Utilization of Bovine Blood-Rumen Digesta Mixture as Replacement for Soybean Meal and Groundnut Cake Feedstuff in Growing Pigs

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Abstract

Mixture of bovine blood and rumen digesta (BBRDM) was evaluated for 56 days as a replacement for soybean meal (SBM) and groundnut cake (GNC) at 100% on protein to protein basis in the diets of growing pigs to assess the nutritive value of BBRDM on the growth performance, nutrient digestibility and cost benefits. Hence, a total of 18 growing pigs were allotted on weight equalization basis into three dietary treatments consisting of six pigs per treatment in a completely randomized design. Three diets were formulated such that T_1 : served as the control diet without BBRDM but contained both soybean meal and groundnut cake. T_2 : BBRDM replaced soybean meal and T_3 : BBRDM replaced groundnut cake. Result indicated that BBRDM contained 28.65% crude protein, 13.17% ether extract, 5.26% crude fibre, 11.29% ash and 31.65% nitrogen free extract. Dietary treatments did not significantly ($P>0.05$) influenced the growth parameters observed in this study. Although there were no significant ($P>0.05$) difference on the nutrient digestibility parameters investigated but birds in T_3 recorded highest numerical values for crude protein (77.23), crude fibre (62.46%), ether extract (92.33%), nitrogen free extract (89.61%), ash (70.28%) and nutrient dry matter (91.67%) while the least values were obtained from birds in T_1 . Cost of feed decreased with the inclusion of BBRDM while the cost per weight gain also improved with the replacement of the conventional feed ingredients. The result also showed that an appreciable amount of money was saved when BBRDM was included in the ration of growing pigs. It is therefore concluded that BBRDM could be used as an animal protein source to compliment plant protein source such as soybean meal and groundnut cake in the diet of growing pigs.

Keywords: Pig, Bovine Blood Rumen Digesta Mixture, Groundnut cake, Soybean meal.

Introduction

The problem of food scarcity continues to plague many undeveloped countries like Nigeria as the population increases simply because the increase in population does not matched increase in food production; hence countries are always faced with inadequate supply of protein. Insufficient protein in the diet can be ascribed to many factors such as inadequate livestock feed, failure to harmonize crops with animal production, socio-cultural factors, prevalence of diseases, insects and pest infestation. These have led to non-availability of animal protein for consumption in the tropical region. More so, the availability of the

world's raw material is diminishing as population grows exponentially together with the real threat of global shortage which contributes to a new awareness of the need for the re-use of materials which would have been thrown away without second thought. Originally, recycling mainly concerned the urban environmentalist but when livestock scientist discovered that poultry, and other animal wastes could in fact constitute a precious resource, inputs into this research and technology began to expand rapidly. The primary purpose of recycling is to prevent animals from competing with humans for the same food resources. Since feed costs usually

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represent 60-80% of the total production costs, the utilization of animal waste will inevitably lead to a significant reduction in the cost of meat, milk and other animal products. Animal wastes which include poultry manure, poultry litter, blood, bone, rumen content, cattle manure, pig manure etc when properly processed are wholesome in appearance, taste and smell and they do not have other original characteristics. Animal wastes are almost 50% higher in crude protein than the feeding ration from which they are derived. In addition they contain other basic nutrients, crude fibre, calcium, phosphorus, other minerals and trace elements, vitamins and some unidentified factors. Rumen content and blood are substantial wastes (about 50,000 and 17,000 metric tonnes available/year, respectively; Makinde, 2006) generated daily at abattoirs in Nigeria (Adeniji, 1995; Odunsi *et al.*, 2004).

Rumen content is plant material at various stages of digestion rich in microbial protein (McDonald *et al.*, 1990). Blood is a source of high quality protein as blood meal (80-90% crude protein high in the essential amino acids, especially lysine; NRC, 1994), and nutritional value of blood meal increases when fed in combination with other protein sources (Ilori *et al.*, 1984; Dafwang *et al.*, 1986). Therefore, a combination of rumen content and blood assures a potential alternative protein source. Conversion of these wastes into animal feed will increase the flexibility of ration formulation, conserve foreign exchange, and reduce environmental pollution. However, results from growth performance trials have been variable and a simple standard processing method is not available and despite previous work on such a combination as feed for poultry (Adeniji, 1995; Lien *et al.*, 1995; Odunsi, 2003; Odunsi *et al.*, 2004). These studies

involved the heating of blood for various time-periods, but blood is sensitive to heat damage (reduction in the availability of essential amino acids due to reactions between lysine and reducing sugars; NRC, 1994). However, sun drying offers a cheaper and probably less deleterious alternative (Azad, 2008). Therefore, this study was undertaken to investigate the utilization of Bovine Blood-Rumen Digesta Mixture as replacement for soybean meal and groundnut cake feedstuff in growing pigs.

Materials and methods

Experimental sites

The experiment was carried out at the piggery unit of the Teaching and Research farm of the University of Agriculture, Abeokuta, Ogun State, Nigeria (7°15'N, 3°25'E), located in the rain vegetation zone of the South Western part of Nigeria. It receives a mean rainfall of about 1,037mm and the average relative humidity of about 82% throughout the year.

Preparation of the experimental diet

The rumen content and blood used for the study were collected from a nearby abattoir located at a distance of about seven kilometers from the experimental site. The blood was collected fresh into a clean bowl directly from the slaughtered cattle and was persistently stirred to prevent clotting of the blood. Similarly, the rumen digesta was collected fresh immediately after opening the rumen of the slaughtered cattle, packed into a sac and pressed using a locally fabricated screw to reduce the moisture content to a considerable level. The rumen digesta was then soaked in the blood in a ratio of 2:1; the mixture was then dried and milled to give Bovine Blood Rumen Digesta Mixture (BBRDM). Three experimental diets were formulated with diet 1 serving as the control without the inclusion of BBRDM while diet 2 and 3

contained BBRDM. In diet 2, BBRDM substituted soybean meal (SBM) at 100% on protein basis. In diet 3, BBRDM

substituted groundnut cake (GNC) at 100% also on protein basis (Table 1).

Table 1: Gross composition of experiment diets (%)

Ingredient	Inclusion levels of BBRDM		
	0%	12.30%	17.30%
Maize	53.00	53.00	53.00
Wheat Meal	25.00	20.70	18.70
Soybean Meal	8.00	0.00	8.00
GNC	11.00	11.00	-
BBRDM	-	12.30	17.30
Bone meal	2.00	2.00	2.00
Salt	0.05	0.05	0.05
Premix	0.05	0.05	0.05
Total	100	100	100
Determined Analysis			
Dry matter (%)	89.74	89.26	89.58
Crude protein (%)	18.55	19.08	18.90
Crude fibre (%)	8.96	7.84	7.81
Ether extract (%)	4.02	4.14	4.08
Ash (%)	9.62	9.96	9.59
NFE (%)	48.59	48.24	49.14
G.E (kcal/kg)	4,009	4,079	4,044

Experimental animals and their management

Eighteen growing pigs (40 ± 5kg) used in this study were selected from the piggery unit of the Teaching and Research Farm of the University of Agriculture Abeokuta, Ogun State. The experimental animals were distributed on weight equalization basis into three experimental groups that was replicated thrice with each group having six pigs with two 2 pigs per replicate. The experiment lasted for 10 weeks. Water and feed were supplied *ad-libitum*.

Data collection

Growth performance

The initial weights of the pigs were taken prior to the commencement of the experiment and were subsequently taken weekly. The daily feed intake was estimated by calculating the difference in the feed supplied and left over. The weekly weight changes were estimated by deducting the previous weight from the final weight. The market costs of the

ingredients at the time of the study was used to calculate the total cost of feed per kg diet, total cost of feed consumed per pig and the cost per kg of weight gain.

Digestibility trial

Six pigs were assigned to each dietary treatment and were transferred into a separate metabolic cages provided with net for collection of faeces and nylon for urine collection. The animals were fed weighed amounts of concentrate diets and water was provided *ad libitum*. Animals were allowed seven days adaptation period and seven days excreta (faeces) collection. Subsamples of daily feed offered, refusals and faeces voided per pig were collected and weighed. At the end of collection period, the faeces collected from each pig were thoroughly mixed, to have two subsamples. One of the samples was used for estimating dry matter (DM) by oven-drying at 105°C for 24 hours, while the second sample was oven-dried at 60°C for 72 hours, milled and 10% aliquot was taken

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for each goat for chemical analysis.

Chemical analysis

Subsample of the experimental diet was dried at 60 °C for 24 hours and ground to pass a 1-mm sieve screen using laboratory hammer mill machine. Dry matter (DM), Ash, crude protein CP; (N x 6.25), ether extract (EE) and crude fibre (CF) were determined on dry samples according to the methods of AOAC. (2000).

Statistical analysis

Data collected were analyzed using one-way analysis of variance of (SAS, 2010) statistical package and the significant differences between means were compared at 5% confidence level using Duncan multiple range tests of the same package.

Results and discussion

Indicated in Table 2 is the proximate composition of Bovine Blood-Rumen Digesta Mixture. The proximate composition of Bovine Blood-Rumen Digesta Mixture (BBRDM) showed that it contains 28.65% crude protein, 5.62% crude fibre, 13.17% ether extract, 11.29 ash and 31.65% NFE which was a sharp

contrast to the values obtained by Odunsi (2003), which were 46.10%, 6.38%, 2.13%, 23.40% and 16.00% for crude protein, crude fibre, ether extract, ash and Nitrogen free extract, respectively. The difference in values could be adjudged to the difference in ratio of the mixture which was 2:1 in the present study as against 1:1 mixture reported by Odunsi (2003). The disparity observed in crude protein composition values could be attributed to the type of pasture consumed by the animals and the proportion of the constituent mixtures. More so, this could be influenced by the period of fasting prior to slaughter and stage of digesta degradation in the rumen. However, the values obtained from this study agree with the values obtained by Alhassen *et al.* (1985) when blood and rumen content were mixed in a similar ratio of 2:1 which were 27.58, 4.92, 13.09 and 10.78% for crude protein, crude fibre, ether extract and ash respectively. Odunsi (2003) further reported that the proximate composition of BBRDM depends on the proportion of the constituent mixtures and can also be influenced by the stage of digesta degradation in the rumen.

Table 2: Proximate Composition of Bovine Blood-Rumen Digesta Mixture

Parameters	%
Dry matter	90.38
Crude protein	28.65
Crude fibre	5.62
Ether extract	13.17
Ash	11.29
NFE	31.65

NFE: Nitrogen free extract

Performance characteristics of growing pigs fed the experimental diet are shown in Table 3. There were no significant differences ($P>0.05$) in the parameters measured. The average daily weight gain recorded for animals in T_1 - T_3 were 0.49 kg/d, 0.49 kg/d and 0.46 kg/d respectively, with those in T_3 recording the lowest value despite consuming the largest quantity of

feed per week. The daily weight gain values observed decreased across the dietary treatments from 0.49 kg/d in T_1 and 2 to 0.46 kg in T_3 . On the average total weight gain, there were no significant ($P>0.05$) differences among the treatment means but numerically, the highest value (27.34 kg) was recorded with animals in T_1 followed closely by those fed diet 2 (27.16kg) but the

least value (25.00kg) recorded with those fed diet 3. This result in the present study agree with the work of Alhassan *et al.* (1985) who recorded a decrease in weight of ruminant animals fed BBRDM at graded levels. This was also in line with the result reported by Odunsi (2003) who observed a weight gain reduction from 12.5g/bird/day to as low as 2.0g/bird/day when BBRDM was used to replace fish meal and groundnut cake meal in layer diets. More feed were consumed by pigs in T₃ which has the highest quantity of BBRDM (17.30%) substituting 100% of GNC. The insignificant difference observed in feed intake of the pigs on BBRDM diets could be attributed to depressed appetite resulting from the unpleasant smell of the diets. Donkoh *et al.* (1999) and Dongmo *et al.* (2000) had earlier reported that the inclusion of blood meal and/ or rumen content impart obnoxious odour to the final diet and make it less palatable to birds causing a depression in consumption. In addition, the reduced feed intake with

increase in the dietary BBRCM inclusion could also be due to the increase in the dietary energy concentration of the diets since birds eat to satisfy their energy requirement, they tend to attain their energy level faster with BBRDM diet (Onu, 2007; Teimouri *et al.*, 2005). The feed conversion ratio revealed that those in T₃ had the highest value (3.83) while the least value was recorded in T₁ (3.51). The result of the feed conversion ratio showed a non-significant difference between the treatment groups. It was also observed that as the level of BBRDM increased from 12.30% in T₂ to 17.30% in T₃, the feed conversion values also increased as observed between those birds in T₂ and T₃ where an increment from 3.53 to 3.83 was. The results supported the observations of Omoniyi (2001) and Dafwang *et al.* (1986) who reported that as the level of metabolizable energy in the diets increases or decreases feed intake changes inversely, although the rate of adjustment is not always sufficient to keep energy intake constant.

Table 3: Performance Characteristics of Growing Pigs fed diets containing varying levels of Bovine Blood -Rumen Digesta Mixture

Parameters	Inclusion levels of BBRDM			
	0%	12.30%	17.30%	SEM±
Initial weight (kg)	34.33	35.17	39.50	0.72
Final weight (kg)	61.67	62.33	64.50	0.58
Total weight gain (kg)	27.34	27.16	25.00	0.57
Daily weight gain (kg/d)	0.49	0.49	0.46	0.18
Feed conversion ratio	3.51	3.53	3.83	0.89
Daily protein intake (Kg/d)	0.35	0.36	0.36	0.08
Protein efficiency ratio	0.90	0.86	0.74	0.11

Presented in Table 4 is the Nutrient digestibility value of growing pigs fed diet containing varying levels of BBRDM. No significant ($P>0.05$) difference was observed among the treatments for the digestibility study. Highest numerical digestibility values was obtained from pigs in T₃ having crude protein (77.23%), crude fibre (62.46%), ether extract (92.33%),

nitrogen free extract (89.61%), ash (70.28%) and total digestible nutrient (91.67%). Nutrient digestibility is an important measure of the nutritional value of feed. Since feed is basically an economic store of nutrients, its nutritional value depends partly on its digestibility. The crude protein digestibility values increased across the dietary treatment as the BBRDM

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increased and this increment observed was also a pointer to the fact that the lesser the crude fibre content in the diet the greater the crude protein digestibility. This result was in agreement with the report of Adegbola

and Osuji (1985). Pigs in T₃ had the highest digestibility values for all nutrients while those in T₁ had the least values for most of the nutrients except for crude fibre where it had a higher value of 44.79% compared to 41.92% in treatment 2.

Table 4: Nutrient digestibility (%) of growing pigs fed diet containing varying levels of Bovine Blood-Rumen Digesta Mixture

Parameters	Inclusion levels of BBRDM			
	0%	12.30%	17.30%	SEM±
Dry matter	83.89	84.78	91.67	0.97
Crude protein	71.96	75.50	77.23	0.98
Crude fibre	44.79	41.92	62.46	1.35
Ether	86.00	88.39	92.33	0.82
Nitrogen free extract	81.44	83.28	89.61	0.87
Ash	48.78	56.43	70.28	1.23

Indicated in Table 5 is the Cost benefit of feeding BBRDM to growing pigs. The cost benefit analysis obtained in this study showed that the total cost of feed/kg reduced steadily from ₦22.50 in treatment 1 to as low as ₦17.10 in treatment 3. The cost of feed/kg weight gain also showed a reduction from ₦85.72 in treatment 1 to ₦73.60 in treatment 3. It could therefore be

affirmed that it was cheaper to reduce the GNC and SBM content of pig diet by substituting either of them with BBRDM in the diet. The result of the cost benefit of the inclusion of BBRDM in this study was in agreement with the reports of Odunsi (2003); Adeniji (1995); Alhassen *et al.* (1985); Abubakar and Yusuph (1991); Ajibosin (1998); Omoniyi (2001); and Dafwang *et al.* (1986).

Table 5: Cost benefit analysis of feeding varying levels of Bovine Blood-Rumen Digesta Mixture

Parameters	Inclusion levels of BBRDM			
	0%	12.30%	17.30%	SEM±
Total weight gain (kg)	27.34	27.16	25.00	0.57
Total feed consumed (kg)	104.16	104.72	106.96	0.50
Cost of feed/kg (₦)	22.50 ^a	20.35 ^b	17.10 ^c	0.41
Total cost feed consumed/pig (₦)	2343.60 ^a	2131.05 ^b	1829.02 ^c	4.18
Cost of feed/weight gain (₦)	85.72 ^a	78.46 ^{ab}	73.60 ^b	2.41

^{a, b, c} Means on the same row with different superscripts are significantly different (P<0.05).

Conclusion

The study showed that Bovine Blood-Rumen Digesta Mixture can successfully be used as a substitute for groundnut cake or soybean meal in the diet of growing pigs. An appreciable amount of savings could be made by using Bovine Blood-Rumen Digesta Mixture as plant protein source. Effective collections and preservations of

blood and rumen content should be encouraged from all the slaughter houses across the country to ensure its availability.

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