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Effect of Replacement of Maize by Animal Fat on Energy Utilization in Pigs

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ABSTRACT

The experiment was conducted to assess the effect of replacement of maize by different levels of animal fat on energy utilization in Large White Yorkshire (LWY) pigs. Thirty weaned piglets were randomly divided into three groups and were allotted to the three dietary treatments, T_1 (control ration as per NRC, 1998), T_2 (50 percent of maize of control ration replaced by animal fat) and T_3 (100 percent of maize of control ration replaced by animal fat). A Digestibility trial was conducted following total collection method and gross energy was estimated using bomb calorimeter. Gross energy of feed and faeces were 4144.68, 4173.92, 4249.99 and 4102.04, 3834.24, 3453.09 kcal/kg, respectively for T_1, T_2 and T_3 treatments. The apparent digestibility of GE was 85.85, 74.37 and 66.78 percent and the calculated digestible energy of feed was 3558.12, 3104.22 and 2837.90 kcal/kg, respectively for three treatments. The result of this experiment revealed that as the level of replacement of maize by animal fat increases, the efficiency of energy utilization was reduced in pigs fed isocaloric and isonitrogenous diet.

Key words: Animal fat, Energy levels, Feeding of pigs, Maize

INTRODUCTION

Maize forms the major source of energy in the swine feed. Even though, India produces more than 20 million MT of maize per year, it could meet only 60 percent of the requirement in the country. The lower availability coupled with increasing price of maize, necessitates an alternative energy source for incorporation in the swine feed. Animal fat is a byproduct of meat industry and can be included as a source of energy in swine ration. India produces 0.14 million MT of tallow and 0.02 million MT of lard per year (FAO, 2010). The use of fat as an energy source for pigs has been shown to increase digestibility of nutrients, improve growth rate and also reduces dustiness of feeds and, increases palatability.

Improved dry matter and nitrogen digestibility and nitrogen and energy retention were found in pigs fed diet with tallow at 0.33 and 0.75 percent of body weight (Galloway and Ewan, 1989), with white choice grease at 10 percent (Li *et al.,* 1990) and with lard at six percent of the diet (Lawrence *et al.,* 1994). Overland *et al.* (1994) reported that the apparent ileal and overall digestibility of crude fat and total fatty acids, apparent digestibility of dry matter, nitrogen and calcium and retention of nitrogen and energy were increased in pigs fed diets with six percent of rendered fat. Reis *et al.* (2000) observed increased apparent digestibility of ether extract and energy in pigs fed diet with eight percent of tallow compared to that with four percent tallow. However, studies on the effect of replacing maize by animal fat on energy utilization was not studied much in India, hence this work was carried out in growing Large White Yorkshire piglets.

MATERIALS AND METHODS

The experiment was conducted to assess the effect of replacement of maize by different levels of animal fat on energy utilization in growing piglets. Thirty weaned female Large White Yorkshire piglets were randomly divided into three groups with five replicates in each group. Each replicate were allotted with two piglets and housed in a single pen. All piglets were housed in the same shed and were maintained under identical management conditions throughout the experimental period of 70 days. Animals were allowed to consume as much as they could, within a period of one hour and the balance feed was collected and weighed after each

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

Ingredients	Grower rations[1]			Finisher rations[1]		
	T_1	T_2	T_3	T_1	T_2	T_3
Yellow maize	70	35	0	74	37	0
Wheat bran	1.5	31	59.8	3.6	34.7	64.9
Soyabean meal	26.25	25.5	25.0	20.5	19.7	19.2
Animal fat	0	6.5	13	0	7	14
Salt	0.5	0.5	0.5	0.5	0.5	0.5
Dicalcium phosphate	0.9	0.4	0	*0.65*	0.10	0
Calcite	0.85	1.1	1.7	0.75	1.0	1.4
Total	100	100	100	100	100	100
Nicomix AB_2D_3K [1], g	25	25	25	25	25	25
Nicomix BE [2], g	25	25	25	25	25	25
Zinc Oxide[3], g	45	13	0	30	0	0
Oxylock antioxidant [4], g	10	10	10	10	10	10

[1]Nicomix A, B2, D3, K (Nicholas Piramal India Ltd, Mumbai) containing Vitamin A- 82,500 IU, Vitamin B2-50 mg, Vitamin D3-12,000 IU and Vitamin K-10 mg per gram; [2]Nicomix BE (Nicholas Piramal India Ltd, Mumbai) containing Vitamin B1-4 mg, Vitamin B6-8 mg, Vitamin B12-40 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.

feeding. Clean drinking water was provided *ad libitum* in all the pens throughout the experimental period.

The animals were fed with standard grower ration containing 18 percent of CP and 3265 kcal of ME/kg of feed up to 50 kg body weight and finisher ration with 16 percent CP and 3265 kcal of ME /kg of feed from 50 kg body weight as per NRC (2012). The three groups of piglets were randomly allotted to the three dietary treatments, T_1 (control ration as per NRC, 2012), T_2 (50 percent of maize of control ration replaced by animal fat) and T_3 (100 percent of maize of control ration replaced by animal fat). Ingredient and chemical composition of pig grower and finisher ration were given in the Table 1 and 2. The ration used in this study had similar nutrients as per NRC (2012) recommendations. The animal fat was a mixture of mainly beef fat (tallow), pig fat (lard) and little of poultry fat, obtained from rendering plant of Meat Technology Unit, College of Veterinary and Animal Sciences, Mannuthy, freshly as and when the feed was prepared. Digestibility trial was conducted towards the end of the experiment following total collection method.

Gross energy of feed and faeces were estimated using bomb calorimeter (plain jacket calorimeter, model: 1341, Parr instruments co., USA) to determine the energy utilization of pigs fed three experimental rations.

Data collected on various parameters were statistically analyzed by Completely Randomized Design (CRD) method and means were compared by Duncan Multiple Range Test (DMRT) using Statistical Package for Social Studies (SPSS. 17.0.1v) software.

RESULTS AND DISCUSSION

Data on energy utilization of pigs under the three experimental rations T_1, T_2 and T_3 are presented in Table 3. Gross energy of feed and faeces were 4144.68, 4173.92, 4249.99 and 4102.04, 3834.24, 3453.09 kcal/kg, respectively for T_1, T_2 and T_3 treatments. The gross energy converted as digestible energy was 85.85, 74.37 and 66.78 percent and the calculated digestible energy of feed was 3558.12, 3104.22 and 2837.90 kcal/kg, respectively for three treatments.

The control group (T_1) had higher ($P<0.01$) DE than T_2 and T_3 and the lowest DE was recorded in T_3.

Table 2. Chemical compositionof pig grower and finisher rations

Parameters	Grower rations[1]			Finisher rations[1]		
	T_1	T_2	T_3	T_1	T_2	T_3
Dry matter, %	89.20±0.12	90.56±0.11	91.41±0.13	89.11±0.12	90.41±0.17	91.50±0.18
Crude protein, %	18.25±0.11	18.18±0.17	18.03±0.13	16.39±0.10	16.28±0.06	16.06±0.18
Ether extract, %	3.10±0.05	8.53±0.09	13.69±0.10	3.28±0.06	9.04±0.11	14.11±0.07
Crude fibre, %	3.72±0.11	6.58±0.13	9.42±0.10	3.73±0.07	6.54±0.10	9.40±0.03
Total ash, %	5.64±0.17	9.50±0.20	12.40±0.18	5.54±0.15	9.54±0.12	12.47±0.14
Nitrogen free extract, %	69.29±0.16	57.21±0.21	46.46±0.21	71.06±0.20	58.60±0.30	47.96±0.05
Acid insoluble ash, %	1.10±0.02	4.51±0.09	6.63±0.12	1.04±0.06	4.29±0.13	6.52±0.16
GE, kcal/kg	4132.18±22.92	4134.95±14.98	4212.87±9.21	4165.18±22.24	4203.07±17.05	4448.30±36.74
Calcium, %	0.59±0.01	0.62±0.006	0.78±0.01	0.62±0.02	0.65±0.01	0.77±0.02
Phosphorus, %	0.58±0.01	0.71±0.01	0.85±0.01	0.55±0.02	0.72±0.02	0.83±0.01
Magnesium, %	0.14±0.006	0.24±0.009	0.40±0.007	0.13±0.008	0.25±0.01	0.37±0.02
Manganese, ppm	16.78±0.38	39.14±1.76	69.99±1.18	16.59±0.45	38.76±0.96	69.85±1.31
Copper, ppm	6.35±0.08	9.34±0.06	12.62±0.19	6.15±0.15	9.17±0.08	12.39±0.15
Zinc, ppm	71.52±1.29	67.19±2.23	88.52±1.15	71.39±1.36	64.95±1.47	88.50±1.62

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

Reddy (2009) opined that an increase in dietary fibre level by one percent (beyond maximum level) will depress the digestibility of gross energy by about 3.5 percent. T_1 ration had no animal fat whereas T_2 and T_3 had 7 and 14 percent animal fat respectively, could be the main reason for lower energy utilization in growing pigs. Also when maize was replaced by different level of animal fat, wheat bran was added to adjust the ration to make iso-calorious and iso-nitrogenous.

The level of wheat bran in T_1, T_2 and T_3 ration were 3.6, 34.7 and 64.9 percent respectively which could increase crude fibre and acid insoluble ash level from

Table 3. Energy utilization of LWY pigs maintained on the four experimental rations

Parameter	Three experimental rations[1]		
		T_1	T_2 T_3
Average dry matter intake, kg	2.3208±0.07^{ab}	2.4330±0.08^{b}	2.2871±0.04^{ab}
Gross energy of feed, kcal/kg	4144.68	4173.92	4249.99
Gross energy intake, kcal	9618.84±310	10155.02±647	9720.01±179
Dry matter voided, kg	0.3304±0.007^{a}	0.6718±.02^{b}	0.9343±0.03^{c}
Gross energy of faeces, kcal/kg	4102.04±132^{b}	3834.24±94^{ab}	3453.09±69^{a}
Gross energy voided, kcal	1357.35±65^{a}	2580.87±122^{b}	3221.65±102^{c}
Gross energy-digested, kcal	8216.48±304^{b}	7574.15±431^{ab}	6498.36±244^{a}
Percent gross energy as digestible energy	85.85±0.76^{c}	74.37±1.83^{b}	66.78±1.45^{a}
Digestible energy of feed, kcal/kg	3558.12±31.47^{c}	3104.22±76.15^{b}	2837.96±61.48^{a}

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

3.73 and 1.04 percent (T_1 ration-control group) to 6.54 and 4.29 percent (T_2 ration-50 percent maize replacement) and 9.40 and 6.52 percent (T_3 ration-100 percent maize replacement). The increased level of crude fibre and acid insoluble ash in the T_2 and T_3 ration mighthave contributed to the lowered digestibility of energy. Everts *et al.* (1986) observed reduced digestibility of dry matter, organic matter and crude protein with increased level of crude fibre (11.26 percent) in the diet of pigs. Bhar *et al.* (2000) also observed decreased digestibility of dry matter, organic matter, crude fibre, total carbohydrate, nitrogen free extract and energy with increased level of wheat bran (0, 50 and 100 percent maize replacement) in the diet of crossbred pigs. The digestive tract enlarges to accommodate a larger volume of feed rich in crude fibre and the rate of passage of ingesta increases, resulting in reduction in digestibility of nutrients (Ewan, 2000; Lentle and Janssen, 2008). Blair (2007) stated that in pigs higher the crude fibre level in the diet lower will be the digestibility of protein and energy. Sheikh *et al.* (2011) observed a significant reduction in digestibility of dry matter, ether extract, crude fibre, NFE and energy in crossbred pigs fed diet containing paddy grain instead of maize.

Lawrence and Maxwell (1983) found that efficiency of use of digestible energy tended to decrease with added choice white grease (0 to 12 percent). Significant improvement in digestibility of energy as a result of fat supplementation in the diet of pigs was also reported by Li *et al.* (1990) (white choice grease supplemented at 10 percent), Overland *et al.* (1994) (six percent of rendered fat) and Reis *et al.* (2000) (eight percent tallow). However no significant difference in the energy digestibility in pigs by supplementation of tallow at five percent in the diet was observed by Garry *et al.* (2007) and Huang *et al.* (2010).

CONCLUSIONS

Based upon the result of this experiment it could be concluded that as the level of replacement of maize by animal fat increased, the efficiency of energy utilization was reduced in pigs fed isocaloric and isonitrogenous diet.

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