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Metabolizable Energy and Nutritional Value of Cassava Pulp in 30 kg and 60 kg Pigs

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ABSTRACT

The objectives of this study were to determine the nutritional value digestibility and the utilization of cassava pulp in both starter-pig diets and grower-pig diets. The results demonstrated that the percentage of dry matter (DM), crude protein (CP), crude fiber (CF), fat, calcium ash, phosphorus and nitrogen free extract (NFE) of cassava pulp were 10.40, 2.36, 16.06, 0.26, 4.59, 1.11, 0.06 and 66.33%, respectively and that cassava pulp had a gross energy of 4,178 kcal/kg. Eight barrows of 30 kg body weight were divided into 2 groups. Each group was randomly assigned to two experimental diets for two periods at 30 and 60 kg of body weight, respectively. The experimental diets were: control groups (without cassava pulp); and experimental groups with cassava pulp at 10 and 20% for the 30 and 60 kg body weights, respectively. The availability of DM, CP and CF in the starter diet that consisted of 10% of cassava pulp was 70.96, 64.45 and 62.71%, respectively. The availability of DM, CP and CF in the grower diet which consisted of 20% of cassava pulp was 72.83, 69.63 and 65.97%, respectively. The metabolizable energy of cassava pulp in the starter and grower diets was 2,553 kcal/kg and 2,767 kcal/kg, respectively. The results of this research suggested that cassava pulp can be used as an energy source to replace other raw materials in starter-pig and grower-pig diets.

Key words: nutritional value, cassava pulp, digestive ability, metabolizable energy, pig

INTRODUCTION

Corns, broken milled rice and cassava have long been utilized as energy sources in livestock diets. However, during the past few years, the cost of these raw materials has risen rapidly due to increased demand from the world market. In addition, fuel costs have been higher than in the past, resulting in an increased demand for alternative raw materials in animal-nutrition industries.

Suitable alternatives could be either low-cost materials or by-products from other products. Cassava pulp is a by-product from the cassava flour industry. Puttipipatkajorn and Srinoppakun (1999) reported that approximately 47.8 tons of fresh cassava would produce 12.86 tons of cassava pulp, which made up 26.90% of the raw material. In addition, the cassava pulp still had 75-80% moisture content (Jatupornpong and Jintanawit, 2005). The most crucial problem for some cassava flour plants is to find some way to get rid of cassava

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pulp or some use for it. Some trials used dry cassava pulp with 50 to 60% flour as animal feed, but the cassava pulp still had around 15% fiber that affected the animal's digestive system. Hence, this research studied the suitability of cassava pulp as a food source for pigs as means of efficiently reducing a waste product in the cassava flour industry.

MATERIALS AND METHODS

Nutritional value of cassava pulp

Cassava pulp was analyzed for its nutritional value, including dry matter (DM), crude protein (CP), crude fiber (CF), fat, ash content, calcium, phosphorus and nitrogen free extract (NFE) by the proximate analysis method. Gross energy was measured by a Ballistic bomb calorimeter as described in AOAC (1990). All laboratory methods were performed in the Animal Analysis Laboratory, Department of Animal Science, Faculty of Agriculture Kamphaengsaen, Kasetsart University.

Nutritional availability in cassava pulp

Two weight-matched groups (30 and 60 kg BW) of eight pigs each were randomly selected from a herd. All crossbred pigs (DR × LW × LR) were castrated. The two weight-matched groups of 30 and 60 kg BW pigs were designated as starter pigs and grower pigs, respectively. Pigs in each weight group were randomly allocated into two treatment groups consisting of: A) control; and B) a diet containing cassava pulp. Four rations designated as: starter control (SC), starter experiment (SE), grower control (GC) and grower experiment (GE) were formulated (Table 1). SC and SE were starter diets given to pigs for two weeks commencing at 30 kg BW. SC was the base starter diet, while SE was an experimental diet in which 10% of the corn was replaced by cassava pulp. GC and GE were grower diets given to pigs at 60 kg BW. GC was the base grower diet, while GE was an experimental diet in which 20% of the corn was replaced by cassava pulp.

All pigs were individually Pen. Pigs were fed twice a day at 8 a.m. and 3 p.m with feed

Table 1 Diet formula used in the experiment.

Feed ingredients	Starter		Grower	
	Control	Experiment	Control	Experiment
Corn	27.36	17.36	14.06	4.06
Cassava pulp	-	10.00	-	20.00
Broken rice	17.19	17.19	14.97	4.97
Cassava	10.00	10.00	24.95	24.95
Rice bran	-	-	9.60	9.60
Rice bran oil	2.53	2.53	1.75	1.75
Soybean meal	36.71	36.71	31.46	31.46
Full fat soybean	300	300	-	-
L-lysine	-	-	0.29	0.29
L-threonine	0.03	0.03	0.05	0.05
DL-methionine	0.02	0.02	0.08	0.08
Monodicalciumphosphate	1.85	1.85	1.22	1.22
Calcium carbonate	0.82	0.82	1.02	1.02
Salt	0.25	0.25	0.31	0.31
Premix	0.25	0.25	0.25	0.25
Total	100	100	100	100

restricted to 4% of their body weight. The amount of feed was recorded throughout the experiment. All pigs were fed their designated ration for two weeks, without chromic oxide during the first week and then the same ration with 5% chromic oxide in the second week.

The feces were collected from all pigs. Collection started when the feces had reached a constant green color caused by the chromic oxide and finished when the green color was completely lost. The feces were weighed and a random sample of 30% collected. The sample was dried by exposure to the sun, ground into a powder and stored at 4 °C. Urine was collected from all pigs daily. The total volume of collected urine each day was mixed with 10×10^{-3} l of 6 N sulfuric acid solution and a sample of 25×10^{-3} l was stored at 4 °C.

Experimental diets and feces were analyzed for nutritional parameters including: moisture, CP, CF, ash, calcium, phosphorus and NFE by proximate analysis. Gross energy was measured in the diet mix, feces and urine by a Ballistic bomb calorimeter as described in AOAC(1990). Available digestive values were calculated for DM, CP, CF and the energy availability of the cassava pulp as described by McDonald *et al*. (2002), using the following equations:

Available digestive value of cassava pulp
= (digestive value of experimental diet – (digestive value of control diet * A)) / B

Metabolizable energy of cassava pulp
= (available energy of experimental diet – (available energy of control diet *A)) / B

where
A = (100 - percent of raw materials in diet formula) / 100
B = percent of raw materials in diet formula/100

RESULTS

Nutritional value of cassava pulp

The results of the chemical analysis of the cassava pulp are displayed in Table 2. The DM, CP, CF, fat, ash content, calcium, phosphorus and NFE were 10.40, 2.36, 16.06, 0.26, 4.59, 1.11, 0.06, and 66.33%, respectively. The gross energy was 4,178.2 kcal/kg of dry weight.

Nutritional availability of cassava pulp

Nutritional availability of cassava pulp in starter pigs (weight 30 kg)

The starter diet replaced 10% of the corn with cassava pulp and resulted in available digestive values for DM, CP and CF of 70.96, 64.45 and 62.71%, respectively, as shown in Table 3. The metabolizable energy from cassava pulp was 2,553 kcal/kg.

Nutritional availability of cassava pulp in grower pigs (weight 60 kg)

Two diet formulas were used. The first was a control diet without cassava pulp, while the second one replaced 20% of the corn and broken rice with cassava pulp. The results, shown in Table 4, found that the available digestive values of DM, CP and CF were 72.83, 69.63 and 65.97%, respectively. The metabolizable energy from the cassava pulp was 2,767 kcal/kg.

Table 2 Nutritional value of cassava pulp.

Composition	Nutritional value
Dry matter (%)	10.40
Crude protein (%)	2.36
Crude fiber (%)	16.06
Fat (%)	0.26
Ash (%)	4.59
Calcium (%)	1.11
Phosphorus (%)	0.06
NFE (%)	66.33
Gross energy (kcal/kg)	4,178.20

Table 3 Availability of cassava pulp in starter pigs.

Nutrient	Available digestive values*
Dry matter (%)	70.96
Crude protein (%)	64.45
Crude fiber (%)	62.71
Metabolizable energy (kcal/kg)	2,553

*The available digestive values are derived from the formulas mentioned above.

Table 4 Availability of cassava pulp in grower pigs.

Nutrient	Available digestive values*
Dry matter (%)	72.83
Crude protein (%)	69.63
Crude fiber (%)	65.97
Metabolizable energy (kcal/kg)	2,767

*The available digestive values are derived from the formulas mentioned above.

DISCUSSION

Nutritional value of cassava pulp

The results of the study demonstrated that the cassava pulp used in the study contained 2.36% CP which was similar to the level of 1.59% reported by Thimthong (2003) and 1.64% reported by Nitipot (2004). In contrast, the cassava pulp had a high level of CF and should be strongly considered as constituting the total CF content in a diet. This study found that the gross energy of the cassava pulp was 4,178 kcal/kg, which was higher than the value of 3,872 kcal/kg reported by Thimthong (2003). The difference could have been due to the flour extraction efficiency of the different machines in each factory and this factor then affected the quality of the cassava pulp. Based on the gross energy of the cassava pulp, it could provide an alternative source of energy for pigs and used to replace other raw materials such as corn, broken milled rice and cassava, as these are all more expensive.

Nutritional availability of cassava pulp

Starter and grower pigs could utilize DM, CP and CF from the cassava pulp by digesting it into metabolizable energy with values for starter and grower pigs of 2,553 and 2,767 kcal/kg, respectively. This agreed with work carried out by Thimthong (2003), who used a diet with 10% cassava pulp for starter pigs and found that the metabolizable energy was 2,770.17 kcal/kg. Therefore cassava pulp could be used as a source of energy for starter and grower pigs.

CONCLUSION

From this study, DM, CP, CF, ash, calcium, phosphorus and NFE of the cassava pulp were 10.40, 2.36, 16.06, 0.26, 4.59, 1.11, 0.06 and 66.33%, respectively. The metabolizable energy of the cassava pulp in starter pig and grower pig diets was 2,553 kcal/kg and 2,767 kcal/kg, respectively. The availability of DM, CP and CF in a starter pig diet of cassava pulp was 70.96, 64.45 and 62.71%, respectively. The availability of DM, CP and CF in a grower pig diet of cassava pulp was 72.83, 69.63 and 65.97%, respectively. Based on the results of this study, cassava pulp could be used as an energy source to replace other raw materials in a pig's diet.

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