Performance of broiler chickens fed diets containing cassava leaf: blood meal mix as replacement for soybean meal

Rendimiento de pollos de engorde alimentados con dietas conteniendo una mezcla de hojas de yuca:harina de sangre como reemplazo de harina de soya

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ABSTRACT

The trial reported herein investigated the performance of broiler chicken on diet containing cassava leaf meal (CLM)/blood meals (BM) mix in replacement for soybean meal (SBM). One hundred and fifty, two weeks–old broilers were randomly allotted to five experimental diets such that each dietary treatment was replicated six times with five birds per replicate. The experimental diets were formulated such that the diets contained 0, 25, 50, 75 and 100% CLM/BM mix as replacement for SBM respectively. The diets were fed over a 6-week period. Birds fed 100% CLM/BM replacement for SBM had the highest ($P<0.05$) feed intake, lower weight gain and poorer feed conversion ratio than the control. Weight gain and FCR were significantly higher in birds fed 50% CLM/BM in replacement for SBM than the other CLM/BM based groups. The values for the dressed weight, thigh muscle and drumstick were higher ($P<0.05$) in birds fed 50% CLM/BM diets than in the other dietary groups. The breast weight and abdominal fat were not affected by the diets. The weights of the liver, kidney, heart and spleen were not affected by the treatments whereas those of the crop, gizzard, proventriculus and caecum increased ($P<0.05$) with increasing dietary inclusion of CLM/BM in the diet. In conclusion, it can be inferred based on the general observations recorded in this study that broiler diets containing cassava leaf meal: blood meal mixture in replacement for soybean meal promote comparable daily feed intake and feed to gain ratio as their soybean based control diet and had no deleterious effect on performance. The results obtained in this trial showed that birds on diet 3 (with dietary level of inclusion 50% SBM: 50%CLM: BM) elicited the best response in terms of weight gain, feed intake and feed: gain ratio. It is concluded that not more than 50% of dietary CLM/BM should be used as a replacement for soybean.

Key words: Performance, broiler chicken, cassava leaf: blood meal mix.

RESUMEN

El ensayo investigó el desempeño de pollos de engorde con una dieta que contiene una mezcla de harina de hojas de yuca (HHY)/harina de sangre (HS) en reemplazo de harina de soya (HSY). Ciento cincuenta y dos pollos broiler de dos semanas de edad, se asignaron al azar a cinco dietas experimentales de tal manera que cada tratamiento dietético se repitió seis veces con cinco aves por repetición. Las dietas experimentales se formularon de tal manera que las mismas contenían 0, 25, 50, 75 y 100% de una mezcla HHY/HS en sustitución de la HSY, respectivamente. Las dietas se suministraron durante un período de 6 semanas. Las aves alimentadas con 100% HHY/HS en reemplazo de HSY tuvieron el mayor ($P<0,05$) consumo de alimento, menor ganancia de peso y la más pobre relación de conversión alimenticia que el control. La ganancia de peso y FCR fueron significativamente mayores en aves alimentadas con 50% HHY/HS en reemplazo de HSY que los otros grupos basados en las mezclas HHY/HS. Los valores para peso al canal, músculos del muslo y muslo de pollo fueron mayores ($P<0,05$) en las aves alimentadas con 50% de las dietas HHY/HS que en los otros grupos dietarios. El peso de la pechuga y de la grasa abdominal no fueron afectados por las dietas. El peso del hígado, riñón, corazón y bazo no fueron afectados por los tratamientos, mientras aquellos del buche, molleja, proventrículo y intestino ciego se incrementaron ($P<0,05$) con incrementos en la inclusión dietaria de HHY/HS en la dieta. En conclusión, se puede inferir sobre la base de las observaciones generales registradas en este estudio que las dietas de los pollos de engorde que contienen una mezcla de harina de hojas de yuca:harina de sangre en reemplazo de la harina de soya promueve un consumo de alimento diario y una relación consumo:ganancia comparable a la dieta control basada en soya y no tuvo efecto deletéreo sobre el rendimiento.

Los resultados obtenidos en este ensayo mostraron que las aves en la dieta 3 (con el nivel dietario de inclusión del 50% HSY:50% HHY:HS) obtuvo la mejor respuesta en términos de ganancia de peso, consumo de alimento y relación consumo:ganancia. Se concluye que no más del 50% HHY/HS en la dieta debe ser utilizado como un reemplazo para la soya.

Palabras clave: Rendimiento, pollo broiler, mezcla hojas de yuca:harina de sangre.

INTRODUCTION

Poultry, through the provision of meat and egg continue to serve as an excellent and cheap source of animal protein for Nigerians. The full potential of poultry products as as a panacea to insufficient animal protein intake of Nigerian has not been achieved principally because of inadequate feeds. Feed cost remains the major factor limiting the development and expansion of poultry farming. The bulk of the feed cost arises from protein concentrates such as fishmeal, soybean meal and groundnut cake. Prices of these conventional protein sources have soared so high in recent times that it is no konger economical to use them in poultry feeds (Esonu *et al*., 2001).

This perennial problem has necessitated the search for alternatives to the expensive grains and protein concentrates (Adeyemi, 2005). Animal Nutritionists have therefore come to the conclusion that replacement of expensive conventional feed ingredients with cheap and available substitutes represents a suitable strategy at reducing feed cost and encouraging production. Many research efforts were invested in the search for alternatives to soybean in poultry diets. These efforts involve the use of oilseed meals such as Castor oil seed (Ani and Okorie,2009), Mucuna (Iyayi and Taiwo,2003; Tuluen and Patrick,2008),*Alchonia cordifolia* seed meal (Udedibie and Opara,1998; Emenalon et al.,2011), rubber seed meal (Ijaiya et al.,2011). The results of some of these efforts are conflicting and variable. Most of the studies conducted on lesser known oilseed meals indicated the need for further processing as most of them are bedeviled by the presence of antinutritional factors. Another major problem observed in the search for alternatives to soybean meal is the fact that the alternatives are most often seasonal in production and the quantity available is often too small for large scale utilization. As a result it stands to reason that a viable alternative to soybean should not only be rich in nutrients, relatively free from anti-feedants but must be readily available in large quantities. One possible source of cheap protein is leaf meal from some tropical legume and plants. Leaf meal have been reported to provide protein and also some vitamins, minerals and oxycarotenoids, which cause yellow color of broiler skin, shank and egg yolk (D'Mello *et al*., 1987).

Cassava is traditionally grown for the production of roots. It yields about 10 – 30 t ha^{-1} of leaves that is usually wasted or used as manure (Bokanga, 1994). However, the leaves have become increasingly important as a source of protein for monogastric and ruminant animals (Preston 2001; Wanapat 2002). Cassava leaves are rich in protein but they are low in sulfur amino acids (Gomez *et al* 1985; Phuc *et al* 2000). The leaf protein is reported to be limiting in methionine and tryptophan but rich in lysine, with overall biological value of 49-57% (Frochlich *et al* 2001). By the addition of blood meal, the biological value of the protein could be increased. Blood meal is an animal protein source that is readily available in abattoirs at little or no cost. It contains high levels of protein and lysine. However, it is not popular in chicken diets because of its amino acids imbalance, low availability of its calcium, phosphorus as well as poor palatability (Odukwe and Njoku, 1987).

The combination of blood meal (BM) and cassava leaf meal (CLM) is expected to give a good protein concentrates with a good balance of amino acids. This study is therefore designed to determine the performance of broiler chicks fed diets containing CLM/BM mix as partial or total replacement for soybean meal.

MATERIALS AND METHODS

Study area

The experiment was carried out at College of Agricultural Sciences, Olabisi Onabanjo University, Yewa *Campus*, Ayetoro, Ogun State, Nigeria.

Test materials and experimental diets

Cassava leaves without the petioles were harvested, wilted overnight and air-dried under shade

for five days, milled using hammer mill and bagged as CLM. Blood was collected from the Central Abattoir in Ayetoro immediately after cattle were slaughtered. After collection, the blood devoid of extraneous materials was boiled immediately in a cask for 60 minutes in order to let water evaporate and destroy any parasites. After boiling it was then sundried on a concrete platform with screened mesh for 5days, and then ground into flour using an attrition mill.

Samples of the prepared CLM and BM were analysed for proximate composition using the standard methods of A.O.A.C (1990) (Table 1). Cassava leaf meal (CLM) and blood meal (BM) were mixed together in such a manner that the protein value of the mix equaled that of soybean meal (44%) using the Pearson square method. The resulting mix is in the ratio 1.5 parts CLM: 1 part BM. Five experimental diets were formulated (Table 2). The diets are:

Diet	SBM (%)	CLM-BM mix (%)
1 (Control)	100	0
2	75	25
3	50	50
4	25	75
5	0	100

SBM; soybean meal, CLM: cassava leaf meal and BM: blood meal

Management of birds and data collection

Two hundred (200) unsexed Anak strains of broiler birds were obtained at day old from S & D Farms, Abeokuta were used for this investigation. The birds were floor brooded for two (2) weeks with proprietary broiler mash.

One hundred and fifty (150) broilers chicks were randomly selected and divided into five groups of 30 birds each. Each group was further subdivided into 6 replicates of 5 birds each. The replicates were randomly assigned to each of the five diets. The experimental diets were fed in the mash form. The feeding trial started when the birds were two weeks old. They were housed in open sided deep litter pens. A week before the birds were moved into the experimental pen, the pen was thoroughly cleaned, washed and disinfected with a strong solution of IZAL®.

Table 1. Proximate composition of CLM, BM and CL:BM mix.

Proximate fractions	CLM	BM	CLM:BM mix
Dry Matter	91.25	88.10	90.53
Crude Protein	22.15	78.00	42.81
Crude Fibre	12.00	1.67	10.12
Ether extract	3.61	0.61	2.64
Ash	14.55	3.88	11.28

Proximate fractions are on a Dry Matter (DM) basis (%)
CLM: cassava leaf meal and BM: blood meal

Table 2. Composition of experimental diet to feed Anak broiler chickens in Ayetoro, Ogun State, Nigeria .

	Dietary Treatments				
	100% SBM: 0% CLM-BM mix	75% SBM: 25% CLM-BM mix	50% SBM: 50% CLM-BM mix	25% SBM: 75% CLM-BM mix	0% SBM: 100% CLM-BM mix
Fixed Ingredients*	60.00	60.00	60.00	60.00	60.00
Soybean meal	40.00	30.00	20.00	10.00	0.00
CLM:BM	0.00	10.00	20.00	30.00	40.00
Total	100.00	100.00	100.00	100.00	100.00
Determined Analysis					
Crude protein	23.39	23.39	23.39	23.39	23.39
Crude fibre	3.89	4.34	4.91	5.39	5.90
Gross energy Mj/kg	12.00	11.90	11.80	11.69	11.60

SBM; soybean meal, CLM: cassava leaf meal and BM: blood meal

* Maize; 52.00; Wheat/offal: 4.80; Palm Oil: 0.52; Bone meal: 1.00; Oyster shell: 0.70; Vit/Min/Prem**: 0.2; Lysine: 0.30; Methionine: 0.20, Salt: 0.25.

** Provide the following per kg of diet: vit A, 10,000iu, vit. D_3 2000iu;vit E, 5iu; vit K, 2 mg; Riboflavin, 4.20mg; vitB_{12} 0.01 mg; panthotenic acid; 5mg; nicotinic acid, 20mg; folic acid 0.5 mg; choline, 3 mg; Mg, 56 mg; Fe, 20mg; Cu 10mg; Zn, 50mg, Co: 25mg; iodine 0.8mg.

Drinkers were washed daily and fresh feed and water were served daily *ad libitum* for a period of six weeks. The litter was changed fortnightly and the vaccination and medication schedule were strictly adhered to. Records of performance (feed intake and weight gain,) and economic of production (feed: gain ratio) was calculated.

Carcass quality evaluation

At the end of the feeding trial, two birds whose weights were close to the mean replicate weight were selected from each replicate, fasted overnight, weighed, slaughtered, plucked and eviscerated. The weight of carcass abdominal fat, thigh, drumstick, neck, breast, head, shank, gizzard, heart, spleen, and liver were taken and expressed as percent live weight respectively.

Statistical analysis

The data collected were subjected to a one way analysis of variance as appropriate for a completely randomized design according to Steel and Torrie (1980). Significant mean were separated by using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS AND DISCUSSION

Proximate composition of test ingredient and component shows that CLM contained (91.25%DM, 22.15%CP, 12.0%CF, 3.6% EE and 14.55%Ash on a Dry Matter basis), BM contained (88.10%DM, 78.00%CP, 1.67%CF, 0.61% EE and 3.88%Ash on a Dry Matter basis) while CLM:BM mix contained (90.53%DM, 42.81%CP, 10.12%CF, 2.64% EE and 11.28% Ash on a Dry Matter basis)

The performance of broilers fed cassava leaf meal:blood meal mix as replacement for soybean meal is presented in Table 3. Birds on 50% SBM:50%CLM/BM had the highest weight gain ($P<0.05$) when compared with the other treatment groups while those fed 0% SBM:100% CLM/BM diets had the lowest weight gain. Feed intake increased with increasing inclusion levels of the CLM/BM mix at the expense of SBM in the diets. Birds on diet in which SBM was totally replaced with CLM:BM mix had the highest ($P<0.05$) feed intake and the poorest ($P<0.05$) feed conversion ratio, while those fed on diets containing 50% SBM and 50% CLM:BM mix had the best feed conversion ratio value .

Feed intake was affected by dietary treatments ($P < 0.05$). Average feed intake by birds on control diet (100%SBM:0% CLM:BM mix) and Diet 2 (75% SBM: 25% CLM-BM mix) were slightly similar and significantly ($P<0.05$) lower when compared with feed intake of birds on diets Diet 3 (50% SBM: 50% CLM-BM mix), Diet 4 (25% SBM: 75% CLM-BM mix) and Diet 5 (0% SBM: 100% CLM-BM mix). The trend of feed intake may be associated with increasing bulkiness of the feed, bulky feeds are higher in fibre and rather low in nutrient concentration per unit volume and thus birds eat more to satisfy their needs. This result is contrary to the observations of Omekan (1994) that possible drop in feed intake could be that the leaf meal imparted an unpalatable taste to the feed, which consequently inhibited the birds from consuming adequate quantities.

Table 3. Effect of different dietary levels of CLM:BM mix on the performance of Anak broiler finisher in Ayetoro, Ogun State, Nigeria.

	Dietary Treatments					
Traits	100% SBM: 0% CLM-BM mix	75% SBM: 25% CLM-BM mix	50% SBM: 50% CLM-BM mix	25% SBM: 75% CLM-BM mix	0% SBM: 100% CLM-BM mix	SEM
Initial weight	210.50	210.00	210.00	211.00	210.50	0.21
Final weight	1860.00^{b}	1900.00^{b}	2050.00^{a}	1900 .00^{b}	1740.00^{c}	23.20 *
Weight gain	1649.05^{b}	1690.00^{b}	1840.00^{a}	1689.00^{b}	1529.00^{c}	15.44 *
Average weight gain (g/bird/day)	39.28^{b}	40.25^{b}	43.81^{a}	40.21^{b}	36.42^{c}	0.56 *
Average feed intake (g/bird/day)	85.67^{c}	87.89^{c}	94.45^{b}	97.11^{ab}	99.2^{a}	0.89 *
Feed:gain ratio	2.18^{c}	2.22^{c}	2.16^{c}	2.42 ^{b}	2.72^{a}	0.07 *

CLM: cassava leaf meal; BM: blood meal and SBM; soybean meal

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

The final weight and average weight gain for the birds on diet 3 were significantly ($P < 0.05$) better than the results obtained from birds on the others dietary treatments. The inclusion of cassava leaf: blood meal mix above 30% of total diet or 75% replacement of SBM had a negative effect on growth and the performance of the birds. Therefore, the inclusion of CLM: BM mix between 0 - 75 % does not affect feed intake, but attempt to increase it above 75% will affect weight gain, feed intake and feed: gain ratio. The high final live weight and average weight gain by birds fed the diet 3 suggests that this diet promoted better growth than the control and the other CLM:BM mix based diets. Previous studies have shown the adverse effect of amino acid imbalance in the leaf meal based diets compared soybean meal based control diet.The argument had always been that SBM has a better amino acid profile than leaf meals (Agbede and Aletor, 2003). The mixing of blood meal to the leaf meal in this study however appeared to have improved the nutritional value of the cassava leaf meal. Aletor *et al.* (2000) reported that diets with balanced amino acids are palatable and consumed in large amounts with attendant improvement in the performance of broilers

Feed:gain ratio was significantly ($P < 0.05$) affected by dietary treatments, however feed:gain ratio was similar for on birds on diet 1, 2 and 3. Birds on diet 3 in which 50% of the SBM was replaced by CLM:BM mix had the best conversion of feed to flesh, birds on diet 3 used 2.16kg of feed to attain 1kg of body weight compared to those on Diet 4 and 5 requiring over 2.4 and 2.7kg of feed. Another remarkable observation in this study is the fact that when fed in conjunction with maize, 50% of the protein supplied by soybean meal could be replaced with proteins from cassava leaf meal: blood meal mix without deleterious effect on the efficiency of conversion of feed to meat by broilers.The efficiency of birds in converting feed into weight diminished significantly only at 75 and 100% replacement of soybean meal. Blood meal is generally not used in high concentration in poultry diets due to its amino acid imbalance. Constraints could be at 3-6% of the broilers diet, since higher levels were considered to be unpalatable or causes depressed performance (Kartzer and Green, 1957). Donkoh *et al*., (1999) however, reported that dietary sun dried blood meal up to 7.5% of total diet had a positive effect on growth performance of broiler chickens. On the other hand, (Khawaja *et al*., 2007) reported that oven dried blood meal up to 3% of the broiler starter diet did not adversely affect production parameters through the finishing stage of growth. At the rate of 1.5parts of CLM to 1 part of BM to get the CLM-BM mix in this study it will thus appear that replacement of SBM above 50% as in Diet 3 will mean inclusion of blood meal above recommended level. These could be the reason for the depressed performance observed on Diets 4 and 5.

Agunbiade *et al*. (2004) reported that 50% of the protein supplied by soybean meal could be replaced with proteins from shrimp waste and cassava leaf meal without any deleterious effect on efficiency of conversion of broiler feed to meat.

The result of the carcass analysis of broilers fed diets containing cassava leaf meal:blood meals mix in replacement for soybean meal is shown in Table 4.

Table 4. Effect of Different Dietary Levels of CLM: BM mix on the carcass measurements of broiler chicken in Ayetoro, Ogun State, Nigeria .

	Dietary Treatments					
Traits	100% SBM: 0% CLM-BM mix	75% SBM: 25% CLM-BM mix	50% SBM: 50% CLM-BM mix	25% SBM: 75% CLM-BM mix	0% SBM: 100% CLM-BM mix	SEM
Final weight	1860.0^{b}	1900.0^{b}	2050 .0 ^{a}	1900 .0^{b}	1740.0^{c}	16.98 *
Fasted live weight	1755^{c}	1800^{b}	1948.5^{a}	1798^{c}	1650^{d}	15.45 *
Dressed weight	1316.85^{c}	1404.0^{b}	1558.8^{a}	1330.52^{c}	1155.^{d}	0.25 *
Thigh (%DW)	12.04^{c}	12.10^{c}	14.23^{a}	13.86^{b}	12.12^{c}	0.60
Breast (%DW)	23.67	23.89	24.05	23.9	23.9	0.17 *
Drumstick (%DW)	11.88^{bc}	12.04^{b}	12.99^{a}	12.87^{a}	11.21^{c}	0.07 *
Abdominal fat (%DW)	2.16^{a}	1.50^{b}	1.23^{c}	1.20^{c}	0.81^{d}	0.10

CLM: cassava leaf meal; BM: blood meal; SBM; soybean meal and DW: Dressed weight
Means within the same row bearing different superscripts are significantly different * ($p < 0.05$).

The result of the carcass analysis showed that dressed weight, thigh and drumstick weight were significantly (P<0.05) influenced by dietary treatment. Breast weight was however not affected (P>0.05). The breast meat, drumstick and thigh are the most expensive commercial cuts of the chicken (Adeyemi *et al*. 2008). According to Agunbiade (2002), thigh, drumstick and breast cut are prime cuts of chicken, which gives a picture of the carcass meatiness and eventually revenue yield.

Dressed weight was highest in bird on diet 3 and slightly similar to those of birds on the control diet and diet 4. The least dressed weight was obtained from birds on diet 5 which consist of 100% CLM: BM mix. Dressed weight is more important to poultry meat consumers than the live weight because feathers add more to liveweight. The dressed weights represents the absolute value of saleable meat. WB (1983) observed that dressing percentage in the range of 80-84% is the relative value of dressed saleable broiler carcass for maximum profit.

The decrease in abdominal fat decrease as the proportion of soybean reduced in the diet with increasing concentration of CLM-BM mix is in agreement with the report of Abdelsamie *et al.*, (1983) that abdominal fat reduces with increase in fibre content of the diet as observed with increasing replacement of SBM with CLM-BM mix . Jensen *et al.*,(1974) explained explained that fibre had a lowering effect on liver lipid metabolism in chickens.

Dietary treatment did not show any significant (P<0.05) effect on internal organs like liver, kidney, heart and spleen (Table 5). However, as the level of inclusion increases across the treatment there are significant (P<0.05) increases in the weights of crop, gizzard, proventriculus and caecum. These differences in weight seems to correspond with feed consumption. The increasing bulkiness of feed with increasing concentration of CLM:BM mix tends to enlarge gut capacity to enable birds cope with the higher amount of feed intake. Similar trends of increase in the size, lenght and weights of digestive organs with increasing dietary fibre in poultry diets were reported by Hetland *et al*.(2003). Onibi *et al.*,(1999) reported that since the gizzard is responsible for breaking down ingested feed by muscular action, higher dietary fibre would promote higher thickening of the muscles of the gizzard.

CONCLUSION AND RECOMMENDATION

The analyzed data for this study have revealed that cassava leaf and blood meal can replace soybean meal when used up to 50% replacement without any deleterious effect on performance.

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Table 5. Effect of Different Dietary Levels of CLM: BM mix on Organ Weights (% of Live weight) of Anak broiler finisher in Ayetoro, Ogun State, Nigeria .

	Dietary Treatments					
Traits	100% SBM: 0% CLM-BM mix	75% SBM: 25% CLM-BM mix	50% SBM: 50% CLM-BM mix	25% SBM: 75% CLM-BM mix	0% SBM: 100% CLM-BM mix	SEM
Liver	2.08	2.06	2.07	2.06	2.07	0.12
Kidney	0.52	0.51	0.51	0.53	0.52	0.016
Heart	0.49	0.49	0.50	0.49	0.48	0.01
Crop	0.42^{c}	0.46^{b}	0.47^{ab}	0.5^{a}	0.51^{a}	0.012*
Spleen	0.12	0.13	0.12	0.11	0.13	0.07
Gizzard	2.05^{c}	2.18^{b}	2.31^{a}	2.34^{a}	2.40^{a}	0.03*
Proventriculus	0.30^{d}	0.35^{c}	0.41^{b}	0.43^{b}	0.48^{a}	0.006*
Caecum	0.29^{d}	0.31^{cd}	0.35^{c}	0.34^{b}	0.36^{a}	0.007*

CLM: cassava leaf meal; BM: blood meal; SBM; soybean meal and DW: Dressed weight
Means within the same row bearing different superscripts are significantly different * (p < 0.05).

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