THE USE OF TWO EMPIRICAL METHODS OF SUBSTITUTION OF FEEDSTUFFS: PARBOILED CASSAVA PEEL MEAL VERSUS MAIZE IN THE DIETS OF GROWING COCKERELS

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ABSTRACT

The effect of two empirical methods of substituting maize with parboiled cassava peel meal (PCPM) in the diets of 168, 11 - week old Isa Brown cockerels were examined in a 3 - week experiment. The control diet A contained 40% maize while the proportion of maize in the control diet was replaced with PCPM at the graded levels of 20% of diets B and C, 30% of diets D and E and 40% of diets F and G with and without regard to the energy content of PCPM respectively. Consequently, diets A,B,D and F contained metabolisable energy (ME) content of about 2600 kcal/kg while diets C, E and G contained ME of about 2400, 2300 and 2200 kcal/kg respectively. The calculated crude protein (CP) contents of all diets were similar (17% CP). The results on the performance characteristics studied did not reveal any adverse effect of the two empirical methods of substituion of maize with PCPM in the diets of growing cockerels. The growth rate and feed conversion ratio of birds fed on diets containing 50 and 75% of PCPM at the expense of maize using the two substitution methods were similar to those of the control birds. However, there was depression in feed intake at the replacement levels beyond 50%. Thus, it was concluded that the two substitution methods could be used to replace maize with PCPM at the level of 75% of the former without adverse effect on weight gain and feed conversion ratio in the growing cockerels during the early stage of growth.

Key words: Cockerel, parboiled cassava peel meal, maize, substitution, energy: protein ratio and performance characteristics.

INTRODUCTION

Several studies have been reported on the use of cheaper and or unconventional feedstuffs as partial or complete replacements for the expensive ones in the diets of monogastric animals towards reducing cost of production (Eshiett and Ademosun, 1981; Aina, 1990; Adeleye and Odunsi, 1990). Esonu and Udedibie 1993 and Salami and Oyewole, 1994. While the energy: protein ratio of the experimental diets in some studies remain unaltered (Aina, 1990), it was altered with progressive substitution in some studies (Eshiett and Ademosun, 1981; Esonu and Udedibie, 1993), especially when no attention was given to energy and/or protein contents of the substitute. The relevance of energy: protein ratio of diets is that it affects the performance of animals via feed intake of feed nutrients such as protein since animals eat primarily to satisfy their energy requirments (Hill and Dansky, 1954). The principle of energy: protein ratio as it affects feed and nutrient intakes in poultry birds has been discussed fully in Scott et al. (1982) while its effect has also been demonstrated in the feeding trial involving weanling rabbits (Eshiett *et al.*, 1979).

Processed cassava peel meals (CPMs) have been used extensively as cheaper substitutes for maize in the diets of monogastric animals (Obioha and Anikwe, 1982; Tewe and Kasali, 1986; Osei and Duodu, 1988; Osei and Twumasi, 1989; Aina, 1990 and Esonu and Udedibie, 1993) with or without regard to their energy and/or crude protein contents. The energy and crude protein contents 2044.8 kcal/kg and 5.98% respectively for oven dried cassava peel meal (OCPM) according to Eshiett and Amosun (1981) are lower than those of maize as given by Scott *et al.*, (1982). Its use, therefore, as a substitute for maize may cause

lowering of dietary protein and/or energy contents with progressive substitution towards 100% thereby causing disparity in the energy: protein ratio of such diets (Eshiett and Ademosun, 1981 and Esonu and Udedibie, 1993). Aside from its nutritional limitation, the greatest problem in the use of cassava peel meal is that of its appreciable content of antinutritional factor; Hydrocyanic acid (HCN) as reported by several authors (Umah, 1977; Pido et al., 1979; Obioha and Anikwe, 1982; Obioha *et al.*, 1983; Tewe and Kasali, 1986). These authors have therefore developed several processing methods for cyanide reduction in fresh cassava products. One of such methods is parboiling (Salami, unpublished data).

The purpose of this preliminary study was to examine the effects of substitution of maize with parboiled cassava peel meal (PCPM) on the performance of growing cockerels during 11 to 14 weeks of age (in the early stage of growth) with and without regard to the energy content of the substitute.

MATERIALS AND METHODS

Mixtures of bitter and sweet varieties of fresh cassava peels were collected in batches from the gari processing mills at Irepodun Farmers' Market, Iseyin Road, Oyo. The peels were processed into parboiled cassava peel meal (PCPM) as follows:

A 200-litre metal drum half-filled with cold water with its lid on was heated to boiling point (100oC) and followed by immersion of the peels into the boiled water. Source of heat (burning firewoods) was removed immediately the peels were immersed and it was allowed to cool for 12 hours. Following the cooling step, the parboiled peels were removed from the "broth", drained in a wooden basket and was followed by sundrying on a concrete slab for 2 to 4 days until the peels became brittle in readiness for milling. The dried peels were hammer-milled to produce the meal (PCPM) and stored in polysthrene bags in a room until needed for preparation of experimental diets. Sample of PCPM was taken for the determination of proximate fractions according to the methods of AOAC (1990). Seven experimental diets were formulated (Table 1). Diet A contained no PCPM but maize 40% of the diet and served as control. The proportion of maize (40%) in the control diet A was gradually replaced with 20%, 30% and 40% of PCPM in diets B & C, D & E and F & G respectively. All diets contained about 17% crude protein (CP). The calculated metabolisable energy (ME) content of diets A,B,D and F was uniform with about 2600 kcal/kg diet while the ME contents of diets C, E and G were about 2400, 2300 and 2200 kcal/kg diet respectively, formulated without regard to the energy content of PCPM.

At 11 weeks of age, 168 birds were selected from a flock of 180 Isa Brown cockerels, after weighing individually and they were divided into fourteen groups of similar initial body weight (Table 3) with 12 birds making up a replicate. Each treatment group was replicated twice. The birds were quartered in two-tier battery cage placed inside an open-sided poultry house. Birds per replicate were housed in twos per cage compartment measuring 30x38x43 cm for breadth, length and height respectively. A feeding trough was used to serve feed for birds in each replicate while a water trough was used for watering two adjacent replicates. Diets and drinking water were provided *ad libitum* during the study period that lasted three weeks. The water troughs were washed daily before fresh water was served in the morning and this was topped as and when necessary during the day.

The birds were given recommended vacccinations at younger ages against Newcastle, Gumboro and Fowlpox diseases. They were also dewormed with wormazine at the onset of the experiment and were protected from coccidial and bacterial infections with Amprolium and Neocloxin respectively while on the floor pens before the start of the study.

The initial and final body weights of individual birds at 11th and 14th weeks of age were measured respectively to compute the average daily weight gain. Feed intake was also measured weekly to calculate the average daily feed intake. From the records of live weight gain and feed intake, feed conversion ratio was determined.

Data on performance characteristics were subjected to analysis of variance of a completely randomised design. Duncan's Multiple Range

TABLE 1: PERCENT COMPOSITION OF EXPERIMENTAL DIETS

INGREDIENTS	DIETS A	B	C	D	E	F	G
Maize	40.0	20.0	20.0	10.0	-	-	-
PCPM[a]	-	20.0	20.0	30.0	30.0	40.0	40.0
Maize Offal	13.0	16.0	20.0	18.0	22.0	22.5	25.50
Groundnut cake	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Palm Kernel Cake	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Blood meal	3.5	4.5	4.0	5.0	4.5	6.0	5.5
Fish meal	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Rice offal	14.5	7.0	7.0	3.0	4.5	-	4.0
Bone meal	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Oyster shell	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Palm oil	-	3.50	-	5.0	-	6.50	-
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix[b]	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
CALCULATED. ANALYSIS:							
Crude Protein (%)	16.53	15.56	16.60	16.62	16.72	16.67	16.76
ME (Kcal/kg)	2621.35	2638.51	2427.26	2634.44	2316.69	2654.42	2199.17
Energy: Protein	153.00	153.00	141.00	153.00	135.00	153.00	129.00
Crude fibre (%)	8.88	9.21	9.69	9.29	10.21	9.48	11.04
Lysine (%)	0.70	0.97	0.97	0.80	0.86	6.86	6.78
Methionine (%)	0.28	0.25	0.25	0.24	0.24	0.24	0.23
Calcium (%)	1.41	1.40	1.40	1.39	1.42	1.12	1.25
Phosphorus (%)	0.58	0.46	0.46	0.40	0.42	0.35	0.41

[a]PCPM = Parboiled cassava peel meal
[b]See Salami and Oyewole (1997)

Test was also used to compare and separate the means of the dietary treatments (Steel and Torrie, 1980).

RESULTS

The calculated proximate composition of the treatment diets (A to G) is given in Table 1 while that of the substitute for maize, PCPM, is in Table 2. As per calculated analyses, all diets contained about 17% crude protein. The determined crude protein content of the PCPM (on as-fed basis) was 5.13% (Table 2). The metabolisable energy (ME) of PCPM was not determined but the value (204.8 Kcal/kg) determined for oven dried cassava peel meal (OCPM) by Eshiett and Ademosun (1981) was assumed for PCPM. In line with the objective of the study, diet A, B, D and F were formulated to contain similar ME contents (Ca 2,600 Kcal/kg) while diets C, E and G contained Ca 2400, 2300 and 2200 Kcal ME/kg diet respectively. All diets were similar in other calculated chemical characteristics.

Table 3 shows the performance characteristics of the growing cockerels. The two empirical methods of substitution of maize with PCPM in the diets of growing cockerels did not affect their performance characteristics, significantly, at all substitution levels.

TABLE 2: CHEMICAL COMPOSITION OF PARBOILED CASSAVA PEEL MEAL (As-fed basis)

Proximate Fraction	[a]Proportion (%)
Crude Protein	5.31
Crude fibre	12.30
Ether extract	1.13
Total ash	9.88
Nitrogen - free extract	63.29
Moisture	8.09

[a]Values are means of triplicate determinations.

TABELE 3: PERFORMANCE CHARACTERISTICS OF GROWING COCKERELS AS INFLUENCED BY METHODS OF SUBSTITUTING PARBOILED CASSAVA PEEL MEAL FOR MAIZE IN THEIR DIETS

MEASUREMENTS	DIETS A	B	C	D	E	F	G	SEM
Initial body weight (g)	686.36	686.36	690.91	686.36	686.36	681.81	686.81	3.44NS
Final body weight (g)	1099.0^{a}	983.2^{ab}	1099.9^{a}	981.8^{ab}	1011.3^{ad}	883.8^{b}	915.9^{b}	32.35*
Daily weight gain (g/bd)	19.7^{a}	17.1^{a}	19.5^{a}	14.1^{abc}	15.5^{ab}	9.6^{d}	11.1^{cd}	0.78**
Daily feed intake (g/b d)	113.1^{d}	111.5^{a}	107.6^{a}	94.4^{b}	92.9^{b}	76.6^{c}	82.4^{c}	1.96**
Feed conversion ratio	5.76^{ab}	6.51^{ab}	5.53^{a}	6.79^{ab}	6.06^{ab}	8.05^{b}	7.52^{ab}	0.63*

^{a,b,c,d}Means bearing identical or no superscripts are similar while those with unidentical superscripts differ at the levels of probability indicated as follows:

NS = Not significant (P> 0.05)

* = Significant (P<0.05) and

** = Highly significant (P<0. 0)

This was confirmed by the results obtained for birds on diets B & C, D & E and F & G in which PCPM replaced 50, 75 and 100% respectively of the proportion of maize in the control diet A (40%). However, the replacement of maize with PCPM beyond 75% of the proportion of maize in the control diet had adverse effect on growth rate but not on feed conversion ratio while feed intake was depressed at replacement levels beyond 50% of CPM at the expense of maize irrespective of the method of substitution used.

DISCUSSION

The crude protein content of 5.31% (on as-fed basis) or 5.78% (on dry matter basis) determined for PCPM was similar to the values determined by Eshiett and Ademosun (1981),Osei and Duodu (1988), Osei and Twumasi (1989) and Ogbonna and Adebowale (1993) for their respective processed CPMs. It is, thus, evident that the crude protein content of CPMs is not affected by the processing method. Furthermore, PCPM like other processed cassava peel meals (CPMs) namely oven-dried (OCPM), sundried (SCPM), frozen, (FC[M) and ensiled cassava peel meals (ECPM) is lower than maize in crude protein as given by Scott *et al.*, (1982). The lower metabolisable energy (ME) content of CPMs than that of maize was also reflected in the ME values of diets C, E and G in which PCPM was included at the expense of maize without regard to the lower energy content of the former.

Reduced feed intake and poor growth rate have been observed by Eshiett *et al.* (1979) in weanling rabbits fed diets containing abnormal energy: protein (E:P) ratio as exemplified by medium energy - low protein diets. It is, therefore, reasonable to suppose that substitution of one feedstuff with another without regard to the energy and/or protein content(s) (Esonu and Udedibie, 1993) could precipitate wide disparity in the E:P ratio of the test diets, thereby affecting the performance of the experimental animals. Hence, this study was undertaken to verify this phenomenon. In the present study, the E:P ratio of diets A,B,D and F was 153:1 while those of diets C, E and G were 141, 135 and 129:1 respectively (Table 1). The growth rate, feed intake and feed conversion ratio of birds fed on diets B, D and F were similar to those of their counterparts on diets C, E and G respectively. It can be concluded, therefore, that E:P ratio of diets ranging from 129 to 153:1 had similar effect on the performance of growing cockerels in the early stage of growth.

The birds were able to tolerate PCPM up to 75% of the proportion of maize in the control diet A without jeopardising their growth rates. This result is not in agreement with the findings of Aina (1990) and Esonu and Udedibie (1993) who reported safe replacement levels only up to 45to 50% of SCPM at the expense of maize in the diets of grower cockerels and weaner rabbits respectively. The poorer growth rate of birds at 100% replacement level might be explained on account of significant reduction in feed intake since depression occured in this measurement at levels beyond 50%.

The relationship between voluntary feed intake and energy content of animal diet is that birds eat more of low-energy diet than high-energy diet in an attempt to satisfy their energy requirement (Hill and Dansky, 1954 and Scott *et al.*, 1982). On account of this submission, birds fed on diets A,B,D and F were expected to have similar pattern of feed intake but the feed intakes of birds on diets D and F were lower than those on diets A and B. Furthermore, birds on diets C, E and G were also expected to consume more of these diets in view of their lower energy contents as compared with diets A B, D and F but this was not observed. It is, thus, evident that the birds showed aversion to PCPM as a substitute for maize, especially at higher inclusion levels in their diets. Similar observations had been made by Osei and Twumasi (1989), Esonu and Udedibie (1993) and Salami (unpublished data) while replacing maize with OCPM, SCPM and PCPM in the diets of broilers, weaner rabbits and old layers respectively. According to Sainsbury (1980), young and old birds can tolerate dietary fibre contents of 13 and 15% respectively for efficient functioning of the alimentary tract. In the present study, the fibre contents of dietary treatments ranged from 8.88 (diet A) to 11.04% (diet G) thereby suggesting that the slight increasing dietary fibre content with progressive substitution could not be responsible for depression in feed intake and growth rate. Since the treatment diets were similar in other chemical characteristics except energy (Table 1), the depression in feed intake and hence in weight gain with increasing proportion of PCPM in the diet could be attributed to the presence of residual hydrocyanic acid (HCN) in these diets. Residual RCN in PCPM was not determined in this study. Nevertheless, several workers notably Obioha and Anikwe (1982), Obioha et al. (1983), Tewe and Kasali (1986) and Esonu and Udedibie (1993) have implicated the presence of HCN for the poor performance of monogastric animals receiving diets containing cassava products, especially the peel at higher inclusion levels.

The mean values of feed conversion ratio (FCR) in this study ranged from 5.53 (for diet C) to 8.05 (for diet F) which was shown to differ significantly (P 0.05). However, the effect of replacing maize with PCPM in the grower cockerels diets did not follow any consistent trend but the values of FCR obtained for most of the diets are comparable with the values of 5.74, 5.19 and 5.21 quoted for the control grower pullets, weaner rabbits and grower pullets by Eshiett and Ademosun (1981) respectively. However, the present results of FCR disagree with those of Osei and Duodu (1988) and Osei and Twumasi (1989) who observed that FCR tended to deteriorate with progressive CPM inclusion in broilers' diets.

In conclusion, the optimal replacement level of maize with PCPM using the two substitution methods on the basis of weight gain in this study was 75% of the maize in the diet. Although feed cost analysis was left out, the recommended safe replacement level of maize with PCPM is capable of reducing feed cost on the strength of the experiences of Osei and Twumasi (1989), Aina (1990) and Esonu and Udedibie (1993). In line with the objective, this study lasted for a shorter period. Further investigation is therefore advocated for a longer feeding time to allow for treatment effects to manifest fully.

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REFERENCES

ADELEYE, I.O.A. and ODUNSI, A.A. (1990). Utilization of rubber seed meal as a protein supplement in broiler finisher rations. Nig. J. Anim. Prod., 17(1 & 2): 23 - 28.

AINA, A.B.J. (1990). Replacing maize with cassava peels in finisher rations for cockerels: The effects on cut-up pieces of eviscerated carcass. Nig. J. Anim. Prod., 17(1 &2) 17 - 22.

ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS (1990). Official Methods of Analysis. 13th Edition, Washington, D.C.

DAFWANG, I.I. and SHWARMEN, E.B.N.(1996). Utilisation of rice offal in practical rations for broiler chicks. Nig. J. Anim. Prod., 23 (1&2) 21 - 23.

ESHIETT, N.O., OMOLE, T.A. and ADEGBOLA, A.A. (1979). Crude protein and energy requirements of rabbits in the tropics. Niger. Jour. Agric. Sci., 1(2): 113 - 117.

ESHIETT, N.O. and ADEMOSUN, A.A. (1981). Effect of feeding cassava peel meal to growing pullets on their subsequent laying performance. Bull. Anim. Hilth Prod. Afr., 29: 237 - 242.

ESONU, B.O. and UDEDIBIE, A.B.I. (1993). The effect of replacing maize with cassava peel meal on the performance of weaned rabbits. Nig. J. Anim. Prod., 20 (1 & 2): 81 - 85.

HILL, F.W. and DANSKY, L.M. (1954). Studies on the energy requirements of chickens. The effect of dietary energy level on growth and feed consumption. Poult. Sc., 33: 112 - 119.

OBIOHA, F.C. and ANIKWE, P.C.N. (1982). Utilisation of ensiled and sundried cassava peels by growing swine. Nutr. Rep. Int., 26: 961 - 972.

OBIOHA, F.C., OKEKE, G.C., ONUA, E.C. and OBOGBUNAM, S.I. (1983). The effect of varying protein and energy levels on the utilisation of processed cassava peels by mice. Nutr. Rep. Int., 28(3): 531 - 545.

OGBONNA, J.U and ADEBOWALE, E.A. (1993). Effects of sundried cassava peel meal as replacement for maize and wheat offals on performance and nutrient utilisation of cockerels. Nig. J. Anim. Prod., 20(1 & 2): 61 - 70.

OSEI, S.A. and DUODU, S. (1988). The use of sundried cassava peel meal in broiler diets. J. Anim. Prod., Res., 8(2): 69 - 75.

OSEI, S.A. and TWUMASI, T.K. (1989). Effects of oven-dried cassava peel meal on the performance and carcass characteristics of broiler chickens. Anim. Fd. Sci. Tech., 24: 247 - 252.

PIDO, P.P., ADEYANJU, S.A. and ADEGBOLA, A.A. (1979). The effect of graded levels of fermented cassava meal on broilers. Poult. Sci., 58: 427 - 431.

SAINSBURY, D. (1980). Poultry health and management. First Edition. Granada Publ. Ltd., London. p. 33 - 42.

SALAMI, R. I. and OYEWOLE, S.O.O. (1994). Replacement of fish meal by sundried poultry visceral offal meal in the diets of broiler starters and finishers. J. Anim. Prod. Res., 14: 1&2 (in Press).

SALAMI, R.I. and OYEWOLE, S.O.O. (1997). Evaluation of poultry visceral offal meal as a substitute for fish meal in grower pullets' diets. Nig. J. Anim. Prod. Vol. 24 (1&2): 20 - 25.

SCOTT, M.L. NESHEIM, M.C. and YOUNG, R.J. (1982). Nutrition of the chicken. 3rd Edn. M.L. Scott Associates, Ithaca, N.Y.

STEEL, R.G.D. and TORRIE, J.H. (1990). Principles and Procedures of Statistics. 2nd edn. McGraw-Hill Book Company Inc. N.Y.

TEWE, O.O. and KASALI, O.B. (1986). Effect of cassava peel processing on the performance, nutrient utilisation and physiopathology of the African giant rat. (Cricetomy gambianus, water house). Trop. Agric. (Trinidad), 63(2): 125 - 123.

UMEH, E.O. (1977). Cyanide in Gari. 1. Factors governing the observed level of residual cyanide in gari. Bull. Chemi. Soc. Nig. 2: 21 - 32.