REPLACING MAIZE AND WHEAT OFFAL IN DIET OF COCKERELS WITH SUN-DRIED CASSAVA PEEL MEAL: EFFECT ON THE DIGESTIBILITY OF CELL WALL CONSTITUENTS.

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ABSTRACT

The effect of replacing dietary maize and wheat offal with varying levels of sun-dried cassava peel meal (CPM) containing cyanide on the digestibility of the cell wall constituents in cockerels were determined. Four hundred and ninety-two day-old Hyperco cockerels were raised on four experimental diets designated A, B, C and D and containing 0, 17.71, 22.30 and 45.64, respectively, sun-dried CPM at the starters phase and 0, 20.41, 24.95 and 51.75% at the finisher phase. The diets were formulated to be isonitrogenous and isocaloric. Significant differences ($P < 0.05$) among treatments were observed in the intake of all the cell wall constituents at both phases. It was observed that while birds on diet B consistently recorded the lowest intake of the cell wall constituents with the highest digestibility values, those on diet C consistently recorded the highest intake with the low digestibility values. However, it was observed that the lower the dietary cyanide levels, the lower the retention of NDF and ADL in both the starter and finisher phases.
Key Words: **cockerels, cassava peel meal, digestibility, cell wall constituents.**

INTRODUCTION

Lack of information on adequate substitute for maize and wheat offal in the formulation of cockerel ration has hindered progress in cockerel rearing. Furthermore, the use of feeds conventionally used for pullets, layers or broilers in cockerel rearing does not appear profitable. The use of maize and wheat offal in ration formulation has become expensive because of their scarcity following the ban by the Federal Government of Nigeria on the importation of grains. As a result, the usefulness of some agricultural by-products as substitute need to be investigated in poultry ration formulation.

Research has, however, shown that the energy and fibre requirements of cockerels can be partially met through the use of cassava peel meal (CPM) without necessarily affecting production, growth rate and carcass quality of the birds (Osei and Duodu, 1988; Aina, 1990; Ogbonna, 1991). Inference from the chemical composition of CPM given by Oyenuga (1968) showed that apart from its cyanide content which limits its use, the fibre content was also a hindrance to its effective utilisation. Thus, the extent to which the high fibre content of CPM would limit its utilisation in monogastric feed would depend principally on the composition of the fibre and the digestibility of each of the components.

The present study was, therefore, carried out to determine the composition of sun-dried CPM fibre and evaluate the digestibility of each of the fibre components by cockerel

MATERIALS AND METHODS

The cassava peels, of mixed varieties and

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harvested at between 10-12 months of age, were collected from the gari processing centres located at Apata market. 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.

Experimental diets

Four experimental diets (Table 1) were formulated for the starter and finisher phases, respectively. Diet A for both phases served as the control and contained both maize and wheat offal but no CPM, while diets B, C and D contained varying levels of sun-dried CPM and associated free HCN at both the starter and finisher phases. Diet B contained maize but no wheat offal while diet C contained no maize and no wheat offal. Both the starter and finisher rations were isonitrogenous and isocaloric. All diets in the starter phase had equal levels of fish meal, bone meal, oyster shell, vitamin - mineral - premix and salt. The levels of these ingredients in the finisher diets were also fixed. The proximate chemical composition of the test ingredient (CPM) appears in Table 2, while Table 3 shows the proximate chemical composition of the experimental diets.

Management of Birds

The 492 day-old Hyperco breed cockerels used in this study were weighed and randomly allotted to the four treatments and placed on the starter diet for 8 weeks. The rations were both isonitrogenous (21% CP) and isocaloric (2.65 Kcal/g ME). Both treatments consisted of 3 replicates of 41 birds each. At the end of the starter phase, the birds were weighed and then fed on commercial finisher diet for 7 days, after which they were randomly allotted to the experimental finisher diets. All diets were calculated to contain 18% CP and 2.65 Kcal/g ME. The finisher phase lasted 16 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 vaccination and necessary medication 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 according to AOAC (1980) procedure. The energy contents of the CPM, feed and faeces were determined with a ballistic bomb calorimeter in which benzoic acid was used as a standard. The hydrocyanic acid (HCN) contents of the sun-dried CPM and diets were determined titrimetrically using sodium bicarbonate and iodine (Tewe, 1975), while the cell wall constituents were estimated by the methods of Van Soest (1966, 1967) and Goering and Van Soest (1970). All data were subjected to analysis of variance procedure of Snedecor and Cochran (1967), using the Completely Randomised Design. Where statistical significant differences were observed, the treatment means were compared using the Least Significant Difference procedure (Steel and Torrie, 1980).

Digestibility Study

At weeks 8 and 16, 3 experimental birds per replicate of each of the treatments were transferred to metabolic cages for a 5-day collection of droppings following a 7-day adaptation period. The droppings, free of feathers and spilled feed, were dried in a forced-air circulation oven at 60°C to constant weights. The dried samples were subsequently milled for chemical analysis.

RESULTS

Neutral Detergent Fibre (NDF)

The NDF intake, output, retention and percentage digestibility at the starter and finisher phase are shown in Table 4. At both phases, the highest mean value of intake was obtained on diets C and D. Intake values of 104.7 and 99.8g/bird and 134.6 and 127.8g/bird

TABLE 1 COMPOSITION OF EXPERIMENTAL DIETS

Parameters (%)	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	27.30	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	-	-	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	20.09	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. B_2 (g) 1.8; Vit. B_6 (g) 1.2; Nicotinic acid (g) 4.8; Folic acid (g) 0.12; Ascorbic acid (g) 4.8; 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. CHEMICAL COMPOSITION OF CASSAVA PEEL MEAL

Chemical Fraction	(%)
Dry matter	86.2
Ash	9.5
Crude Fibre	16.7
Neutral Detergent Fibre	56.0g/100g DM
Acid Detergent Fibre	35.9 " "
Acid Detergent Lignin	24.1 " "
Hemicellulose	20.1 " "
Cellulose	11.9 " "
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. CHEMICAL COMPOSITION OF EXPERIMENTAL DIETS (DM BASIS)

Chemical Composition (%)	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	3.3	8.9	11.7	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
Neutral Detergent Fibre	33.2	29.9	32.7	32.8	38.4	30.4	37.9	40.5
Acid Detergent Fibre	21.2	18.1	18.6	29.8	25.5	18.5	22.7	21.8
Acid Detergent Lignin	6.5	6.1	6.8	6.9	13.3	10.9	13.5	13.7
Hemicellulose	12.2	11.9	12.0	11.8	12.4	9.2	12.4	10.3
Cellulose	8.8	8.9	9.0	9.2	9.8	9.7	10.2	9.9
Ether Extract	2.9	3.2	8.6	8.1	3.2	4.5	7.5	7.6
Crude Protein	17.9	18.8	20.5	19.3	16.9	17.5	18.9	19.0
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

TABLE 4. NEUTRAL DETERGENT FIBRE DIGESTIBILITY (G/BIRD) AT 8 AND 16 WEEKS

	EXPERIMENTAL DIETS									
	STARTER PHASE					FINISHER PHASE				
Parameters	A	B	C	D	±SEM	A	B	C	D	± SEM
Intake (g/bird)	98.4^{b}	74.8^{c}	104.7^{a}	99.8^{ab}	3.6	119.3^{b}	86.7^{c}	134.6^{a}	127.8^{ab}	10.6
Output (g/bird)	65.1^{b}	44.8^{c}	72.1^{a}	67.0^{ab}	6.0	80.9^{b}	56.4^{c}	96.6^{a}	87.3^{ab}	8.6
Retention (g/bird)	33.2	29.9	32.7	32.8	0.76	38.4^{ab}	30.4^{c}	37.9^{b}	40.5^{a}	2.2
% Digestibility	33.7^{ab}	40.1^{a}	31.2^{c}	32.9^{b}	1.95	32.2	35.0	28.2	31.7	1.40

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

were obtained on diets C and D at the sister and finisher phases, respectively. The lowest intake values (74.8 and 86.7g/bird for the starter and finisher phases, respectively) were observed on diet B. The NDF intake showed significant difference (P< 0.05) between treatments at both phases. The NDF intake increased with increasing wheat offal and CPM in the diets (Table 1). However, retention and % digestibility were significant (P< 0.05) only at the finisher and starter phases, respectively.

Acid Detergent Fibre (ADF)

The ADF intake values were highest on diets C and D, both at the starter and finisher phases (Table 5), probably due to the high level of wheat offal and CPM in diet C and the high level of CPM in diet D (Table 1), in both phases. In the starter phase, intake values of 81.8 and 79.9g/bird were obtained on diets C and D, respectively, while the intake values of 102.4 and 95.0g/bird were obtained on diets C and D, respectively, in the finisher phase (Table 5). Also, the ADF intake was higher on diet A than on diet B at both phases. The amount of ADF retained showed significant differences (P<0.05) between treatments at week 8 but no significant difference (P>0.05) was observed between treatments at week 16 of the experiment. The percentage digestibility values were highest on diet B (41.2 and 33.9g/bird in the starter and finisher phases, respectively), while the lowest values were obtained on diet C in both phases.

Acid Detergent Lignin (ADL)

Data in Table 6 show that the ADL intake values were highest on diets C and D in the starter and finisher phases, respectively. The amount of ADL retained in both phases showed no significant differences (P> 0.05) between treatments. However, it was observed in both phases that the birds on diet B recorded the highest percentage digestibility, though their intake of ADL was the lowest in both phases.

Hemicellulose

Significant differences (P< 0.05) were observed between treatments in the mean intake values of hemicellulose at both phases. The highest mean intake value was observed on diet C in both phases (Table 7). While in the starter phase a mean intake value of 42.9g/-bird was obtained on diet A, mean intake values of 44.2 and 34.1g/bird were obtained in diets A and D, respectively, in the finisher phase. But in both phases, the lowest mean intake value was obtained on diet B. However, in both phases, it was observed that birds on diet B had the least intake value of this nutrient and so recorded the highest percentage digestibility in both phases.

Cellulose

Data in Table 8 show that the cellulose intake values were highest in diets C and D in the starter and finisher phases, respectively. The amount of cellulose retained in both phases showed no significant differences (P> 0.05) between treatments. However, it was observed that the birds on diet B recorded the highest percentage digestibility in both phases, though their intake of cellulose was the lowest.

DISCUSSION

Generally, results indicate an inverse relationship between cell wall constituents and digestibility. Results of the digestibility of NDF showed significant differences (P<0.05) among the treatments in the starter phase. Comparatively, intake and retention of NDF were higher at the finisher than at the starter phase. This may be due to the greater bulk of the fibrous materials making up the feed, as well as the influence of age of the birds since it has been observed that fibres are better utilised in older birds (Ogbonna, 1991). Significant differences (P<0.05) between treatments were observed in the percentage digestibility of ADF and ADL at both phases. The less the intake of ADL, the better the

TABLE 5. ACID DETERGENT FIBRE DIGESTIBILITY (G/BIRD) AT 8 AND 16 WEEKS

	EXPERIMENTAL DIETS									
	STARTER PHASE					FINISHER PHASE				
Parameters	A	B	C	D	±SEM	A	B	C	D	±SEM
Intake (g/bird)	60.2^{b}	43.9^{c}	31.8^{a}	79.9^{ab}	9.0	84.5^{b}	54.6^{c}	102.4^{a}	95.0^{ab}	10.50
Output (g/bird)	39.0^{b}	25.8^{c}	63.2^{a}	50.2^{ab}	8.0	58.9^{b}	36.0^{c}	79.7^{a}	73.2^{ab}	9.7
Retention (g/bird)	21.2^{bc}	18.1^{c}	18.6^{b}	29.8^{a}	2.7	25.5	18.5	22.7	21.8	1.4
% Digestibility	30.2^{b}	41.2^{a}	27.7^{c}	37.2^{ab}	3.1	30.2^{ab}	33.9^{a}	22.2^{c}	22.9^{b}	2.9

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

TABLE 6. ACID DETERGENT LIGNIN DIGESTIBILITY (G/BIRD) AT 8 AND 16 WEEKS

	EXPERIMENTAL DIETS									
	STARTER PHASE					FINISHER PHASE				
Parameters	A	B	C	D	±SEM	A	B	C	D	±SEM
Intake (g/bird)	20.4^{b}	17.5^{c}	27.8^{ab}	30.1^{a}	2.8	33.7^{b}	27.3^{c}	44.3^{a}	38.1^{ab}	3.6
Output (g/bird)	13.9^{b}	11.4^{c}	20.9^{ab}	23.1^{a}	2.8	20.4^{b}	16.3^{c}	30.8^{a}	24.4^{ab}	3.1
Retention (g/bird)	6.5	6.1	6.8	6.9	0.21	13.3	10.9	13.5	13.7	0.66
% Digestibility	31.9^{ab}	34.9^{a}	24.7^{b}	23.2^{c}	2.8	39.6^{ab}	40.3^{a}	30.5^{c}	35.9^{b}	2.2

a, b, c, Means with different superscripts on the same row within each feeding phase differ significantly (P<0.05)

TABLE 7. DIGESTIBILITY OF HEMICELLULOSE (G/BIRD) AT 8 TO 16 WEEKS

	EXPERIMENTAL DIETS									
	STARTER PHASE					FINISHER PHASE				
Parameters	A	B	C	D	±SEM	A	B	C	D	±SEM
Intake (g/bird)	42.9^{b}	29.7^{c}	51.6^{a}	48.0^{ab}	4.8	44.2^{ab}	28.3^{c}	55.8^{a}	34.1^{b}	6.0
Output (g/bird)	30.7^{b}	17.7^{c}	36.6^{a}	36.2^{ab}	4.4	31.8^{ab}	19.1^{c}	43.4^{a}	23.8^{b}	5.4
Retention (g/bird)	12.2	12.0	15.0	11.8	0.74	12.4	9.2	12.4	10.3	0.80
% Digestibility	28.5^{b}	40.5^{a}	29.1^{bc}	24.7^{c}	3.4	27.9^{b}	32.5^{a}	22.2^{c}	30.2^{ab}	3.5

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

TABLE 8. DIGESTIBILITY OF CELLULOSE (G/BIRD) AT 8 AND 16 WEEKS

	EXPERIMENTAL DIETS									
	STARTER PHASE					FINISHER PHASE				
Parameters	A	B	C	D	±SEM	A	B	C	D	±SEM
Intake (g/bird)	39.9^{b}	29.8^{c}	50.8^{a}	46.9^{ab}	4.5	45.3^{b}	37.0^{c}	50.6^{ab}	52.9^{a}	3.3
Output (g/bird)	31.1^{b}	20.9^{c}	41.8^{a}	37.7^{ab}	4.6	35.5^{b}	27.3^{c}	40.4^{ab}	43.1^{a}	3.5
Retention (g/bird)	8.7	8.9	8.9	9.2	0.10	9.8	9.7	10.2	9.9	0.11
% Digestibility	21.9^{bc}	29.8^{a}	17.7^{c}	19.7^{b}	2.7	21.6^{ab}	26.2^{a}	20.2^{b}	18.6^{c}	1.6

a, b, c, Means with different superscipts on the same row within each feeding phase differ significantly ($P<0.05$)

efficiency of its utilisation. Diet B, with the least intake and highest digestibility of hemicellulose at both phases, indicates that its better utilisation lies with its lower intake. Also, the study clearly indicates that the less the intake of cellulose by cockerels, the better its efficiency of utilisation.

These results agree with the observation of other workers (Osei and Duodu, 1988; Aina, 1990; Ogbonna, 1991) that the high crude fibre and/or ash content of CPM had negative effects on the digestibility of other components. Ogbonna (1982) observed an inverse relationship between the ADF, Lignin and cellulose contents of the test ingredients and the ME values, Ogbonna *et. al.* (1988) also reported that the apparent digestibility of palm kernel meal (pkm) decreased with the increasing dietary fibre dilution. Hemicellulose was better digested than cellulose by cockerels. These observations agree with the findings of Scott *et. al.* (1976) and Keys *et. al.* (1968). Birds on diet B, with the lowest intake of all the cell wall constituents, consistently had high digestibility values, thus indicating that the lesser the amount of cell wall constituents consumed by the animal, the better their utilisation.

In an earlier work on performance characteristics, Ogbonna and Adebowale (1993) showed that feed conversion and efficiency rations were enhanced by CPM even beyond 45.64%. This work however indicates that cell wall constituents did not affect weight gain significantly and particularly in the finisher phase.

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