EFFECTS OF SUN-DRIED CASSAVA PEEL MEAL AS REPLACEMENT FOR MAIZE AND WHEAT OFFALS ON PERFORMANCE AND NUTRIENT UTILIZATION OF COCKERELS

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ABSTRACT

Five hundred (500) day-old Hyperco cockerels were raised on four experimental starter diets, A,B,C, and D containing 0, 17.71, 22.30 and 45.64% sun-dried cassava peel meals (CPM), respectively, as replacement for maize and wheat offals. At the finisher phase, the test ingredient was substituted on weight basis at the rates of 0, 20.41, 24.95 and 51.75%. The calculated cyanide contents of the starter diets were 0, 17.62, 22.19 and 45.41 mg HCN/kg for diets A,B,C and D, respectively, at the finisher phase. The duration of the study was 20 weeks. In the finisher phase, the highest mean daily feed intake values (129.6 and 123.5g/bird) were obtained on diets C and D, respectively, while the least mean values (116.9 and 106.5 g/bird) were recorded on diets A and B, respectively. The ME utilisation increased with increasing dietary energy levels in the starter phase and decreased with increasing dietary energy levels in the finisher phase. The daily nitrogen retained decreased with increasing dietary CPM levels in both phases.

Key Words: Cockerels, Cassava peel meal, performance, nutrient utilisation.

INTRODUCTION

In many developing countries, feed cost is estimated to represent over 70% of the total

cost of producing livestock intensively (Oluyemi, 1984; Ogunlowora, 1984). It is also known that maize and wheat offals, which are the conventional sources of energy and fibre, account for over 60% in a balanced poultry ration (Oluyemi, 1984).

In Nigeria, limited supplies of protein and energy carriers and consequent importation usually result in significant increases in the cost of domestic livestock production (Cantner, 1987). Any attempt to mitigate this problem could lower livestock production cost. There is evidence that the current acute shortage of protein in Nigeria and the rapidly increasing demand for livestock products could be alleviated through the production of poultry meat and eggs. The large-scale importation of frozen meat which was permitted in order to ease the situation in 1977 was found to be not only expensive but also inimical to entrepreneurial initiative. Continuation of such a policy is indefensible where poultry can be easily produced even by small scale farmers.

Scientific investigations on the nutrition of poultry have neglected cockerels as a specific type of poultry. Lack of definite information on specific nutritional requirements limited the rearing of cockerels on commercial basis in Nigeria.

Cockerel rearing has, however, attained some importance in this country in recent times due to a better understanding among poultry farmers that the need for efficient and better economy of poultry production calls for the development of cockerels into commercial and

profitable industry. Their major advantages over other birds include hardiness and relatively high survival rate. However, cockerel production does not appear profitable when the conventional rations utilised by the other stock are used for its production. There is, also, very limited information on the energy and nutrient requirements of cockerels in the tropics. Many workers (Osei and Duodu, 1988; Aina, 1990; Ogbonra, 1991) have shown that incorporation of cassava peel meals into cockerel ration reduced the cost of production without any adverse effect on carcass quality and economy of feed conversion of the birds.

Okosun (1987) reported that cockerels consuming a 21% protein and a between 2.45 and 2.65 Kcal/g ME of feed at the starter phase and finishing with a 16% protein and 2.25Kcal/g ME of feed gave the best feed conversion values. The author further recommended that cockerels, could be finished on a lower energy level (2.25 Kcal/g ME) and higher levels of fibrous, agro-industrial by-products, such as cassava peel meals.

It is against this background that this study was designed to evaluate the performance and nutrient utilisation of cockerels fed varying levels of sun-dried CPM as replacement for maize and wheat offals, at both the starter and finisher phases.

MATERIALS AND METHODS

The cassava peels, of mixed varieties and harvested at between 10-12 months of age, were collected from the gari processing centres located at Apata market on Ibadan - Abeokuta road. They were sun-dried on clean cement floors immediately after collection for 7 days after which the dried samples were ground, packed in polythene bags and stored at room temperature.

Four experimental diets were formulated for each of the starter and finisher phases. Diet A for both phases served as the control diet and contained both maize and wheat offals but no CPM and mg HCN/kg at both the starter

and finisher phases. Also, while diet B contained maize but no wheat offal, diet C contained no maize but wheat offal. Diet D contained no maize and no wheat offal. Both the starter and finisher rations were isonitrogenous (21 and 18% CP, respectively) and isocaloric (2.65 Kcal/g ME). All diets in the starter phase had equal levels of fish meal, bone meal, oyster shell, premix and salt. The levels of these ingredients in the finisher phase were also, fixed. These ratios and their calculated chemical composition are shown in Table 1. The proximate analysis of the test ingredient (CPM) - appears in Table 2, while Table 3 shows the proximate analysis of the experimental starter and finisher diets.

Management of Birds

500 day-old Hyperco breed cockerels were used for the study. They were weighed and randomly allotted to the four treatments and placed on the starter rations for 8 weeks. The rations were both isonitrogenous (21% CP) and isocaloric (2.65 Kcal/g ME). Each treatment consisted of 3 replicates with 41 birds making up a replicate. At the end of the starter phase, the birds were weighed and then fed a commercial finisher diet for 7 days, after which they were placed on the experimental finisher diets. All diets were calculated to contain 18% CP and 2.65 Kcal/g ME. The finisher phase lasted 20 weeks. In both phases, feed and water were supplied *ad libitum*. Weight gain and feed intake were recorded weekly while mortality was recorded as it occurred. Routine vaccinations and necessary medications were administered on the birds as and when necessary.

Chemical Analyses

The sun-dried CPM and the experimental diets were analysed separately for their proximate constituents (Table 2) according to AOAC (1980) procedure. The energy contents of the CPM, feed and faces were determined with a ballistic bomb calorimeter in which benzoic acid was used as a standard.

TABLE 1: RATION AND CALCULATED CHEMICAL COMPOSITION OF EXPERIMENTAL DIETS

Parameters (%)	Experimental Diets							
	Starter Phase				Finisher Phase			
	A	B	C	D	A	B	C	D
Maize	43.40	43.40	-	-	47.46	47.46	-	-
Wheat Offal	27.35	-	27.35	-	31.45	-	31.45	-
Cassava Peel Meal (Sun-dried)	-	17.71	22.30	45.64	-	20.41	24.95	51.75
Groundnut Cake	20.00	29.64	29.80	35.91	14.84	25.88	24.80	31.95
Fish Meal	5.00	5.00	5.00	5.00	2.00	2.00	2.00	2.00
Bone Meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Tallow (Oil)	-	-	11.30	9.20	-	-	12.55	10.06
Vit-Min-Premix*	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oyster shell	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calculated Analysis:								
Crude Protein (%)	21.24	20.68	21.04	20.99	18.07	17.96	17.98	17.98
ME (Kcal/g)	2.65	2.68	2.65	2.65	2.65	2.69	2.65	2.65
Free Cyanide (mg/kg)	-	17.62	22.19	45.41	-	20.31	24.83	51.49

* The vit-min-premix used in this study was a product of Roche. Each 1 kg contains: Vit A (I.U.) 4,000,000; Vit D (I.U.) 1,000,000; Vit E (I.U.) 4,800; Vit K (g) 0.8; Vit B (g) 0.4; Vit B₂ (g) 1.8; Vit B₆ (g) 1.2; Nicotinic acid (g) 4.8; Folic acid (g) 0.12; Ascorbic acid (g) 20.0; Choline chloride (g) 120.0; Mn (g) 40.0; Fe (g) 20.0; Zn (g) 18.0; Cu (g) 0.80; I (g) 0.62; Co (g) 0.09; Se (g) 0.04

TABLE 2: PROXIMATE CHEMICAL COMPOSITION OF CASSAVA PEEL MEAL

Fraction	% (DM basis)
Dry matter	86.2
Ash	9.5
Crude Fibre	16.7
Ether Extract	1.2
Crude Protein	5.1
Nitrogen-Free Extract	67.5
Gross Energy (Kcal/g)	3.21
Free HCN (mg/kg)	99.5

TABLE 3: PROXIMATE CHEMICAL COMPOSITION OF EXPERIMENTAL DIETS (DM BASIS)

Parameters (%)	Starter Phase				Finisher Phase			
	A	B	C	D	A	B	C	D
Dry matter	82.6	86.5	81.7	87.9	85.6	85.5	79.0	86.7
Ash	8.3	8.9	11.4	9.9	7.3	6.4	9.8	10.0
Crude Fibre	5.1	4.9	7.3	6.8	4.6	3.8	6.9	8.5
Crude Protein	17.9	18.8	20.5	19.3	16.9	17.5	18.9	19.0
Ether Extract	2.9	3.2	8.6	8.1	3.2	4.5	7.5	7.6
Nitrogen-Free Extract	65.8	64.2	52.2	55.9	68.0	67.8	56.9	54.9
Gross Energy (Kcal/g)	4.90	4.51	6.32	6.16	3.80	4.10	3.10	4.10
Free HCN (Mg/kg)	-	17.6	22.2	45.4	-	20.3	24.8	51.5

The cell-wall constituents of the sun-dried CPM and diets were estimated by the methods of Van Soest (1966, 1967) and Gooving and Van Soest (1970), while the hydrocyanic acid (HCN) contents were determined titrimetrically using sodium bicarbonate and iodine. Records of weekly feed intake/bird (g) and body weight gain/bird (g) were maintained and used to determine the nitrogen retention (%) and protein efficiency ratios.

The data obtained in these studies were subjected to analyses of variance, using Complete Randomized Design. The Duncan's Multiple Range Test (Steel and Torrie, 1980) were used to assess significant differences.

RESULTS

The results of performance and energy utilisation studies are presented in Table 4 for the starter and finisher phases. In the starter phase, the mean daily feed intake values showed no significant differences ($P > 0.05$) between treatments. However, mean values for body weight gain were significant ($P < 0.05$) between treatments. The highest mean body weight gain (463.5g/bird) was obtained on diet C, while the least value (362.6 g/bird) was recorded on diet A. A feed conversion ratio of 3.9 was obtained on diet C; while a value of 5.7 was obtained on diet A; thus the best feed conversion ratio was obtained on diet C.

The results of daily protein intake were not significantly different ($P > 0.05$). A daily protein intake value of 7.1g/bird was obtained on diet D, while diets A and C recorded a value of 6.6g/bird. However, the efficiency of protein utilisation was not significant ($P > 0.05$) among treatments. Mean values for mortality were significant ($P < 0.05$) between treatments. The highest mortality of 15.3% was obtained on diet A, while the lowest mean value of 6.5% was obtained on diet B.

In the finisher phase, the feed intake differed significantly ($P < 0.05$) between the experimental diets. The highest daily intake (129.6 g/bird) was observed in the group on

diet C, while the lowest value (106.5g/bird) was obtained on diet B. The mean feed intake in diets D and A were 123.5 and 116.9 g/bird/d, respectively. Mean body weight gains were not significantly different ($P > 0.05$) among treatments. Birds on diet C and D gained 1650.0 and 1598.4g/bird, respectively. Protein intake value of 24.6g/bird was obtained on diet C, while the mean value of 18.6g/bird was obtained on diet B. Protein intake and protein efficiency ratios were, however, not statistically affected ($P > 0.05$) by treatments. No mortality was recorded among the birds on diets A, B and D during this phase while a low mortality rate of 1.23% was recorded on diet C.

Caloric intake of the birds showed significant differences ($P < 0.05$) between treatments in the starter phase. The mean daily gross energy intake values (Kcal/bird) obtained were highest on diet C (231.3) but lowest on diet B (165.9). Generally, the intake tended to increase with increasing dietary energy levels. The apparent ME values showed significant differences ($P < 0.05$) between treatments in both the starter and finisher phases. The highest mean ME values of 5.4 and 5.3 Kcal/g in the starter phase were observed in diets C and D, respectively, while in the finisher phase, the highest ME value of 3.4 Kcal/g was obtained on diet B.

Nitrogen Utilisation

Data in Table 5 show the nitrogen intake, nitrogen retained and percentage nitrogen-retention of the birds in both phases. The percentage daily nitrogen retention showed significant differences ($P < 0.05$) between the treatments in both phases. The highest mean value of 78.7% was recorded on diet B in the starter phase, while in the finisher phase, the highest values of 81.9 and 79.2% were observed in diets B and A, respectively. The lowest value of 65.4% was obtained on diet D in the starter phase, while in the finisher

TABLE 4: PERFORMANCE AND ENERGY UTILISATION

Parameters	EXPERIMENTAL DIETS									
	STARTER PHASE					FINISHER PHASE				
	A	B	C	D	SEM	A	B	C	D	SEM
Mean initial										
Live weight (g/bird)	31.1	40.7	39.4	38.3	2.40	393.7 ^a	466.7 ^a	475.9 ^a	473.7 ^a	39.84
Mean final										
Live weight (g/bird)	393.7 ^b	466.7 ^a	475.9 ^a	473.7 ^a	39.84	2053.0 ^a	2019.7 ^b	2121.9 ^a	2072.1 ^a	16.24
Mean Body										
Weight gain (g/bird)	362.6 ^b	426.0 ^a	463.5 ^a	435.4 ^a	28.03	1659.3	1553.0	1650.0	1598.4	37.60
Daily Feed										
Intake (g/bird)	36.8	36.3	32.1	36.6	6.25	116.9 ^{ab}	106.5 ^b	129.6 ^a	123.5 ^a	42.02
Feed Conversion ratio	5.7	4.8	3.9	4.7	1.09	5.4	5.3	6.1	5.9	0.75
Feed Efficiency ratio	0.18	0.21	0.26	0.21	0.05	0.18	0.19	0.17	0.17	0.39
Daily Protein Intake										
(g/bird)	6.6	6.8	6.6	7.1	0.34	19.9	18.6	24.6	23.6	0.36
Protein Efficiency ratio	5.5	6.3	7.0	6.2	0.3	1.09	1.08	0.87	0.88	0.26
GE of feed (K cal/g)	4.9	4.5	6.3	6.1	0.44	3.8	4.1	3.1	4.1	0.24
Daily GE Intake										
(Kcal/bird)	179.9 ^{bc}	165.9	231.3 ^a	223.9 ^b	16.12	443.3	436.7	401.8	508.4	22.22
Daily Faecal Output										
(g/bird)	9.1	6.7	10.4	8.9	0.77	30.9	29.1	45.2	38.6	3.71
GE of Faeces (Kcal/g)	2.9	2.4	2.6	2.2	0.15	3.0	2.6	3.5	3.0	0.18
Daily GE Output										
(Kcal/bird)	26.3	16.2	26.9	19.7	2.65	92.6	75.6	158.3	115.9	17.92
Apparent ME (Kcal/g)	4.18	4.06	5.46	5.57	0.40	3.07	3.40	1.88	3.21	0.34
Mortality (%)	15.3 ^a	6.5 ^c	12.1 ^{ab}	10.5 ^b	0.19	-	-	1.23	-	0.00

a, b, c Means with different superscripts on the same row differ significantly ($P < 0.05$).

TABLE 5: NITROGEN UTILISATION

Parameters	EXPERIMENTAL DIETS									
	STARTER PHASE					FINISHER PHASE				
	A	B	C	D	SEX	A	B	C	D	SEX
Daily Nitrogen Intake (g/bird)	1.3	1.3	1.4	1.1	0.34	4.3	4.5	3.8	4.0	0.36
Daily Nitrogen Output (g/bird)	0.4	0.3	0.4	0.4	0.24	0.9	0.8	1.3	1.1	0.23
Daily Nitrogen Retention (g/bird)	0.9	1.0	1.0	0.7	0.43	3.4	3.7	2.5	2.9	0.47
Nitrogen - Retention (%)	70.4 ^{ab}	78.7 ^a	69.8 ^{ab}	65.4 ^b	5.36	79.2 ^a	81.9 ^a	66.2 ^b	73.5 ^{ab}	3.83
a, b	Means with different superscripts on the same row differ significantly (P < 0.05).									

a, b Means with different superscripts on the same row differ significantly ($P < 0.05$).

phase, the lowest value of 66.2% was obtained on diet C.

DISCUSSION

The gross energy of 3.21 Kcal/g obtained for the sun-dried CPM used in this study was higher than the value of 2.16 Kcal/g reported by Longe *et al.* (1977) and the value of 2.16 Kcal/g reported by Tewe (1984). The high energy value reported in this study may be attributed to the presence of small tubers and edible pulps in the peels. Longe *et al.* (1977) reported on the rind only while Tewe (1984) reported on the peels without the inclusion of small tubers.

Variations in energy value may be due to differences in the chemical composition among samples of an ingredient (Farrell, (1978). The methods used to estimate energy values could result in a range of values for the same sample (Vohra, 1972). Oluyemi *et al.* (1976) showed that variable energy values may be obtained for different batches of same ingredients due to differences in composition related to differences in cultivars, soil, climatic factors and processing techniques. Ogbonna *et al.* (1988) also reported that the GE contents of the diets increased with increasing dietary fibre levels. Variations in the residual oil contents of the diets, relating to the inclusion of tallow to the diets diluted with CPM could account for the higher energy values observed in the present study. This observation agrees with the report of Oluyemi *et al.* (1976) that variation in the residual oil contents of the oilseed meal accounted for the higher energy values observed in this study. Apart from possibility that increase in the groundnut cake levels in the CPM-diluted diets resulted in the observed higher CP levels in the test diets, Clark (1969) reported that long drying period of cassava peels (particularly during the rainy season) could cause proliferations of micro-organisms in the media, with the resultant increase in the CP content of the diets.

Nwonkolo *et al.* (1977) reported a GE value

of 4.68 Kcal/g for palm kernel meal (pkm), a value that disagrees with 3.21 Kcal/g reported for sun-dried CPM in this study. Osei and Duodu (1988) reported an ME value of 2.73 Kcal/g for the 15% CPM diet in their study on the use of sun-dried CPM in broiler diets. The HCN contents of the test diets in the present study are safe for animal consumption and agree with the reports of Bolhuis (1954) and Delange and Alluwalia (1980). Courtesy (1991) reported that birds can tolerate high levels of cyanide, up to 150 ppm. Work on chicks indicated that much energy may be expended on feeding activity (Keddy *et al.*; (1962). Thus, the birds receiving low fibre diet would conserve energy by feeding less and perhaps this extra food energy was stored as fat which could account for their greater body weights. However, the result in the present study is the opposite of this thinking since the birds on higher dietary fibre, especially at the finisher phase, ate more feed and recorded similar body weights as the birds on the control diet.

In the present study, the ME value of 2.65 Kcal/g ME proved adequate for satisfactory performance at the starter phase. However, Okosun (1987) recommended a minimum value of 2.45 Kcal/g ME at the starter phase. Statistical analyses in the present study indicated that there were significant differences ($P < 0.05$) between treatments in feed intake but none ($P > 0.05$) in the body weight gain for the different dietary treatments among the birds at the finisher phase. This observation might be due to the increased level of fibre in the different dietary treatments.

Nutrient Utilisation

The ME values reported for the cockerels in this trial were lower than the levels recommended by Olomu (1976) and Fetuga (1984) for optimum performance of broiler chicks raised in Nigeria. This suggests that cockerels require a lower ME level than broiler chicks. However, the ME values for cockerels as observed in this study are in agreement with

the recommendation of Tewe (1984) for tropical pullets. The age of the experiment birds at the time of the ME determination was 20 weeks. Thus, the birds were mature (adults). This probably explains the higher ME obtained in the trial.

Nitrogen (Protein) Utilisation.

From the results obtained in the present study, nitrogen retention was highest in diet B in both phases. It was observed that with exception of diet B decreasing exception of diet B decreasing nitrogen-retention resulted form increasing dietary CPM dilution rates at the starter phase, while at the finisher phase nitrogen-retention values increased with increasing level of dietary CPM dilution. This observation suggests that above the CPM dilution level in diet B the response of cockerels to increasing levels of dietary CPM in relation to nitrogen retention differs with age. Thus CPM addition to cockerel chick diets tended lower the nitrogen-retention ability of the chicks but enhanced the nitrogen-retention ability as the birds grew older. The effects of the anti-nutritional factors of CPM which limit the utilisation of the CPM must have been responsible for this observation. It has also been shown that the high-fibre content of diets hinders the efficient utilisation of the nutrients (Potter *et al.* 1960; Sosulki and Cadden, 1982). The finding of Okosun (1987) also supports this observation.

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