs.

Key words: Animal fat, Pig, Growth, Feed efficiency

1. Introduction

The use of animal fat as an energy source for pigs has been shown to increase

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digestibility of nutrients, improve growth rate and feed conversion efficiency and also reduces dustiness of feeds and increases palatability. The present work aims to study the effect of supplementation of animal fat on growth and feed conversion efficiency of weaned female Large White Yorkshire female piglets.

1.1.Growth and feed efficiency

Studies by Duxbury-Berg (1999) showed that adding five per cent tallow to growing-finishing swine rations resulted in a 50 per cent reduction in aerial dust levels in confinement and improved animal growth performances. Tartrakoon *et al.* (1999) reported that among six fat sources used in swine diet lard and soyabean oil produced significantly higher growth performance than tallow, rice bran oil and palm oil. Gatlin *et al.* (2002) reported a linear increase in feed intake and feed efficiency when soyabean oil replaced animal fat in pig feeds, but growth rate was unaffected. Beaulieu *et al.* (2009) conducted an experiment using tallow at 0.5 and 4 per cent in the feeds for pigs and reported a linear increase in growth rate with increasing energy concentration in the diet.

Lack of any significant effect on growth performance by pigs fed different levels of fat was reported by Guo *et al.* (2006) (3.5 per cent tallow) and Apple *et al.* (2007) (five per cent tallow or soyabean oil). The final body weight, average daily feed intake, average daily gain and feed to gain ratio were not significantly different between pigs fed either five per cent of the beef tallow or sunflower oil in the diet (Mitchaothai *et al.*, 2007; Mitchaothai *et al.*, 2008). Apple *et al.* (2009) noticed no difference in average daily gain, feed intake or feed efficiency in pigs fed diet containing five per cent of beef tallow, poultry fat or soyabean oil. Realini *et al.* (2010) formulated swine diets with 10 per cent each of tallow, sunflower oil or linseed oil and found no difference in the average daily gain and average daily feed intake among the treatment groups. Lee *et al.* (2011) found no difference on average daily gain, average daily feed intake and feed conversion efficiency by feeding diets containing three per cent of tallow with other energy sources (15 per cent of corn germ, 5 per cent of glycerol or l5 per cent of palm kernel oil).

Lawrence and Maxwell (1983) observed decreased feed intake with increasing levels of choice white grease (0, 4, 8 and 12 per cent) in the diet of pigs. Benz *et al.* (2011) used five per cent of choice white grease or soyabean oil in the diet of pigs and found greater average daily gain in soyabean oil fed group. However no difference was observed in average feed intake or feed efficiency.

2. Materials and Methods

Twenty weaned female Large White Yorkshire piglets were randomly divided into two groups with five replicates in each group. Each replicates were allotted with two piglets and housed in a single pen. All piglets were maintained under identical management conditions throughout the experimental period of 70 days.

2.1.Experimental Rations

The animals were fed with standard grower ration containing 18 per cent of crude

protein (CP) and 3265 kcal of metabolizable energy (ME)/kg of feed up to 50 kg body weight and finisher ration with 16 per cent CP and 3265 kcal of ME /kg of feed from 50 kg body weight as per NRC (1998). The two groups of piglets were randomly allotted to the two dietary treatments, T1-control ration as per NRC (1998) and T2-control ration supplemented with five per cent of animal fat. Ingredient and chemical composition of pig grower and finisher ration were given in the Table 1and 2. The ration used in this study had similar nutrients as per NRC (1998; 2012) recommendations.

Table 1. Ingredient composition of pig grower and finisher rations, %

	Experimental grower rations[1]		Experimental finisher rations[1]	
Ingredients	T1	T2	T1	T2
Yellow maize	70	70	74	74
Wheat bran	1.5	1.5	3.6	3.6
Soyabean meal	26.25	26.25	20.5	20.5
Animal fat	0	5	0	5
Salt	0.5	0.5	0.5	0.5
Dicalcium phosphate	0.9	0.9	*0.65*	0.65
Calcite	0.85	0.85	*0.75*	0.75
Total	100	105	100	105
Nicomix AB_2D_3K [1], g	25	25	25	25
Nicomix BE [2], g	25	25	25	25
Zinc Oxide[3], g	45	45	30	30
Oxylock antioxidant [4], g	10	10	10	10
Cost per kg feed[5], Rs.	18.05	19.37	17.23	18.30

[1]Nicomix A, B_2, D_3, K (Nicholas Piramal India Ltd, Mumbai) containing Vitamin A-82,500 IU, Vitamin B_2-50 mg, Vitamin D_3-12,000 IU and Vitamin K-10 mg per gram.

[2]Nicomix BE (Nicholas Piramal India Ltd, Mumbai) containing Vitamin B_1-4 mg, Vitamin B_6-8 mg, Vitamin B_{12}-40 mg, Niacin-60 mg, Calcium pantothenate- 40 mg and Vitamin E-40 mg per gram.

[3]Zinc oxide (Nice Chemicals Pvt. Ltd., kochi) containing 81.38% of Zn.

[4]Oxylock antioxidant (Vetline Ltd., Indore) contains Ethoxyquin, Butylated HydroxyToluene (BHT), Chelators and Surfactantant.

Table 2. Chemical composition*of grower and finisher rations

Parameters	Treatments (grower ration)[1]		Treatments (finisher ration)[1]	
	T1	T2	T1	T2
Dry matter, %	89.20±0.12	89.10±0.13	89.11±0.12	89.10±0.06
Crude protein, %	18.25±0.11	17.88±0.17	16.39±0.10	15.76±0.12
Ether extract, %	3.10±0.05	7.75±0.06	3.28±0.06	8.05±0.04
Crude fibre, %	3.72±0.11	3.41±0.07	3.73±0.07	3.52±0.13
Total ash, %	5.64±0.17	5.45±0.24	5.54±0.15	5.23±0.10
Nitrogen free extract, %	69.29±0.16	65.51±0.31	71.06±0.20	67.44±0.12
Acid insoluble ash, %	1.10±0.02	1.05±0.05	1.04±0.06	0.93±0.06
GE, kcal/kg	4132.18± 2.92	4436.27± 0.62	4165.18±22.24	4390.61±31.34
Calcium, %	0.59±0.01	0.58±0.006	0.62±0.02	0.60±0.007
Phosphorus, %	0.58±0.01	0.64±0.06	0.55±0.02	0.54±0.02
Magnesium, %	0.14±0.006	0.14±0.004	0.13±0.008	0.13±0.01
Manganese, ppm	16.78±0.38	15.92±0.25	16.59±0.45	15.91±0.01
Copper, ppm	6.35±0.08	6.30±0.10	6.15±0.15	6.10±0.20
Zinc, ppm	71.52±1.29	65.56±0.91	71.39±1.36	67.45±2.18

* On DM basis; [1] Mean of four values with SE

Fresh rendered animal fat was obtained from Meat Technology Unit, Department of Livestock products Technology, College of Veterinary and Animal Sciences, Mannuthy as and when the feed was prepared. The animal fat is a mixture of mainly beef fat (tallow) and pig fat (lard) and little of poultry fat.

2.2.Feed intake, Body weight and Feed efficiency

Weighed quantities of feed were offered twice a day at 9.00 am and 3.00 pm. After adding feed in the manger little water was sprinkled over to moistening. The feed intake was measured daily after collecting the left over feed if any and body weight of the individual animals were taken fortnightly in the morning hours before feeding. Then average daily gain and feed conversion efficiency was calculated. Data collected on various parameters were statistically analyzed by Completely Randomized Design (CRD) method and m means were compared by Duncan Multiple Range Test (DMRT) using Statistical Package for Social Studies software.

3. Results and Discussion

3.1.Feed intake

Data on weekly average feed intake of pigs given the two experimental rations T1 and T2 and are presented in Table 3. The total feed intake recorded for two treatments were 159.28 and 148.61 kg, respectively. No significant difference in weekly feed intake except eighth and tenth week, during these period pigs in T2 had lower feed intake than T1. Overall supplementation of five per cent animal fat (T2) resulted in significantly lower ($P<0.01$) feed intake compared to control group, which may due to

high energy density (4390.61kcal ME/kg) of the ration. This is in agreement with the findings of Cera *et al.* (1989) and Apple *et al.* (2008). The ability of animals to regulate the feed intake is based on the energy content of the feed and gut capacity of pigs (Azain, 2000; Ellis and Augspurger, 2000). Addition of fat to the diet of pigs increases energy density and results in a reduction in feed intake to maintain a constant DE intake (Ewan, 2000). Increase in energy concentration is usually associated with a reduction in voluntary feed intake in pigs (Noblet, 2006).

3.2.Body weight and Weight gain

The data on the body weight and weight gain of pigs are presented in Table 4 and 5. The average initial and final body weight of piglets belonging to two groups were 23.94, 24.18 kg and 80.85, 82.15 kg, respectively. The statistical analysis of the data revealed no significant difference in the average body weight and weight gain between two treatments. Supplementation of five per cent animal fat over the requirement had no significant effect on body weight of pigs.

In agreement to the results obtained in the present study non significant growth performance in pigs by different levels of fat supplementation were reported by Brumm *et al.* (1982) (five per cent lard), Brumm and Peo (1994) (tallow at five per cent), Reis *et al.* (2000) (tallow at four and eight per cent), Guo *et al.* (2006) (3.5 per cent tallow) and Realini *et al.* (2010) (animal fat at five per cent).

Table 3. Average feed intake of LWY pigs maintained on the two experimental rations, kg

Week	Feed intake[1]		Cumulative feed intake [1]	
	T1	T2	T1	T2
1	9.83±0.51	9.12±0.19	9.83±0.51	9.12±0.19
2	10.92±0.77	9.84±0.22	20.75±1.28	18.96±0.39
3	12.58±0.68	12.11±0.47	33.33±1.93	31.07±0.85
4	13.98±0.84	13.74±0.54	47.31±2.73	44.81±1.37
5	17.14±0.81	16.62±0.52	64.45±3.50	61.43±1.88
6	17.52±0.75	16.76±0.34	81.97±4.19	78.19±2.20
7	18.22±0.69	17.13±0.33	100.19±4.81	95.32±2.49
8	19.18±0.75^{b}	17.90±0.36^{a}	119.37±5.51	113.22±2.69
9	18.86±0.57	17.56±0.26	138.23±6.04^{b}	130.78±2.89^{a}
10	21.05±0.53^{b}	17.83±0.27^{a}	159.28±6.5^{b}	148.61±3.12^{a}
Average total feed intake	159.28±6.54^{b}	148.61±3.12^{a}	159.28±6.54^{b}	148.61±3.12^{a}

[1]Mean of 5 observations; a, b - Means of different superscripts within the same row differ significantly ($P<0.05$)

Table 4. Average body weight of LWY pigs maintained on the two experimental rations, kg

Fortnight	Two experimental rations[1]	
	T1	T2
Initial body weight	23.94±1.30	24.18±1.12
1	34.19±1.71	34.57±1.42
2	44.54±2.04	45.52±1.82
3	56.87±2.35	57.79±1.90
4	68.00±2.31	69.10±2.01
5	80.85±2.76	82.15±2.77

[1]Mean of 5 observations

Table 5. Average body weight gain of LWY pigs maintained on the two experimental rations

Fortnight	Weight gain[1]		Cumulative weight gain[1]	
	T1	T2	T1	T2
1	10.25±0.50	10.39±0.47	10.25±0.50	10.39±0.47
2	10.35±0.63	10.95±0.47	20.60±0.81	21.34±0.74
3	12.33±0.39	12.27±0.45	32.93±1.09	33.61±0.95
4	11.13±0.39	11.31±0.26	44.06±1.15	44.92±1.14
5	12.85±0.73	13.05±0.81	56.91±1.48	57.97±1.88

[1]Mean of 5 observations

3.3.Feed conversion efficiency

The data on the fortnightly feed conversion efficiency and their cumulative values of pigs under two treatment groups are presented in Table 6. The overall feed conversion efficiency recorded was 2.80 and 2.57, respectively. Statistically T2 treatment had higher feed conversion efficiency than that of T1 treatment for overall period and also in all the fortnight except in third fortnight, in this period both the treatment had similar feed conversion efficiency. Higher energy ration in the T2 treatment reduced the total feed intake but maintained similar body weight, so could yield better feed conversion efficiency compared to control group fed diet with normal energy level. This is in agreement with the findings of Cera *et al.* (1989) and Apple *et al.* (2008). Similar results were observed in pigs fed diet containing tallow at 5 and 22 per cent (Liao and Venum, 1994), tallow at 5 and 7.5 per cent (Nichols *et al.,* 1991), choice white grease at six per cent (Smith *et al.,* 1996) and tallow at five per cent (Eggert *et al.,* 1998a) levels.

Table 6. Average feed conversion efficiency of LWY pigs maintained on the two experimental rations

Fortnight	Feed conversion efficiency[1]		Cumulative feed conversion efficiency[1]	
	T1	T2	T1	T2
1	2.03±0.12[b]	1.83±0.05[a]	2.03±0.12[b]	1.83±0.05[a]
2	2.58±0.13[b]	2.37±0.07[a]	2.29±0.07[b]	2.10±0.17[a]
3	2.82±0.11	2.74±0.13	2.48±0.06[b]	2.33±0.04[a]
4	3.38±0.18[b]	3.10±0.08[a]	2.71±0.08[b]	2.52±0.05[a]
5	3.13±0.13[b]	2.75±0.15[a]	2.80±0.05[b]	2.57±0.04[a]

[1]Mean of 5 observations; a, b- Means of different superscripts within the same row differ significantly (P<0.05)

In contrast to these present findings, Apple *et al.* (2009) (five per cent beef tallow), Realini *et al.* (2010) (10 per cent of each tallow) and Lee *et al.* (2011) (three per cent tallow) found no difference on average daily gain and feed conversion efficiency by feeding animal fat in pigs.

3.4.Daily gain and feed conversion efficiency of growing pigs

Average daily gain and feed conversion efficiency of growing pigs maintained on the two experimental grower rations T1 and T2 are presented in Table 7. The average total weight gain and average daily gain of these pigs during growing stage was 27.10, 27.73 kg and 774.29 and 792.29 g, respectively for two treatments and statistically non significant. The total feed intake of grower ration and feed conversion efficiency was 64.45, 61.43 kg and 2.37, 2.22, respectively for two treatments. The treatment T2 had significantly lower feed intake and better feed conversion efficiency than that of T1 treatment due to higher energy content in the T2 ration.

Table 7. Average daily gain and feed conversion efficiency of LWY pigs maintained on the two experimental rations

Parameters	Growing period		Finishing period		Overall period	
	T1	T2	T1	T2	T1	T2
Average initial body weight, kg	23.94 ±1.30	24.18 ±1.12	51.04 ±2.13	51.91 ±1.85	23.94 ±1.30	24.18 ±1.12
Average final body weight, kg	51.04 ±2.13	51.91 ±1.85	80.85 ±2.76	82.15 ±2.77	80.85 ±2.76	82.15 ±2.77
Total weight gain, kg	27.10 ±0.89	27.73 ±0.82	29.81 ±0.72	30.24 ±1.11	56.91 ±1.48	57.97 ±1.88
Average daily weight gain, g	774.29 ±25.57	792.29 ±23.42	851.71 ±20.48	864.00 ±31.67	813.00 ±21.20	828.14 ±26.80
Total feed intake, kg	64.45 ±3.50[b]	61.43 ±1.88[a]	94.83 ±3.27[b]	87.18 ±1.42[a]	159.28 ±6.54[b]	148.61 ±3.12[a]
Feed conversion efficiency	2.37 ±0.06[b]	2.22 ±0.04[b]	3.18 ±0.06[b]	2.89 ±0.07[a]	2.80 ±0.05[b]	2.57 ±0.04[a]

[1]Mean of 5 observations with SE; a, b - Means with different superscripts within the same row differ significantly Significant (P<0.05)

3.5.Daily gain and feed conversion efficiency of finisher pigs

Average daily gain and feed conversion efficiency of growing pigs maintained on the

two experimental finisher rations T1 and T2 are presented in Table 7. The average total weight gain and average daily gain of these pigs during growing stage was 29.81, 30.24 kg and 851.71, 864.00g, respectively for two treatments and statistically non significant. The total feed intake of grower ration and feed conversion efficiency was 94.83, 87.18 kg and 3.18, 2.89, respectively for two treatments. The treatment T2 had significantly lower feed intake and better feed conversion efficiency than that of T1 treatment due to higher energy content in the T2 ration.

3.6.Overall daily gain and feed conversion efficiency of experimental pigs

Average daily gain and feed conversion efficiency of growing pigs maintained on the two experimental finisher rations T1 and T2 are presented in Table 7. The average total weight gain and average daily gain of these pigs during growing stage was 56.91, 57.97 kg and 813.00, 828.14 g, respectively for two treatments and statistically non significant. The total feed intake of grower ration and feed conversion efficiency was 159.28, 148.61 kg and 2.80, 2.57, respectively for two treatments. The treatment T2 had significantly lower feed intake and better feed conversion efficiency than that of T1 treatment. Higher energy ration in the T2 treatment reduced the total feed intake but maintained similar body weight, so could yield better feed conversion efficiency compared to control group fed diet with normal energy level. This is in agreement with the findings of Cera *et al.* (1989) and Apple *et al.* (2008).

4. Conclusion

The supplementation of energy by animal fat at five per cent level over and above the requirement, improves the average daily gain and feed conversion efficiency in large White Yorkshire piglets.

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