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Blend of Bovine Blood and Rumen Digesta as a Replacement for Fishmeal and Groundnut Cake in Layer Diets

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Abstract: The mixture of bovine blood and rumen digesta (BBRDM) was evaluated as a replacement for groundnut cake (GNC) and fishmeal (FM) in the diets of layer chickens. Five diets were formulated in which diet 1 served as the control diet (CD) without BBRDM. Diets 2 and 3 contained 5 and 10 % BBRDM replacing 28 and 56% respectively of the GNC in the CD. Diets 4 and 5 contained BBRDM at 5 and 10% replacing 50 and 100% of the FM also in the CD. Each diet was offered to 18 layers (36 weeks old) divided into three equal replicates for a period of 8 weeks. On analysis, BBRDM contained 46.1% crude protein, 2.13% ether extract, 6.38% crude fibre, 23.4% ash and 16.02% nitrogen free extractive. Results indicated significantly lower ($p < 0.05$) feed intake, hen-day egg production, egg weight and shell thickness in birds fed BBRDM based diets with a worsened feed/egg ratio compared to the CD. Haugh unit and yolk index were however, enhanced ($p < 0.05$) with the use of BBRDM. Feed cost per kg egg was reduced in diets in which BBRDM replaces FM while this parameter increased for GNC. Net returns were raised by 4 and 10% in FM diets whereas negative returns were recorded for GNC. The profit-maximizing objective of table egg production is achievable by BBRDM utilization in layer feed as a replacement for FM and not for GNC. Results suggested that in the form fed, BBRDM should be cautiously used and that layers fed diets in which FM was replaced gave a better performance compared to those involving GNC.

Key words: Bovine blood, rumen digesta, feedstuff, layers, nutrition

Introduction

Various studies have reported on the substitution of the more expensive protein concentrates particularly fish meal in poultry diets with cheaper and less competitively demanded feeding resources (Fanimo *et al.*, 1998; Udedibie *et al.*, 1988; Dafwang *et al.*, 1986). The primary aim was to reduce feed cost and consequently cost of producing a unit of the product like egg or meat. In the same vein, recycling of slaughterhouse wastes, as feed for various categories of livestock has been a continuous subject of investigation (Kingori *et al.*, 1998; Haapapuro *et al.*, 1997; Swan, 1992). Furthermore, the need to maximize the economic and environmentally benign disposal of slaughterhouse by-products (NAVN, 1994) also stimulated a renewed interest in the investigation of these by products for possible use as protein feedstuffs. In the present study, blood and rumen digesta collected from bovine animals are exploited for use in layer diets. Although, both had been individually investigated as sources of dietary ingredients (Dongmo *et al.*, 2000; Donkoh *et al.*, 1999; Emmanuel, 1978), fewer reports are available when they are fed as a processed mixture for the production of table eggs.
This study is thus, aimed at evaluating the nutritional potential of blood and rumen digesta when processed and mixed at equal proportions. It will also assess its comparative effectiveness when used to substitute groundnut cake and fishmeal as sources of dietary vegetable protein and animal protein respectively.

Materials and Methods

The study was carried out at the Ladoke Akintola University of Technology Research Farm, Ogbomoso, in the southwestern hinterland of Nigeria. The bovine blood and rumen digesta used were collected from the abattoir of a major cattle market in Ogbomoso. Fresh blood drained of the plasma fraction was collected into a clean container while rumen digesta was obtained from freshly eviscerated cattle. Bovine blood and rumen digesta were weighed in a ratio of 1:1 into a drum. The drum containing the blood-rumen digesta mixture was placed on burning firewood and boiled for 90 minutes and was constantly stirred as it boiled until the mixture was almost free of steam. The boiled BBRDM was preserved by sun-drying for two to three days on a clean drying slab to a moisture content below 15%, milled, bagged and stored in a cool dry place. Groundnut cake (GNC) and fish meals (FM) were procured from a feed ingredient supply firm. Samples of BBRDM, GNC and FM were analyzed for proximate composition (Table 1).
GNC having a protein content of 40.4% DM basis was included in a control diet 1 (CD) at 18% and BBRDM with a protein content of 46.1% DM was incorporated at 5 and 10% to replace 28 (diet 2) and 56% (diet 3) respectively of the protein of the groundnut cake (major plant protein source). FM with a protein content of

68.6%DM basis was included in the CD at 6% and BBRDM included at 5.0 and 10% to replace 50 (diet 4) and 100% (diet 5) protein respectively of the FM (major animal protein source) in the CD (Table 2). Each diet was fed to three replicates of Isa Brown layers (36 weeks old) with six birds per replicate for 8 weeks. The six layers of each replicate were placed in three contiguous cages with two layers per cage and were provided with a common feeder. Prior to the experiment, all the birds were reared under a similar management and feeding regime.

During the trial, daily egg production, weekly feed intake, feed/egg ratio and body weights of birds for each replicate were recorded. Egg weight, shell thickness, yolk index (height/average diameter) and Haugh unit scores were determined using three eggs/day/replicate on the last three days of each fortnight. Feed consumption per replicate was used to multiply cost per kg of feed to obtain the cost of feeding a bird for the period. The feed cost per kilogram of egg was calculated by dividing the cost of feeding by weight of eggs laid. The cost differential and relative cost benefit of the diet in relation to the control diet were calculated as follows: Cost differential (X) = Cost per kg egg of control diet less cost per kg egg of test diets, whereas relative cost benefit describes the percentage gain or loss realized by feeding BBRDM at two levels in relation to GNC and FM.

Proximate composition of diets and test ingredients (BBRDM, GNC and FM) was determined using analytical methods of AOAC (1990). Data obtained were analyzed for variance and tested for significance among the treatments using the Duncan multiple range test (Steel and Torrie, 1980).

Results and Discussion

The proximate composition of BBRDM, GNC and FM (Table 1) showed that BBRDM contained 5.69%CP, 1.33%CF and 17.9% ash more, but 5.48%EE and 15.47%NFE less than GNC. Compared to FM, BBRDM had 5.28%CF, 12.1% ash and 6.95% NFE more but 22.4% CP and 0.69% EE less. This indicated that the protein content of BBRDM is lower than that of FM but higher than that of GNC. The proximate composition of BBRDM depends on the proportion of the constituent mixtures and could be influenced by the stage of digesta degradation in the rumen.

Results of the experiment are summarized in Table 3. Generally, the performance data (Table 3) obtained from layers fed on the CD was superior ($p < 0.05$) to all BBRDM based diets. The use of BBRDM as a replacement for either GNC or FM resulted in a significantly linear depression in feed consumption and rate of egg production. The decrease in consumption observed for layers fed BBRDM was in the magnitude of 5.2, 6.1, 2.4 and 8.8% for diets 2, 3, 4 and 5 respectively whereas the reductions observed for hen-day egg

Table 1: Proximate composition of bovine blood rumen digesta mixture, groundnut cake and fish meal (% DM basis)

Parameters	BBRDM	GNC	FM
Dry matter	94.0	90.54	92.76
Crude protein	46.1	40.41	68.50
Ether extract	2.13	7.61	2.82
Crude fibre	6.38	5.05	1.10
Ash	23.4	5.51	11.3
Nitrogen free extracts	16.0	31.96	9.04

BBRDM- Bovine Blood Rumen Digesta Mixture; GNC - Groundnut Cake; FM - Fish Meal

production are 13.5, 31, 8 and 18% in diets 2, 3, 4 and 5 respectively relative to the CD. Kingori *et al.* (1998) observed that when cooked blood was sun dried, it resulted in chocolate brown lumps with an unpleasant smell. Also, the inclusion of blood meal and / or rumen content was reported (Donkoh *et al.*, 1999; Abubakar and Yusuph, 1991) to impart obnoxious odor to the final diet and make it less palatable to birds causing a depression in consumption and subsequently poor performance (Dongmo *et al.*, 2000; Emmanuel, 1978). Findings in this trial further paralleled the observations of Adeniji (1995) who recorded a stepwise decrease in egg production for pullets fed diets containing high levels of a mixture of blood and rumen content. In this trial, the diets became darker in colour and the odor more accentuated with an increase in BBRDM. The combination of these two factors will negatively influence palatability resulting in low consumption. Concurrently, the intake of major nutrients like protein and energy would be adversely affected, hence the poor laying performance recorded. Layers on diets 2 and 3 performed poorly than those fed diets 4 and 5 possibly as a result of nutrient imbalance. BBRDM could be considered to be an animal protein on account of its blood meal and microbial digested ruminal contents. Hence, the addition of BBRDM to a diet where FM was made constant would lead to a situation of negative nutrient-nutrient interactions. It is possible then that this interferes with nutrient utilization (Boorman and Ellis, 1996). This underscores the need for a vegetable protein source in layer diets. BBRDM could replace part of what was lost through the removal of FM whereas it appears this was not so in the GNC based diets.

Egg quality analysis showed a significant decrease ($p < 0.05$) in egg weight and shell thickness but higher ($p < 0.05$) Haugh unit and yolk index with increase in BBRDM. The reduction in shell thickness for BBRDM fed layers is an indication of poor availability of calcium for shell formation. The synthesis of internal components was not affected by dietary treatments in spite of the reduced feed intake on BBRDM diets; hence their higher Haugh unit and yolk index.

Economic analysis of production of table eggs on the diets showed that cost of feed consumed per kg egg laid during

Table 2: Composition and determined analysis of diets containing BBRDM as a replacement for groundnut cake and fish meal

	CD	28%GNC	56%GNC	50%FM	100%FM
Maize	43.25	43.84	44.36	41.25	39.25
Groundnut cake	18.0	12.41	6.89	18.0	18.0
Fish meal	6.0	6.0	6.0	3.0	0.0
BBRDM	-	5.0	10.0	5.0	10.0
Fixed ingredients	32.75	32.75	32.75	32.75	32.75
Chemical analysis (%DM)					
Crude protein	18.5	18.4	18.1	18.1	18.4
Ether extract	3.1	2.8	3.5	2.9	3.3
Crude fibre	4.28	4.0	4.2	4.21	4.38
Ash	3.69	4.56	5.24	4.14	5.21
M.E (MJ/Kg)	10.45	10.52	10.58	10.37	10.29

Fixed ingredients supplied: 20% wheat offal; 9% oyster shell; 3% bone meal; 0.25% methionine; 0.25%salt and 0.25%premix supplying per kg diet: Mg, 300mg; Mn, 80mg; Fe, 80mg; Zn, 50mg; Cu, 3.5mg; I, 0.4mg; retinal acetate, 2.1mg; cholecalciferol, 0.015mg; dl-a-tocopherol acetate, 2.27mg; menaphthone, 1.3mg; riboflavin, 4mg; niacin, 25mg; pantothenic acid, 10mg; biotin, 50ug; cyanocobalamin, 10ug.

Table 3: Performance and egg quality data of layers fed BBRDM as a replacement for groundnut cake and fish meal

	BBRDM replacing					
Parameters	CD	28%GNC	56%GNC	50%FM	100%FM	SEM
Feed intake(g/d)	116.0^{a}	110.5^{c}	108.9^{c}	113.2^{b}	105.8^{d}	1.86
Hen day production (%)	80.5^{a}	69.6^{c}	55.9^{d}	74.1^{b}	66.1^{c}	4.46
Weight gain (g/d)	12.5	13.2	2.0	9.5	5.4	2.06
Feed:egg ratio	2.42^{a}	2.87^{c}	3.52^{d}	2.66^{b}	2.91^{c}	0.20
Egg weight (g)	59.6^{a}	55.8^{c}	55.6^{c}	57.6^{b}	55.2^{c}	1.07
Haugh unit (%)	71.5^{a}	71.1^{a}	80.7^{b}	79.6^{b}	79.6^{b}	2.38
Yolk index	0.33^{a}	0.36^{b}	0.37^{b}	0.35^{b}	0.41^{c}	0.01
Shell thickness (mm)	34.6^{a}	33.3^{b}	32.3^{b}	31.7^{c}	31.0^{c}	0.63
Diet cost(N/kg)	26.0	25.3	24.5	22.8	19.6	-
Feed cost/kg egg (N)	63.0^{a}	72.6^{b}	86.4^{b}	60.5^{a}	56.8^{b}	3.51
Cost differential (N)	-	-9.6	-23.4	2.5	6.2	-
Relative cost benefit/kg egg(%)	-	-15.2	-37.1	4.0	9.8	-

SEM: Standard Error of Mean, ^{a,b,c}: Means with different superscripts on the same row are significantly different ($p < 0.05$), N = Naira

the 8th week period were N63, N72.6, N86.4, N60.5 and N56.8 for diets 1, 2, 3, 4 and 5 respectively. The cost differential per kg egg and relative cost benefit per kg egg recorded improved savings with the use of BBRDM to replace fish meal at 50 and 100% levels which however, was not feasible when BBRDM replaces GNC. From the relative cost benefit per kg egg parameter, it could be seen that the use of BBRDM to replace FM has the effect of raising net returns by 4 and 10% whereas net losses of 15 and 37% were recorded with GNC. The cost of BBRDM was estimated to include that of transportation, drying/processing and energy for heating. All these amounted to about N16/kg whereas FM was purchased at N100/kg and GNC cost N28/kg. The price differential contributed largely to the reduction in production cost of layers due to BBRDM utilization. The performance of the layers in the diets in which BBRDM replaces GNC however did not allow the expected economic benefit to materialize.

Results of the present study indicated that BBRDM in the form fed did not fully support productive performance of layers when compared to a diet without it. In addition, layers on diets where FM was replaced by BBRDM gave better performance response than those in which GNC was replaced. Attention should be focused on nutrient imbalance in the utilization of bovine blood and rumen content mixture and possibly masking of the odor to enhance intake in the diet of layers.

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