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THE USE OF WHOLE CASSAVA MEAL AND LEAF MEAL IN BROILER DIETS

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Target Audience: Avian scientists, nutritionists, poultry farmers and feed millers.

ABSTRACT

Two-week-old broilers of the "Anak" strain were randomly alloted to six iso-enrgetic and iso-nitrogenous experimental diets having energy: protein ration maintained at about 0.55. Diet 1 was a maize-soyabean based control while diets 2 through 6 contained whole cassava meal (WCRM) in total replacement for maize. Diet 2 had full-fat soyabean (FFSB) as a major source of protein. Taking the protein supplied by FFSB in Diet 2 as 100%, FFSB, cassava leaf meal (CLM) and / or fish meal (FM) were combined in Diets 3 (75% FFSB: 25% CLM); 4(87.5% FFSB: 12.5% CLM); 5(75% FFSB: 12.5% CLM: 12.5% FM) and 6(75% FFSB: 25% FM). The diets were fed over a 7-week period. Average daily feed intake (ADFI), water intake (ADWI), weight gain (ADWG) and feed conversion ration (FCR) were significantly (P<0.05) affected by dietary treatments. ADFI and ADWG of birds on the WCRM based diets were significantly better (P<0.05) than those of birds on the maize-baised control diet. Dry matter faecal output was significantly higher (P<0.05) on WCRM diets while approximate dry matter digestiblity was lower (P<0.05) for birds on the WCRM based diets. Haematological measurements of packed cell volume (PCV) and haemoglobin value (Hb) were significantly (P<0.05) higher on the WCRM based diets compared with the maize-based control diet. Tehre no significant (P>0.05) effects of dietary treatment on thigh, neck, wings, back, drumstick and shanks.

The weight of breast expressed as a percentage of eviscerated weight was significantly (P<0.05) higher on the WCRM based diets. The liver and pancreas weights were however significantly (P<0.05) reduced on the WCRM diets. Improvement was observed in the performance of birds fed soyabean-cassava product ration as a result of fish meal addition, in indication that the fish meal may have provided a deficient factor or removed an inhibiting factor. Clarification of this situation which would enable proper utilization of cassava products in a complimentary manner should be further pursued in future studies.

Keywords: Whole cassava root meal, cassava leaf meal, broilers, growth attributes.

DESCRIPTION OF PROBLEM

Growth of Nigerian poultry has been hampered by problems of inadequate and high cost of energy feed ingredients brought about by the stiff demand for grains particularly the maize. Whereas an increased production of cereals may be the most obvious solution, the use of alternative energy sources had long been suggested (1).

Root and tuber crops are known for their high-energy content (2). These crops abound in Nigeria. Cassava is perphaps the most promising of these root crops as an alternative energy source. Nigerai is currently the world most important cassava producing country (3 and 4). The use of cassava in diets nfor animals is not a recent development. Over the decades scientists from all over the world have been actively involved in the use of energy in the diet of non-ruminants (5). The utilization of cassava root meal in diets of monogastrics is however beset with the limitation of very low quantity and quality protein as well as the fact that it is very dusty with ulcerogenic properties (6). When a balanced poultry ration is fromulated by using cassava, it must be supplemented with protein, amino acids, fats, mineralos and vitamis at higher levels than are nedded in cereal-based diets. With such supplementation however the feed cost may be very high hence the need to look for cheap protein sources that could be fed in combiantion with cassava root meals.

Cassava leaf meal (CLM)is rich in high quality protein (7) and could be used to lower the cost of feeding cassava products. Cassava leaves, constituting a major by product of cassava harvest, is equivalent to about 30% of the root yield (7). It has been reported that 7-20n tons of cassava leaves could be harvested per hectare of cassava farmland(8). Reports have shown that leaf harvest does not have a negative effect on root yield(9). Reveiwing the nutritive value of cassava leaves, it has been reported that their proxiamte composition of other feedstuffs like alfalfa meal (10).

This study was conducted to investigate protein source combinations that would best complement whole cassava root meal (WCRM) in conjunction with Full Fat Soyabean (FFSB) in total repalcement for maizee in broiler diets.

MATERIALS AND METHODS

The study was carried out at the Poultry Unit of the Teaching Reserach Farm, College of Agricultural Sciences, Olabisi Onabanjo University, Ago-Iwoye. The test materials evaluated were whole cassava root meal (WCRM), cassava leaf meal (CLM) and cassava peel meal (CPM). The materials were obtained from an 18 months old TMS 30211 cassava variety obtained from IITA, Ibadan and grown on the Teaching and Research Farm. Soil particles were washed off from unpeeled tubers, sliced into thin chips and sun-dried for 7 days on a concrete paltform. The dried chips were later milled to obtain whole cassava root meal (WCRM). Fresh cassava leaves, harvested without petioles were chopped into smaller sizes immedaitely. wilted under 24 hours and sundried until practical dryness was achieved. Peels were milled separately to obtain cassava leaf meal (CLM) and cassava peel meal (CPM), respectively. Other matrials such as full-fat soyabean (FFSB), fish meal (FM) e.t.c. were market grade.

Six dietary treatments (Table1) were formulated to be iso-energetic (11.51-12.25 MJkg^{-1}) and iso-nitrogeneous (212.4-225.2 gkg^{-1}). The energy to protein

Table 1 : Composition of experiemntal diets (g kg^{-1})

	Diets					
Ingredients	1	2	3	4	5	6
Maize	511.2	-	-	-	-	-
Wheat offal	81.8	-	-	-	-	-
WCRM	-	300.0	300.0	300.0	300.0	300.0
CPM	-	112.0	-	34.7	62.5	191.8
CLM	-	-	241.9	125.7	125.7	-
FFSB	370.0	505.0	366.0	442.6	366.0	354.0
Palm Oil	-	46.0	55.3	60.0	71.9	48.2
Fish meal	-	-	-	-	36.9	69.0
Oyster shell	10.0	10.0	10.0	10.0	10.0	10.0
Salt	2.5	2.5	2.5	2.5	2.5	2.5
Vit/Min Premix	2.5	2.5	2.5	2.5	2.5	2.5
Fish meal	-	-	-	-	36.9	69.0
Oyster shell	10.0	10.0	10.0	10.0	10.0	10.0
Salt	2.5	2.5	2.5	2.5	2.5	2.5
Vit/Min Premix	2.5	2.5	2.5	2.5	2.5	2.5
Methinine	2.5	2.0	2.0	2.0	2.0	2.0
Bone meal	20.0	20.0	20.0	20.0	20.0	20.0
Total	1000	1000	1000	1000	1000	1000

ratio was maintained at about 0.55. Diet 1 was maize-soyabeans based control. WCRM was fixed at 300g kg-1 in diets 2 to 6 where it served as the major energy ingredient. The major protein source in the diets was FFSB (Diet 2) and combinations of FFSB and / or CLM and / or FM in diets 3 to 6.

Taking the protein supplied by FFSB in Diet 2 100%, FFSB, CLM and FM were combined in other diets to supply the protein in following combinations:

Diet 3 -75 (FFSB): 25(CLM)

Diet 4 - 87.5 (FFSB): 12.5 (CLM)

Diet 5 - 75 (FFSB): 12.5 (CLM): 12.5 (FM)

Diet 6 - 75 (FFSB): 25 (FM)

Ninety, 2 -wk-old Anak broiler chicks were divide into six groups of 15 birds and randomly alloted to the dietary treatments. Each group of 15 birds was further divided into five (5) sub-groups of 3 birds, which represented the treatment replicates. Thus, each dietary treatment was replicated five times. Birds were fed ad libitum and allowed free access to water throughout the 7 weeks trial. Body weight changes, feed and water intake and mortality were recorded weekly forneach replicate.

At the end of the trial, bird slaughtering, blood collection and carcass evaluation were carried out. Three birds on each dietary treatment were slected from each of the six treatments, fasted overnight and blood collected by venipuncture into labelled bottles containing Ethylene Diamine Tetra Acetic Acid (EDTA) according to standard methods (11). Sampled birds were weighed and slaughtered by severing the jugular vein to measure dressing and carcass attributes.

Samples of test materials and diets were analysed according to standard procedure(12) while all data were subjected to analysis of variance using a completely randomized design(13).

RESULTS AND DISCUSSION

The productive performance of experimental birds over the seven-week period is shown in Table 2. The birds were generally healthy with low and non-significant mortality during the experiment.

Average daily feed intake, weight gain, feed conversion ratio (FCR) were significantly. ($P<0.05$) affected by dietary treatment even thought eh diet were formulated to be iso-nitrogenous and iso-energetic with the Energy / Protein (E/P) ration maintained at 0.55. Daily feed intake was higher ($P<0.05$) for birds on cassava-based diets compared with the maize-based control. The higher feed intake on cassava-based diet cannot be attributed to differences in energy or protein when compared with intake on the maize-based control since the experimental diets were iso-energetic and iso-nitrogenous. It has been observed that birds fed low protein or low energy diets increased their feed consumption presumably in an effort to overcome the protein or energy deficiency (14). Recent reports have shown uniformity in feed intake of broiler chickens when diets had similar energy and protein contents(15). It has been explained however that many studies criticized the use of the energy: protein ratio on the basis that they wer unable to demonstrate consistent relationship between the ratio and productive performance (16).

Table 2: Performance of broilers fed diets containing cassava products.

Measurements	Dietary Treatments 1	2	3	4	5	6	SEM
Initial weight (g)	207.67	213.67	214.67	217.67	208.34	218.67	21.3
Final weight (g)	1006.00^{d}	1580.00^{b}	1280.00^{d}	1450.00^{bc}	1610.00^{b}	1850.00^{a}	55.0^{*}
Weight gain (g / bird / day)	17.10^{e}	27.70^{bc}	21.72^{d}	25.08^{c}	28.64^{b}	33.30^{a}	0.99^{*}
Feed intake (g/bird/day)	66.27^{b}	83.53^{a}	80.85^{a}	84.12^{a}	81.76^{a}	82.35^{a}	1.31^{*}
Feed conversion ratio	4.15^{a}	3.26^{bc}	3.72^{ab}	3.37^{bc}	2.88^{cd}	2.48^{d}	0.21^{*}
Water consumption (ml/day).	178.29^{c}	267.39^{ab}	259.35^{ab}	258.24^{b}	261.02^{ab}	276.10^{a}	5.14^{*}
Dry matter faecal output (g / day)	11.25^{c}	14.91^{bc}	19.08^{a}	18.83^{a}	17.75^{ab}	14.33^{bc}	1.21^{*}
Approximate D. M. digestibility(%).	73.54^{a}	68.14^{ab}	54.31^{c}	61.58^{bc}	59.52^{c}	69.00^{ab}	2.55^{*}

*Means in the same row with different superscripts differ significantly ($P<0.05$)

Birds on Diet 6, where dietary protein was supplied by full-fat soyabean and fish meal, recorded the highest average daily weight gain. The inclusion of a high amount of CPM did not affect the performance of birds on this diet.When ranked with respect to weight gain the diets were in the order Diet 6 > Diet 5 > Diet 2 > Diet 4 > Diet 3 > Diet 1.

Birds on the cassava-based diets were also found to be better converters of feed to weight. The feed conversion ratio was inthe order Diet 6 < Diet 5 < Diet 2 < Diet 4 < Diet 3 < Diet 1. The perforamnce of birds on cassava-based diets was at variance with teh observation of (17) who reported that when various levels of cassava was fed to broilers in mash form, poorer growth and feed conversion were obtained than with maize-based diets, presumably because of dustiness and bulkiness which were related to palatablity and thus reduced feed intake. The better performance of birds on WCRM was however in agreement with earlier reports taht cassava is superior to other sources of carbohydrates particularly when fed along with well-bålanced protein sources (18). The report of (5) gave further credence to this finding. It was reported that unpeeled cassava gave a meal with reduced powdery consistency which could be used at up to a level of 30%, as a total replacement for maize in diets for layers without affecting producction and egg quality traits(5). The addition of palm oil to all WCRM-based diets apart from ensuring no deficienciels in essential long chain fatty acids could also have resulted in reduced dustiness and hence improved feed intake and palatability (19).

What consumption was generally high among WCRM based diets and significantly higher ($P<0.05$) than that of birds on the control diet. All cassava-based diets were observed to have slightly higher crude-fibre value. This perhaps explains the reason for the significantly higher water consumption of birds on the WCRM diets. A high positive relationship ($r = 0.99$) existed between feed intake and water consumption. Significant differences ($P<0.05$) were also observed in dry matter faecal output and approximate digestibility. Dry matter faecal output was generally higher for the cassava based diets, however the dry matter faecal outputs were similar on Diets 1, 2 and 6. All dietary treatments with CLM inclusion had higher value with Diet 3 (with highest CLM) having the highest DM faecal output. This depicts that digestibility decreased with an increase in CLM inclusion level. It has been reported that in addition to the cyanide content, cassava forage contains condensed tannins that reduce digestibility possibly due to non-digestible tannin-protein complexes (20). Apparent DM digestibility followed the trend Diet 1>Diet 6>Diet2>Diet 5> Diet 3. An indication that the control diet was more digestible compared with the cassava based diets, particularly those containing CLM. Dietary treatments without CLM had higher approximate digestibility than those with CLM. This may be attributed to the content and nature of fibre in CLM.

There were no significant (P>0.05) differences in the cost per kilogram weight gain of birds on all experimental diets (Table 3). Diets 5 and 6 on per kg. weight

Table 3 : Feed economy of broilers fed diets containing cassava products.

	Dietary Treatments						
Economic Criterion	1	2	3	4	5	6	SEM
Cost / kg. Feed	21.13	22.91	19.42	21.84	26.04	29.44	-
Cost / kg. Weight gain	87.65	74.73	72.32	73.51	74.94	73.13	4.55
Cost of Feeding	68.64^{e}	101.63^{b}	76.91^{d}	90.03^{c}	104.25^{b}	118.74^{a}	3.00*

*Means in the same row followed by different superscripts differ significantly (P<0.05).

basis were very expensive because of the presence of fishmeal in them. Diet 2 and 5 were not different (P>0.05) in terms of cost of feeding during the experimental period. However all other treatments were different (P<0.05) from one another. Although Diet 1 had the least cost of feeding (₦68.64), it nevertheless had the highest cost per kilogram weight gain.

Table 4 shows the effect of dietary treatment on hematological measurement of broilers. Significant differences (P<0.05) were observed in packed cell volume (PCV) and Haemoglobin (Hb) values. There were however no differences in these measurements among the birds on the cassava based diets. Although the PCV and Hb values for birds on cassava based diets fell within the normal range established (21 and 22), for domestic chicken, the values for PCV and Hb for birds on the control diet (Diet 1) were however lower than the normal range. The PCV and Hb values for birds on cassava based diets may be taken as an indication that the diets were not nutritionally similar to the maize based control diet.

Table 4: Haematological measurements of broilers fed diets containing cassava products

	Dietary Treatments						
	1	2	3	4	5	6	SEM
PCV (%)	18.00^{b}	26.00^{a}	26.33^{a}	26.67^{a}	25.67^{a}	25.33^{a}	1.72*
Haemoglobin value (Hb) g / 100 ml.	5.80^{b}	8.57^{a}	8.57^{a}	8.67^{a}	8.33^{a}	8.23^{a}	0.58*

*Means in the same row followed by different superscripts differ significantly (P<0.05).

Carcass characteristics, gut measurements and relative organ weights of experimental birds are shown in Tables 5 and 6 respectively. The results showed

Table 5: Carcass measurements of broilers fed various experimental diets

	Dietary Treatments						
	1	2	3	4	5	6	SEM
Fasted							
Liveweight (g)	950.00^{d}	1570.00^{ab}	1206.67^{cd}	1443.33^{ab}	1650.00	1800.00^{a}	104.39*
Dressed weight	806.87^{d}	1422.33^{ab}	1091.29^{cd}	1289.70^{bc}	1464.23^{ab}	1602.20^{a}	83.15*
Eviscerated weight	619.93d	1123.77^{ab}	846.27^{cd}	993.47^{bc}	1198.87^{ab}	1331.40^{a}	62.56*
Dressing percentage	66.10	72.07	70.10	68.83	72.57	74.03	1.90
Carcass component (% Eviscerated weight).							
Head	6.31^{a}	3.63^{c}	5.37^{ab}	4.49^{bc}	4.63^{bc}	4.15^{c}	0.32*
Neck	7.33	6.93	6.79	7.22	6.72	6.52	0.47
Wings	13.47	12.82	13.92	12.89	12.87	12.76	0.51
Back	19.26	19.24	17.69	15.74	17.51	17.78	1.72
Breast	17.76^{c}	22.68^{ab}	19.98^{bc}	24.22^{a}	22.15^{ab}	22.17^{ab}	1.16*
Thigh	14.48	14.47	13.98	15.58	15.00	16.12	0.71
Drumstick	13.31	13.34	13.96	12.64	14.26	13.27	0.71
Shank	8.09	6.91	8.30	7.22	6.85	7.23	0.67

*Means in the same row bearing different superscripts differ significantly ($P<0.05$).

Table 6: Organ weights of broilers fed diets containing the various cassava products expressed as percentage of eviscerated weights.

	Dietary Treatments						
	1	2	3	4	5	6	SEM
Crop	2.363	1.020	1.553	1.193	1.847	1.183	0.517
Gizzard							
- Full	6.263	4.597	4.947	4.400	4.700	1.130	0.496
- Empty	4.287	3.380	3.403	3.370	3.410	3.123	0.264
Liver	3.900^{a}	2.780^{bc}	3.273^{ab}	2.637^{bc}	2.453^{c}	2.590^{bc}	0.243*
Heart	0.913	1.043	0.740	0.617	0.727	0.720	0.719
Spleen	0.413	0.170	0.160	0.173	0.150	0.147	0.024
Pancreas	0.443a	0.343bc	0.460a	0.380ab	0.317bc	0.273c	0.024*
Small Intestine							
- Full	8.493	5.123	9.047	5.600	6.063	4.740	1.044
- Empty	5.353	3.937	5.087	3.723	3.393	3.130	0.517

*Means in the same row bearing different superscripts differ significantly (P<0.05).

that fasted live-weights, dressed weights and eviscerated weights were significantly (P<0.05) influenced by dietary treatments. Dressing percentage was however not affected (P>0.05). The better live-weight, eviscerated-weight and dressed weight obtained for cassava root meal-based diets compared with the maize-based control obtained for cassava root meal-based diets compared with the maize-based control obtained in this study agrees with earlier findings that cassava root meals being basically an energy supplying foodstuff, compares favourably well with maize when fed along with well-balanced protein sources(18). The fact that 30% level of inclusion of WCRM produced a better performance compared with maize in all indices measured corroborates the findings that live-wieght gain of broiler was satisfactory when fed diets containing 30% cassava tuber meal (23) and confirmed further the reports that at 20% and 30% inclusion levels of cassava root meal a better carcass quality was observed than at 10% inclusion level (24).

Of all the carcass traits measured, significant variations were observed only in the head and breast weights. While the proportion of breast of birds fed the cassava-based diets was generally higher than those of birds on the maize based control, the reverse was the case with respect to head proportion. This observation of lack of significant influence (P> 0.05) of diet on carcass traits except head and breast weight may be taken to indicate that the experimental treatments produced identical influence on carcass.

The relative weight of pancreas and liver were significant influenced by dietary treatment (P<0.05). There was, however, no clear-cut trend in the way dietary treatments affected these organs. The liver was, however, heavier on Diets -1 and 3, which had 25% CLM. This finding was however contrary to the reports of (25), where it was reported that liver weight decreased significantly as the dietary concentration of CLM increased in graded levels from 0-25%. The same trend as observed for the liver was repeated with respect to the pancreas. Hypertrophy in all organs of broilers fed cassava that had high cyanide level has been reported (26). The liver being the major detoxifying organ (27), showed an hypertrophy in birds fed diet 3 which contained more than the recommended level of cassava leaf meal (28).

The pancreas is basically the organ responsible for digestion because it produces the pancreatic juices (29). Hypertrophy was largest in diet 3 probably due to its bulkiness resulting from high level of cassava leaf meal inclusion.

Dietary treatments had no effect (P>0.05) on other gut measurements. This finding is in consonance with earlier reports that varying levels of processed CLM in diets of broiler chicken had no adverse effect on the gut morphology (25).

The overall performance of birds on the various experiemental diets prompted a closer look at the amino-acid profile of experiemental diet. Examination of the amino acid profile of the various experimental diets compared with the standard amino acid profile published NRC (30) showed that all the diets were deficient in terms of methionine plus cystine and with the exception of the control diet, in terms of threonine and arginine (Table 7). This was in spite of the fact that a 0.2% methionine supplementation was employed in all the diets.

Table 7: Amino acid profile of the various experiment diets (% of lysine)

	Diets						
Amino acid	1	2	3	4	5	6	NRC (1994) Standard Profile
Lysine	100	100	100	100	100	100	0.517
Methonine + Cystine	89.65	68.28	65.23	68.49	62.65	68.49	82
Thyreonine	75.35	64.40	68.04	66.38	59.02	62.88	82
Arginine	127.26	108.88	107.25	107.53	93.02	109.92	113
Tryptophan	23.89	21.86	24.35	23.48	20.79	19.83	18
Isoleucine	82.90	74.24	76.89	75.98	66.78	69.73	73
Leucine	169.42	121.87	129.48	126.89	111.94	116.66	109
Valine	97.65	82.08	87.29	85.55	75.62	80.12	82
Histidine	55.09	44.05	42.87	43.32	37.19	42.50	32
Phenylalanine + Tryosine	171.17	131.10	140.51	136.85	119.46	121.23	122

The relatively poor performance of birds on the control maize diet compared with the cassava root diets which was also supported by the haematological results could be due to the fact that over 20% of those amino acids were supplied by the maize component of the diet. It has been reported that the protein in maize is mainly as prolamin (zein) and assuch its amino acids profile is not ideal for poulty (31). The greater percentage of the protein in the cassava-soyabean diet was from soyabean meal crude protein which probably provided a better balance of amino acids than that of the maize-based diet. The poor balance coupled with reduced availability of amino acids in the diet could have been contributory to the relatively poor performance of birds on the control maize-based diets.

CONCLUSIONS AND APPLICATIONS

The data from this study have demonstrated relatively better performance of birds fed cassava-soyabean diets compared with the maize-based control. Poor balance and reduced availability of amino acids in the latter diet could have been responsible. The result also indicated improvement in the performance of birds when soyabean-cassava product rations were fortified with fish meal. It could be that fish meal supplementation provided a deficient factor or aided in removing an inhibiting factor in the diets. Clarification of this situation which would enable proper utilisation of cassava products in an integrated fashion will be subject of future research.

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