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Full Length Research Paper

Fresh cocoa pod husk as an ingredient in the diets of growing pigs

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The growth rate, feed intake, feed to gain ratio and cost of gain of growing pigs fed diets containing 250 g kg^{-1} dry cocoa pod husk (control) (diet I) and 200 (diet II) or 300 (diet III) g kg^{-1} cocoa pod husk in the form of fresh (wet) cocoa pod husk were investigated in a feeding trial set up as a completely randomized design, at two (2) locations, with three (3) treatments replicated four (4) times and lasting 140 days. The variances at the two locations proved to be homogenous and as such data from the two (2) locations was pooled with the analysis being handled as a single-factor design with treatment as the only factor. There was no significant difference ($p > 0.05$) between treatments for average daily weight gain, average daily feed intake and feed conversion ratio. Cost of gain for 300 g kg^{-1} fresh (wet) cocoa pod husk treatment was, however, significantly higher ($p < 0.05$) than the other feeds. It was concluded that feeding fresh (wet) cocoa pod husk to growing pigs, up to 300 g kg^{-1} (on air-dry weight basis) of the diet had no deleterious effects on the pigs.

Key words: Feeding trial, fresh cocoa pod husk, growing pigs, growth rate, feed to gain ratio.

INTRODUCTION

The use of dried cocoa pod husk (CPH) in poultry and livestock feeding is well documented (Barnes et al., 1985; Adomako et al., 1985; Donkor et al., 1991; Adomako and Osei- Amaning, 1996; Adomako et al., 1999; Agyente-Badu and Oddoye, 2005). Cocoa pod husk is usually dried before storage and later use but the drying of the material has remained a challenge. The material is usually sun-dried. The greater part of the main harvesting season coincides with the rainy season, however, and therefore, sun-drying at this time has not been effective. Initially the Cocoa Research Institute of Ghana (CRIG) employed a mechanical drier which operated on diesel fuel, for this purpose.

The escalating cost of energy, however, made this method of drying uneconomical. These problems with drying have hampered efforts to popularize the use of CPH as a feed ingredient for poultry and livestock. In the light of the above problems, the idea of feeding the material in its fresh (wet) state, without drying, was therefore considered as a viable option. This study aims at developing rations for growing pigs using fresh (wet) cocoa pod husk.

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MATERIALS AND METHODS

Location

The trial was carried out simultaneously at the Acherensua (Ashanti Region) and Worakese (Central Region) plantations of the Cocoa Research Institute of Ghana.

Experimental animals, treatments and design

Twelve large white growing pigs were used for the experiment at each plantation, and were fed for one hundred and forty (140) days, that is, from January 15, 2009 until June 03, 2009. All pigs were purchased from the Kwame Nkrumah University of Science and Technology, Kumasi, Ghana. There was an initial adjustment phase of ten days, from January 05, 2009 to January 14, 2009 to allow pigs to adjust to their new diets. Pigs were individually housed at each plantation. Pens were similar at each plantation and were constructed with cement blocks, had concrete floors with a rough finish and were roofed with aluminium roofing sheets. At each plantation, pigs were balanced for age, sex, litter and

Table 1. Composition of experimental diets.

	Experimental diet		
Feed ingredient (g kg^{-1})	**Diet I (control)**	**Diet II[1] 200 g kg^{-1} fresh CPH**	**Diet III[2] 300 g kg^{-1} fresh CPH**
Air-dry CPH	250	-	-
Cassava Peels	300	340	505
Wheatbran	100	234	83.2
Soya cake (local)[3]	130	120	215
Tuna meal	100	130	170
Palm kernel cake	100	-	-
Copra cake	-	150	-
Oyster shell	13	17	17
Salt	2.5	3	3.57
Premix	1.25	1.75	1.8
Michochem[4]	1	1.25	1.43
Lysine	2.25	3	3
Total	1000	1000	1000
Calculated analysis			
Digestible energy (MJ Kg^{-1})	9.75	11.15	11.67
Crude protein (g kg^{-1})	170.6	203.7	210.3
Lysine (g kg^{-1})	12.3	14.2	16.6
Methionine + Cystine (g kg^{-1})	5.2	6.2	6.8
Calcium (g kg^{-1})	12.1	13.0	14.5
Available phosphorus (g kg^{-1})	4.3	7.1	5.6
Cost (GH¢ metric tonne^{-1})[5]	0.301	0.300	0.32

NB
1. The fresh/wet CPH equivalent of 200 g kg^{-1} air-dry CPH is fed with the concentrate (800 g kg^{-1}) at feeding time.
2. The fresh/wet CPH equivalent of 300 g kg^{-1} air-dry CPH is fed with the concentrate (700 g kg^{-1}) at feeding time.
3. Soya cake produced locally by an expeller process.
4. Michochem is a commercial mould fixing agent which is added to feeds at a rate of 1 kg per 1000 kg of feed. It binds mycotoxins *in vivo* preventing them from causing harm to the animals.
5. 1GH¢ = 0.697USD as at August 31, 2009. Cost of feed includes the cost of the raw cocoa pod husk

randomly allocated to one of three (3) treatments. Diet I, which served as the control, was the normal diet fed to grower pigs and contained 250 g kg^{-1} dry cocoa pod husk (CPH). Diet II contained the equivalent of 200 g kg^{-1} CPH but fed fresh (wet) and Diet III contained the equivalent of 300 g kg^{-1} CPH but fed fresh (wet). The experiment was laid out at each plantation as a completely randomized design with 3 treatments and 4 replicates making a total of 12 experimental units.

Feeds, feeding and management

Using diet I as a basis, two (2) concentrates were formulated to supply all nutrients in the control diet, less than what would be supplied by 200 g kg^{-1} air- dry CPH (diet II) and 300 g kg^{-1} air -dry CPH (diet III), respectively (Table 1). The CPH portion of the diet was fed as the equivalent of fresh CPH at feeding time. For example, at the start of the trials when pigs were being fed, an allowance of 1 kg day^{-1}, 0.8 kg and 0.7 kg of concentrate, with 0.2 and 0.3 kg equivalent of fresh CPH was fed to pigs on diet II and diet III, respectively. The diets were, therefore, iso-energetic and iso-nitrogenous. A price of GH¢ 0.10 kg^{-1} was assigned to air-dry cocoa pod husk based on the prevailing price of wheat bran and the nutrient content of dried cocoa pod husk relative to wheat bran as at the time of the feeding trials.

Pigs were fed an allowance, equivalent to 5% of their body weight, once a day and water was provided *ad libitum*. Any feed left over at the beginning of the next day was weighed and subtracted from that which had been fed the previous day to determine feed intake. Feed allowance was adjusted at the end of each month after the pigs had been weighed.

Data collection and analysis

Feed intake was recorded daily for each pen and pooled for a month (28 days). This was then used in the computation of average daily feed intake. Similarly, weights taken at the end of every month were used in the computation of average daily weight gain. The average daily feed intake, divided by the average daily weight gain was calculated as the feed to gain ratio, that is, the weight of feed needed to produce one kilogram of gain. Similarly, the feed to gain ratio multiplied by the cost of a kilogram of feed was calculated as the cost of gain or the cost of feed needed to produce a kilogram of weight gain. Samples of each feed and fresh CPH were subjected to proximate chemical analysis (AOAC, 2000).

Table 2. Proximate analysis of experimental diets and fresh CPH.

	Diet I	Diet II 200 g kg^{-1} fresh CPH	Diet III 300 g kg^{-1} fresh CPH	Fresh (wet) CPH
Dry matter (g Kg^{-1})	897	914	873	130
g Kg^{-1}DM				
Organic matter	888	913	877	938
Crude protein	205	229	263	78
Ether extract	35	70	40	19
Crude fibre	106	98	37	179
Nitrogen-free extract	565	553	557	565
Calcium	9.3	9.1	9.9	8.0
Phosphorus	10	11	10.5	4.1

Table 3. Performance of pigs on experimental diets.

	Diet I	Diet II 200 g kg^{-1} fresh CPH	Diet III 300 g kg^{-1} fresh CPH	SED
Parameter				
Average daily gain (kg day^{-1})	0.31	0.31	0.32	0.010
Feed intake (kg day^{-1})	2.07	2.15	2.11	0.050
Feed conversion ratio	6.69	6.63	6.69	0.066
Cost (GH¢)	2.02a	2.01a	2.12b	0.020

N.B: Means in a row with different postscripts are significantly different. SED – Standard error of the difference between two means.

Statistical analysis

The effects of the various treatments on average daily weight gain, average daily feed intake, feed conversion ratio and cost of gain were investigated using analysis of variance (GENSTAT, 2007), with the initial weight of pigs serving as a covariate. Variances at the two locations proved to be homogenous and as such data from the two locations was pooled and handled as a single factor model with treatment being the only factor and location being used as a block to allow the variation due to location to be accounted for (Steel et al., 1997).

RESULTS

The composition of experimental diets and the results of proximate analysis are shown in Tables 1 and 2, respectively. Means for the various treatments for average daily feed intake, average daily weight gain, feed to gain ratio and cost of gain are shown in Table 3. Dietary treatment did not significantly ($p > 0.05$) affect average daily weight gain, average daily feed intake and feed conversion ratio. There was, however, a significant difference ($p < 0.05$) between treatments for cost of gain. Diet III was significantly different ($p < 0.05$) from the other two treatments. Pigs consumed all the feed offered (both concentrate and fresh (wet) cocoa pod husk.

DISCUSSION

Adjusted means (adjusted for initial weight) were quite similar and this points to the fact that the diets were comparable. The complete consumption of fresh (wet) cocoa pod husks by pigs indicates that, it was palatable to them. Theobromine content of air-dry CPH is about 2.0 g kg^{-1} as opposed to 10.0 g kg^{-1} in dry cocoa bean shells (seed testa) (Obiakor and Nwako, 1977; Oddoye, 1984). There have been no previous reports of theobromine toxicity in experiments in which air-dry CPH was fed to pigs and poultry. Even though it was not possible to measure theobromine content of the fresh pod in this experiment, the performance of pigs and the fact that no health problems were observed during the 140 days of the trial suggest that the pigs were not adversely affected by the feeding of fresh cocoa pod husk.

The results suggest that, it may be possible to feed fresh cocoa pod husk at a higher level. The problem with this will be the high cost of the concentrate to go with the higher level of fresh cocoa pod husk. At 300 g kg^{-1} fresh CPH as fed in this trial, the high cost of the concentrate used reflected in significant ($p < 0.05$) differences in cost per gain with diet III being significantly ($p < 0.05$) more expensive than the other two diets. This is because as the quantity of fresh CPH increases, the concentrate feed will need to supply all other nutrients required in the growing pig's diet apart from those contained in the fresh CPH. As CPH is not that nutritious (low metabolisable energy content due to high fiber content), this will require a concentrate with high level of nutrients (particularly metabolisable energy) to make up the deficit.

There is a paucity of information on the feeding of fresh cocoa pod husk to pigs and it has therefore not been possible to compare this study to others. However, both

Barnes et al. (1985) and Okai et al. (1985) fed air-dry CPH at 150, 200 and 250 g kg^{-1} of the diet and reported comparable results (growth rate, feed efficiency and carcass characteristics) with the control feed which had no CPH. They reported live weight gains ranging from 0.417 - 0.56 kg day^{-1}, which are much higher than that reported in this study (0.31 - 0.32 kg day^{-1}). Both of their diets contained maize as the major energy source whereas, this study used cassava peels. There may be the need to increase energy content of diets in future work, by including some maize or vegetable oils, to attain a higher growth rate.

The results of this study will be of particular interest in cocoa growing areas where cocoa pod husks are usually left on the farm to rot. Farmers could be encouraged to keep a few pigs for fattening, using cocoa pod husk as one of their feed resources, to improve their incomes and also to provide some animal protein in their diets.

Conclusion

In conclusion, this study has confirmed the possibility of feeding fresh CPH to form up to 300 g kg^{-1} (on air-dry weight basis) of their ration. For the most economical results, however, it should not form more than 200 g kg^{-1} (on air-dry weight basis).

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