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SHORT COMMUNICATION

Visual assessment, proximate composition and cost analysis of three differently processed discarded vegetable-bovine blood-rumen content mixtures

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Abstract

With increased search for least-cost alternative feed resource in animal production, this study was conducted to determine the visual properties, chemical composition and cost analysis of three differently processed discarded vegetable-bovine blood-rumen content mixture as potential alternative feed resource. These mixtures were obtained by mixing whole bovine blood, discarded vegetable and rumen content at ratio 1:1:1 under different processing methods. The processed mixtures obtained were in three categories: discarded vegetable-fresh bovine blood-fresh rumen digesta (D1), discarded vegetable-ensiled bovine blood-fresh rumen digesta (D2) and discarded vegetable-fresh bovine blood-ensiled rumen digesta (D3). The mixtures were cooked and sun-dried to constant moisture content and thereafter were subjected to particle size reduction. Chemical composition of the products indicated a good potential nutritional quality with metabolizable energy and crude protein contents ranging from 9.66 to 10.49 MJ/kg and 40.79 to 50.21, respectively. Crude fibre concentrations were relatively low (8.39-13.14) for most of the products compared to conventional protein sources. Visual assessment of processed mixtures revealed D1 to be brownish in colour while D2 and D3 tend towards grey. In terms of odour, all three test mixtures were strongly pungent. Processed mixture D1 had an intermediate texture (it was neither finely ground nor coarse) where D2 and D3 had a finely ground texture. Cost analysis revealed a lower production cost for the three processed mixtures indicating its adequacy to replace soybean and other plant and animal protein sources in terms of their cost/kg inclusion in diet. Processed mixtures can serve as suitable replacements for soybean meal in terms of chemical constituents and reduced cost/kg feed for animal.

Key words: Bovine blood, rumen digesta, discarded vegetable, visual assessment, proximate composition, cost analysis.

Introduction

Blood and rumen contents are currently major pollutants in our abattoir in developing countries. However, as slaughtering becomes concentrated into fewer large units, the collection and processing of these wastes into feasible beneficial by products is economically more attractive. But with a critical view at the present situation in Nigeria where the by-products from thousands of animals slaughtered in the abattoir are left to waste, then less can be spoken of the slaughtered at the unapproved premises because there is no full utilization of the animals slaughter and abattoir (Aganga and Belino, 1983). The estimate of rumen content of bovine origin in Nigeria abbatoir is put at 9,634 tonnes while 18,067 tonnes per annum could be obtained from caprine sources (Adeniji, 1996) while over 1.873 million heads of cattle are slaughtered. Previous studies (Mann, 1984; Adeniji and Balogun, 2002) have shown that rumen content as well as blood or blood and rumen-content mixture are good sources of protein in monogastric rations. Broilers fed with agroindustrial by-product such as rumen –blood meal have shown to have comparable feed intake values that were significantly higher than for the birds placed on maize milling waste diets (Adeniji and Balogun, 2002). These tend to justify the need to search for least –cost alternative protein and energy sources for livestock feeds. Leafy vegetables are important items of diet in many Nigerian homes and they are valuable sources of nutrients especially in rural areas where they contribute substantially to protein, mineral, vitamins, fibre and other nutrients which are usually in short supply in daily diets (Mosha and Gaga, 1999). Another potential advantage of the leafy vegetable is the chemical composition which is highly in favour of the plant leaves as a source of plant protein (Leung *et. al.,* 1968 and **Aletor and Adeogun, 1995**). The protein and amino acid composition of Amaranth leaf make it ranks alongside other conventional protein sources especially of plant origin (Fasuyi, 2007) and distinct it from other unconventional sources. Its consideration stems from results of previous studies reporting good chemical constituents (Fasuyi, 2007), its structure to hold the other components from denaturing during processing and its shorter shelf-life which results into wastage in large quantities of the amaranth leads to its incorporation into practical feed manufacturing. Limited information is available on mixture of vegetable carriers with rumen fluid and bovine blood and best replacement for major plant protein sources. Therefore, development of appropriate processing technologies for abattoir waste is important. Hence the study was designed to develop simpler method of refining and converting wastes (discarded vegetable and abattoir wastes) into animal feedstuff.

Materials and Methods

Discarded vegetables (*Amaranthus spp.*) which has wilted and undergoing decomposition was obtained from two commercial markets namely Ipata and Oja-Oba in Ilorin, Kwara state between July – November 2011. Fresh blood and rumen content were collected from several cattle which have been physically examined and ascertained fit for slaughtering at Ipata market slaughter slab in Ilorin, Kwara state. Blood was collected directly from the neck of the slaughtered cattle with the aid of wide and shallow plastic bowls, used one after the other to minimize blood loss and contamination. Fresh rumen content was collected immediately the visceral is split from freshly slaughtered cattle. The dietary mixtures were then processed as follows:

Preparation of Mixtures

Discarded vegetable, fresh bovine blood and fresh rumen digesta (D1)

The chopped Amaranthus, fresh bovine blood and bovine rumen digesta were weighed out (weight for weight) at a ratio of 1:1:1 and mixed in a drum. The mixture was cooked at a temperature of 100^{o}C and stirred intermittently for duration of 2 hours until the mixture is semi-dried. Stirring was done to prevent burning. After cooking, the mixture was sundried to constant moisture content.

Discarded vegetable, ensiled bovine blood and fresh rumen digesta (D2)

Freshly collected blood was covered up in an hermetic container for 3 days. It was then mixed with chopped Amaranthus and fresh bovine rumen digesta at a ratio of 1:1:1 in a drum. The mixture was subjected to similar cooking procedure as D1 above.

Discarded vegetable, fresh bovine blood and ensiled rumen digesta (D3)

Freshly collected bovine rumen was obtained from bowels of cattle. Rumen content was left for few hours in open air to reduce moisture and then covered up in an hermetic container and subjected to a fermentative process (ensiling) for three days. Ensiled rumen content was then mixed with chopped Amaranthus and fresh bovine blood at ratio 1:1:1 in a drum and subjected to similar cooking method as D1 above.

Drying of Processed Mixtures

All mixtures were dried using solar radiation. Black polythene nylons were purchased and spread on an open concrete floor. Semi-dried mixture which was properly drained of liquid using perforated aluminium containers was spread evenly on the nylon sheets. Mixtures were weighed intermittently until constant moisture content was obtained.

Visual assessment of Processed Mixtures

After subjection of processed mixtures to particle size reduction (milling), visual assessment test was carried out on each mixture in other to determine their physical qualities at Animal Products and Processing Laboratory, Department of Animal Production and Health. A nine-man panellist was provided with a score sheet to grade each test ingredient. The score sheet had three qualities (attributes) listed with a 3-point scale provided for objective assessment according to Williams (1982).

Chemical analysis

After sun-drying and subjection to particle size reduction, triplicate chemical composition was carried out on each processed mixture at JaaGee Laboratories, Ibadan, Oyo State, Nigeria according to method of AOAC (2000). Dried meals were milled through a 1 mm screen. Dry matter content was determined by drying the samples at 105°C for 24 h, cooled in desiccators and weighed until constant weight was attained. Ash was determined after ignition in a mufΣe furnace at 500± 15°C for 4 h. Crude protein (CP) was estimated from N determined using a Kjeltec 2300 Analyser Unit (Kjeltec auto distillation unit, model: Kjeltec 8200) after samples were digested in concentrated sulphuric acid. Ether extract (EE) was determined by using petroleum ether (bp 60–80°C) extraction in a Soxhlet extracting system (Phillip Harris, Birmingham, England: Model: 2050).Crude fibre (CF) was determined using fibertec cold extraction unit (Model: 1021).

Cost Analysis

The cost of each test materials (Amaranthus, bovine blood and bovine rumen digesta) used were recorded and used in the overall cost estimation of the processed mixtures.

Statistical analysis

The experimental design was a Completely Randomised Design (CRD) and data obtained were subjected to Analysis of Variance. Significant ($P<0.05$) differences among treatment means were determined using Duncan Multiple Range Test (Duncan, 1955) as contained in SAS (2011) package.

Experimental model;

γ_{ij} = $\mu + T_i + + \Sigma_{fj}$

γ_{ij} = Observed Yield

μ = Overall mean value

Ti = Effect of Processing methods

Σ_{fj} = Random residual error

Result

The physical properties of the processed mixtures at 5% level of significance are shown in Table 1. It could be observed that there was significant ($P<0.05$) in most physical qualities considered except in odour where all mixture fell within similar point-scale. Processed mixture 1 (D1) tends towards brownish colour while D2 and D3

Table 1: Visual properties of Processed Mixtures

Parameter	D1	D2	D3	SEM
Colour	2.00^{c}	3.00^{a}	2.67^{b}	0.97
Odour	1.11	1.00	1.33	0.07
Texture	2.78^{a}	1.22^{b}	1.33^{b}	0.16

$^{a, b}$: Means in the same row by factor with different superscripts differ significantly(P<0.05).
SEM: Standard Error of Mean.
Colour: Scale 1: Amber
2: Brown
3: Grey
Texture: Scale 1: Finely ground
2: Coarse
3: Intermediate
Odour: Scale 1: Strongly pungent
2: Sweet-smelling
3: Moderately pungent

tend towards grey. In terms of odour, all three mixtures were strongly pungent. Processed mixture 1 (D1) had an intermediate texture (it was neither finely ground nor coarse) with D2 and D3 having a finely ground texture.
Chemical composition (% air-dry basis) of the three processed mixtures and soybean meal presented in table 2 revealed crude protein was highest in D1. The crude protein (P<0.05) contents of D2 and D3 were 40.79 and 41.92%, respectively and less than the value obtained in D1 (50.21%) and SBM (45.00). Crude fibre values obtained for D2 and D3 were 60.12 and 48.85% higher than the crude fibre of D1. Similar observation was made for the ash content of the mixtures with lowest value obtained in D1. Energy content was considerably lower for D2, D3 and soybean meal being 8.12, 4.19 and 3.34 % less than the metabolizable energy value obtained for D1. There was a significant (P<0.05) decrease in cost of production along the row of processed mixtures with the least cost of production obtained in D1 and highest in

Table 2: Chemical composition (%Air-dry Basis) and Cost Analysis of processed mixtures and soybean meal

Parameter	D1	D2	D3	SEM	SBM
Moisture (%)	14.93^{a}	11.33^{c}	13.06^{b}	0.13	N/A
Protein (%)	50.21^{a}	40.79^{b}	41.92^{b}	0.35	45.00
Ether Extract (%)	1.07^{b}	1.72^{a}	1.92^{a}	0.13	3.50
Crude Fibre (%)	8.39^{c}	13.14^{a}	12.16^{b}	0.16	6.50
Ash (%)	10.02^{b}	14.18^{a}	11.15^{b}	0.13	6.0
Nitrogen-free extract (%)	15.85^{c}	18.53^{b}	20.48^{a}	0.24	N/A
*Metabolizable energy (Kcal/kg)	2500.85^{a}	2297.74^{b}	2395.97^{a}	0.08	2420.00
Cost/kg (₦)	90.35^{c}	93.59^{b}	95.13^{a}	2.08	126.00

$^{a, b}$: Means in the same row by factor with different superscripts differ significantly(P<0.05).
*Estimated using the formula by Pauzenga (1985) i.e: ME (kcal/kg)=(37.7 x CP%) + (81.8 x EE%) + (35.5 x NFE%).

D3.

Discussion

The physical properties of the processed mixtures at 5% level of significance are shown in Table 1. The physical quality (appearance) of processed mixtures was dark with processed mixture D1 brownish colour while D2 and D3 tend towards grey. This supports the claim of Odunsi (2003) who observed that diets became darker in colour and the odour more accentuated with an increase in bovine blood and rumen digesta meal (BBRDM). In terms of odour, all three test ingredients were strongly pungent. Adeniji and Balogun, 2002) highlighted that blood rumen content mixture had a repulsive odour and the inclusion of blood meal and / or rumen content was also reported (Abubakar and Yusuph, 1991; Donkoh *et al*., 1999) to impact obnoxious odour to the final diet . Its use as a major source of protein in feeding of livestock could be enhanced by palm-oil inclusion in the feed though useful in boosting energy level of feed, will be effective in masking the obnoxious smell, reduce dustiness and increase palatability of feed as reported by Iji (2009). Processed mixture 1 (D1) had an intermediate texture (it was neither finely ground nor coarse) while D2 and D3 had finely ground textures respectively. This may be as a result of the composition of the processed mixtures (plant and animal origin) being different from fibre component of most conventional feedstuffs, combination ratio and the processing method employed in the preparation of the mixture which might be adequate in reducing the fibre effect since the physical properties of these components are different.

Table 2 shows chemical composition (% air-dry basis) and cost analysis of the three processed mixtures. Crude protein was highest in D1. The crude protein ($P<0.05$) contents of D2 and D3 were 40.79 and 41.92%, respectively and less than the value obtained in D1 (50.21%).The determined chemical composition revealed that processed mixtures had crude protein and metabolizable energy which can adequately replace soybean meal in broiler diets and within comparable range as that obtained by Aduku (1993). The mixtures thereby rank alongside other conventional protein sources especially of plant and animal origin. The crude protein values obtained for the three test ingredients were however higher than those obtained when bovine blood and rumen content were combined at ratio 1:3 as reported by Adeniji, 1996). Crude fibre values obtained for D2 and D3 were 60.12 and 48.85% higher than the crude fibre of D1, though much lower than that obtained by Adeniji, 1996) when bovine blood and bovine rumen digesta were mixed at ratio 1:3. Similar observation was made for the ash content of test ingredient. Metabolizable energy content was considerably lower for D2 and D3 that were 8.12 and 4.19% less than the metabolizable energy value obtained for D1.The reduced energy observed in D3 may be as a result of an increase in ash content (Sogunle *et al.*, 2009). Physical properties of these components are different. The processed mixtures though higher in some chemical constituents (fibre and ash), it however contains negligible or no aninutritional factors (ANFs) (Adeniji, 1996; Fasuyi, 2007) when compared to soybean meal. The ANFs in soybean meal are known to cause depressed growth performance in poultry and swine (Cromwell, 1999). The popularity of soybean meal in swine and poultry feeds is largely due to its high concentration of protein (44 to 48%) and its excellent profile of highly digestible amino acids (Cromwell, 1999). Although not a perfect blend of amino acids (it tends to be low in methionine) while the each material used in this novel mixture are blends of various amino-acids profile.

The cost of producing each processed mixtures varied between 90.35 and 95.13 naira per kg during the duration of the experiment. The processed mixtures which could adequately replace soybean in terms of chemical constituent were also cheaper than cost/Kg of SBM which varied between 125-127/Kg. The production of the processed mixtures was dependent on several factors capable of reducing its cost/kg. These factors included the number of batches of processed mixtures done per day which was mostly dependent on the availability of discarded vegetable, the site of production and season of production. However, the hindering component was the availability of vegetable was scarce during the extended dry season and fasting period since the production mostly done by Hausa farmers dropped significantly in Ilorin environs at this time.

Conclusion and Recommendation

In terms of chemical properties considered, the mixtures are potential ingredients and can produce results equivalent to that of conventional feedstuffs in terms of production performance as well as economic feasibility. Its inclusion in diets can be enhanced by adding flavouring agents (palm-oil as an example) to mask the obnoxious smell and increase the palatability and overall acceptability to livestocks. Cost analysis revealed a lower production cost for the three processed mixtures indicating its adequacy to replace soybean and other plant and animal protein sources in terms of their cost/kg inclusion in diet. Processed mixtures can serve as suitable replacements for soybean meal in terms of chemical constituent and also for better cost/kg inclusion in animal diets.

Further research should be carried out to standardize the chemical constituents of processed mixtures, evaluate their nutritional value and promote their use as a conventional source of protein in Nigeria livestock industry in periods of soybean shortage.

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