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An Assessment Of The Effect Of Processing On The Proximate Constituents Of Blood Meal Sourced From Cattle And Goat In Zaria, Nigeria

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ABSTRACT

The work reports the proximate and mineral composition of non-steam processed and processed samples of blood meal sourced from cattle and goat (n = 5) in Zaria, Nigeria using standard analytical techniques. The blood samples were processed by steam coagulation at a temperature of 100^{o}C for 45 mins, and the solid obtained sun-dried. The ranges of the percentage moisture of the non-steam processed blood meal from cattle and goat were 12.02 – 13.59 % and11.01 – 11.09 %; ash 2.21-2.91 % and 2.00-2.22 %; crude lipid 1.05-1.79 % and 0.72-1.70 %; crude fibre 0.49-0.56 % and 0.51-1.15 % and crude protein 80.75-83.57 % and 83.57 - 85.09% respectively. After processing, the ranges of the moisture content of the blood meals from cattle and goat were 8.99-10.08 % and 8.51-9.99 %; ash 7.15-9.99 % and 7.33-9.91 %; crude lipid 2.24-2.97 % and 2.69 -2.90 %; crude fibre 0.05-0.07 % and 0.01-0.04 %; and crude protein 75.98-80.01% and 74.94-80.20% respectively. The calcium and phosphorus content of the un-processed meal were in the range 344.9-550.5 mg/kg and 430-559 mg/kg for cattle and 293-728 mg/kg and 688-818 mg/kg for goat. Ca and P levels after processing were 6482-8835 mg/kg and 918-1234 mg/kg for cattle, 7536-11090 mg/kg and 1306-1837 mg/kg for goat. The Ca/P ratio, density, acidity, ash content and crude lipid were elevated in the blood meals sourced from cattle and goat as a result of steam processing. Processing of blood meal had no significant difference in pH value of the meal sourced from cattle, but had for goat. Blood meal from cattle and goat are equally enriched with the determined nutritional and mineral contents.

Keywords: blood meal, cattle, goat, mineral contents, nutritional

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1 INTRODUCTION

The world today is challenged with serious shortage of feed ingredients like wheat, corn, soya beans due to the competition imposed by the ever increasing human population [1, 2].

A means to close up the gap between the ever growing human population and the availability of food has become one of the greatest challenges facing mankind, as malnutrition becomes widespread due to protein deficiencies in human diets, especially animal protein [3, 4].

The fish and poultry industry has continually played key roles in many parts of the world as the most common and economic source of protein. However, feeds like soya bean meal, fish meal, meat meal are usually in short supply and expensive. Hence, efforts in the replacement of these more expensive protein concentrates in poultry diets with cheaper and less competitively demanded feeding resources include the usage of by-products like feather meal, bone meal and blood meal [5, 6, 7].

Blood meal is a dry inert powdered matter used as protein supplement for cattle, sheep, fish, swine and poultry due to its high lysine content. The introduction of the product in poultry feed production has brought about great cost effectiveness in poultry production where about 65 – 75 percent of production cost is usually spent on feeding [8].

Blood is a highly perishable product and must be processed as soon as possible after slaughter basically by drying to about 10 – 12 percent moisture content to maintain the product from spoilage. Secondly the product may be heated to 115^{o}C for 15 minutes to destroy pathogenic organism and prevent disease [9]. Nevertheless, excessive heating reduces the digestibility of the product as well as the lysine content and subsequently the available lysine [10].

Common methods of processing blood meal include solar and oven drying, which involves spreading blood meal on clean dry surface under the sun or by boiling fresh blood at a temperature of 100^{o}C for 45 minutes, oven drying at 55^{o}C for 6 days before grinding into fine particles [11]. The ring and flash drying method involves the dispersal of blood into the high velocity venture section of the system; the blood would first come in contact with the hot drying airstream where the bulk of the evaporation occurs. The product is then dried as it is conveyed up through the drying column. The presence of a manifold or internal classifier in the ring system is what differentiates the ring dryer from the flash dryer [12]. Generally the quality of blood meal protein is usually affected by its method of preparation [13].

Blood meal is very rich in lysine and is a good source of arginine, methionine, cystine, and leucine but is very poor in isoleucine and contains less glycine than either fish meal or bone meal [14]. Blood meal can be use to compensate the lysine and methionine deficiencies in vegetable protein based diets [13]. The characteristic smell of blood meal reduces its palatability and then a 5% limit is a usual recommendation for its usage in diets.

American Protein Corporation (APC) reported the proximate constituents of spray dehydrated blood meal as: protein 85%, fat 0.5-3%, fibre (max) 2.5%, ash 6.0 %, moisture (max) 10.5 %, lysine (available) 80% - 90%; colour as uniform reddish-brown [15]. The vitamins and mineral contents of spray dehydrated blood meal has been reported; with the minerals being: Ca 0.41 %, P 0.30 %, K 0.15 %, Cl 0.25 %, Mg 0.15 %, Na 0.38 %, S 0.34 %, Cu 8.2 mg/kg, Fe 2.77 mg/kg, Mg 6.4 mg/kg and Zn 306 mg/kg [9].

The aim of this study is to assess the effect of processing on the proximate and mineral contents of blood meal sourced from goat and cattle in order to obtain the processing condition of optimum nutritional value for blood meals from these ruminants.

2. MATERIALS AND METHODS

2.1 Sample Collection and Treatment

Five composite samples of blood were collected from cattle and goat at the point of slaughter separately in sterilized beakers at Zango and Yan Awaki abattoirs in Zaria - Nigeria in November 2012. The samples were preserved in ice packed polyethylene buckets preceding experimental work. A 1.0 L portion of each of the sample collected was left for 6 h, after which the liquid portion was decanted, the solid was then sun-dried and ground to powder. Also, a 1.0 L portion of each of the blood from cattle or goat was processed by steam coagulation at a temperature of 100^{o}C for 45 minutes (n = 5). The coagulated solid of each group was separated from the liquid portion by decantation, this was then sun dried for 72 h before grinding into meals using an agate mortar and pestle [9].

2.2 Proximate Determination

The proximate analyses of the sample for moisture content, crude fat, crude fibre, carbohydrate and total ash were carried out on the blood meal obtained from cattle and goat before and after processing, using the methods of Association of Official Analytical Chemists, 1990 [17]. While the crude protein was determined by the method developed by Kjeldahl and adopted by Pearson [18] and the Association of Official Analytical Chemists, 1990.

2.3 Determination of Mineral Content

The calcium concentration in the blood meal samples was determined by means of atomic absorption spectrophotometer (Unicam 669) after acid digestion of the samples. The phosphorus content was determined by means of a colorimeter after colour development in the vanadomolybdate method [19].

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2.4 Determination of pH and Density

A pH meter (Jenway 2000) was used to determine the pH of a 1.0 g homogenized blood meal that was solubilized in 10.0 mL distilled water for 10 minutes [13]. The density was determined by the mass to volume ratio.

3 RESULTS AND DISCUSSION

3.1 The Proximate Compositions of Blood Meal Sourced From Cattle and Goat

The blood meals from the two animal sources were reddish brown for the non-steam processed samples and dark reddish brown for the steam processed group. The proximate compositions of blood meal sourced from cattle and goat before and after steam processing are presented in Tables 1 and 2 respectively. There was an average yield of 70% blood meal from serum blood weight, for both animals.

The percentage moisture of blood meal from cattle and goat source has the ranges 12.02 – 13.59 % and 11.01-11.09% before processing and 8.99-10.08 % and 8.51-9.99 % after processing respectively. The high moisture content of the non-steam coagulated blood meal explains why the product is highly perishable [9].

Table 1: Proximate composition of non-steam processed blood meal sourced from cattle and goat (%)

S/N	Sample	Moisture	Crude lipid	Ash	Crude Protein	Crude fibre	Carbohydrate
1	C1	13.59	1.59	2.89	80.75	0.51	0.68
2	C2	12.29	1.06	2.52	83.02	0.49	0.62
3	C3	12.02	1.12	2.91	82.81	0.56	0.62
4	C4	12.02	1.79	2.59	82.47	0.49	0.64
5	C5	12.12	1.05	2.21	83.57	0.50	0.64
6	G1	11.05	1.03	2.00	84.82	0.51	0.66
7	G2	11.01	0.72	2.01	85.09	0.56	0.66
8	G3	11.09	1.02	2.03	84.74	0.51	0.67
9	G4	11.01	1.41	2.22	83.57	1.15	0.65
10	G5	11.09	1.70	2.01	84.09	0.51	0.66

C = blood meal from cattle; G = blood meal from goat

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Table 2: Proximate composition of steam processed blood meal sourced from cattle and goat (%)

S/N	Sample	Moisture	Crude lipid	Ash	Crude Protein	Crude fibre	Carbohydrate
1	C_p1	10.1	2.97	9.99	75.98	0.07	0.66
2	C_p2	9.67	2.24	7.15	80	0.07	0.64
3	C_p3	9.85	2.84	9.23	77.21	0.05	0.61
4	C_p4	8.99	2.35	9.67	78.01	0.06	0.67
5	C_p5	8.99	2.36	7.83	80.01	0.05	0.63
6	G_p1	9.79	2.89	9.91	76.79	0.04	0.65
7	G_p2	8.59	2.69	7.58	80.2	0.03	0.64
8	G_p3	8.98	2.90	7.33	79.98	0.02	0.66
9	G_p4	9.99	2.84	11.25	74.94	0.01	0.65
10	G_p5	8.51	2.83	8.49	79.22	0.03	0.67

C_p = processed blood meal from cattle; G_p = processed blood meal from goat

The ash content (%) ranged from 2.21-2.91% for cattle and 2.00-2.22% for goat in the non-steam coagulated sample; and 7.15-9.99 % for cattle and 7.33-9.91% for goat in the processed counterpart. This implies that the total amount of mineral present within the processed blood meal is about three-fold the unprocessed product, this assertion is in accordance with the report of Adubiaro *et al.* (2011) [21].

Following from Tables 1 and 2, the crude lipid values of range 2.24-2.97% and 2.69 -2.90% after processing blood meal was about double the values in the unprocessed. This value is too low for the product to be regarded as oil product.

The crude fibre content range were 0.49-0.56 % and 0.51-1.15 % in the non-steam processed blood meal of cattle and goat respectively; steam coagulation led to a statistically significant decrease in the crude fibre content of the blood meal obtained from cattle and goat (Duncan grouping, $P < 0.05$) .

Crude protein content ranged from 80.75-83.57% and 83.57-85.09% for the non-steam processed blood meal of cattle and goat; these were 75.98-80.01% and 74.94-80.20 % after steam processing for cattle and goat blood respectively. There was no significant difference in the crude protein level as a result of processing effect. Nevertheless, the high protein content of these meals shows that goat and cattle can equally serve as useful alternative source of protein in livestock feed manufacture. The percentage carbohydrate in each group of both the processed and non-steam processed blood meals of cattle and goat had mean value of 0.650 ± 0.001 %.

The calcium and phosphorus content before processing have the range 344.9-550.5 mg/kg and 430-559 mg/kg for blood meal sourced from cattle, and 293.0-728.0 mg/kg and 688.0-818.0 mg/kg for that of goat source (Table3). However, steam processing led to the range of the calcium and phosphorus contents of the blood meal to become 6482.0 -8835.0 mg/kg and 918-1234 mg/kg for cattle, 7536-11090 mg/kg and 1306-1837 mg/kg for goat as presented in Table 3. The blood meal from goat (the steam - processed and the non-steam processed) recorded elevated levels of Ca and P compared to the samples obtained from cattle ($P < 0.05$).

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The Ca/P ratio presented in Table 3 indicates a generally greater ratio in the processed meal than the non-steam processed. The steam processed meal indicates presence of higher calcium in the product based on the calcium: phosphorus ratio following from Duarte *et al.* (1999) [22].

Table 3: Calcium and phosphorus composition of blood meal non-steam processed and steam-processed

	Unprocessed				Processed			
S/N\ Meal type	Sample	Ca(mg/kg)	P(mg/kg)		Ca/P	Ca(mg/kg)*	P (mg/kg)*	Ca/P*
1	C1	344.9	473.61		0.72	8256	1191.188	6.93
2	C2	350	430.55		0.81	8446	961.5617	8.78
3	C3	578.1	559.72		1.03	6482	1593.035	4.06
4	C4	512.6	430.55		1.19	7810	918.5067	8.5
5	C5	550.5	516.66		1.06	8835	1234.243	7.15
6	G1	498.2	774.99		0.64	11090	1837.013	6.03
7	G2	371.4	688.88		0.53	8406	1306.002	6.43
8	G3	728.5	688.88		1.05	9262	1435.167	6.44
9	G4	293.7	688.88		0.42	7536	1607.387	4.68
10	G5	666.6	818.05		0.81	9571	1707.848	5.6

C= blood meal from cattle; G= blood meal from goat; *= after processing

Ca/P = Calcium to phosphorus ratio

The bulk density and pH values of blood meal from the animals are presented in Table 4. The value of bulk density was generally higher in the steam processed product , this could account for its higher tendency of sparing solubility in saline water at 37^{o}C (0.9% NaCl solution – to mimic body fliud-).However, steam processing of blood from the two animals led to lowering the pH values compared to the non- steam processed counterpart. This demonstrates that storage time of whole blood affects the pH , making it to become mildly acidic [23]. The relatively high bulk density and smaller coarse particle distribution of blood meal when compared to fish meal indicate that blood meal has less preservation potential when used in the unprocessed form [14].

Following from Table 4, the non-steam processed meal from cattle had the pH range 7.53 ± 0.06 – 7.87 ±0.007 compared to that from goat being 7.72 ± 0.07 - 8.00 ± 0.06; however, due to steam processing, pH was more depressed in the processed goat blood meal (range 4.95 ± 0.08 - 5.25 ± 0.08) compared to the cattle counterpart (range 5.16 ± 0.04 - 5.93±0.02. Pearson's correlation ($P < 0.05$) indicated that a statistically significant depression of pH resulted by steam coagulation of blood from goat for blood meal. However, processing of blood meal had no significant difference in pH value for the meal sourced from cattle.

Table 4: Density and pH of non-steam processed and steam-processed blood meal

S/N	Sample	Density (g/cm^3) unprocessed	Density (g/cm^3) processed	pH unprocessed	pH processed
1	C1	0.52±0.01	0.67±0.02	7.61±0.01	5.18±0.06
2	C2	0.54±0.02	0.66±0.01	7.85±0.01	5.16±0.04
3	C3	0.50±0.01	0.68±0.02	7.53±0.06	5.93±0.02
4	C4	0.53±0.01	0.67±0.01	7.87±0.07	5.91±0.07
	C5	0.51±0.01	0.67±0.09	7.80±0.01	5.17±0.06

5					
6	G1	0.60±0.01	0.66±0.06	8.00±0.06	5.18±0.04
7	G2	0.52±0.01	0.65±0.04	8.00±0.06	4.98±0.02
8	G3	0.54±0.02	0.67±0.07	8.00±0.06	4.95±0.08
9	G4	0.53±0.01	0.66±0.04	7.92±0.07	5.25±0.08
10	G5	0.53±0.01	0.66±0.03	7.72±0.01	5.11±0.02

C= blood meal from cattle; G= blood meal from goat;

Values are mean ± standard deviation of n = 5 determinations

4 CONCLUSION

Steam coagulation of blood from cattle and goat led to a significant elevation of the ash content, this inference is buttressed by the Ca and P levels that were highly elevated in the processed counterparts of the two blood meal sources. Crude lipid content was doubled in the blood meal obtained by steam coagulation. However, steam processing has no significant effect on the crude protein content, but led to a significant decrease in the level of crude fibre in the blood meal. Calcium and P levels in the blood meal sourced from goat were in elevated levels than that in the blood meal from cattle. Processing of blood meal had no significant difference in pH value for the meal sourced from cattle, but had for goat. Blood meal from cattle and goat are equally enriched with the determined nutritional and mineral contents, and can continuously serve in the provision of protein and mineral sources for the feed manufacturing industry.

REFERENCES

[1] Steinfeld, H. 2003. Economic constraints on production and consumption of animal source foods for nutrition in developing countries. *J. Nutrit.*133, 4054 – 4061.

[2] Gura, S. 2008. *Industrial livestock production and its impact on smallholders in developing countries*. Consultancy Report to the League for Pastoral Peoples and Endogenous Livestock Development, Germany. P. 65. http://www.pastoralpeoples.org/docs/gura_ind_livestock_prod.pdf. Accessed 20th January, 2013.

[3] Abdullah, R. B., Wanembong, W. K. and Soh, H. H. 2011. Biotechnology in animal production in developing countries. *Proceedings of the 2nd International Conference on Agricultural and Animal Science,* November 25-27, 2011, Singapore, 88-91.

[4] Ray, F. and Syd F. 1978. *Practical Poultry Feeding*. London: Fabar and Fabar press limited. P. 74-91.

[5] Dafwang, I. I. (1979). *The replacement value of blood meal in rations for poultry raised in tropics*. Unpublished M.Sc. Thesis. Department of Animal Science, Ahmadu Bello University, Zaria, Nigeria.

[6]Udedibie, A. B., Anyanwu, I. G., Ukpai, U. I. and Oyet, A. J. 1988. Poultry offal meal as a protein supplement in the diets of broiler starters and finishers. *Nig. J. Anim. Produc.*20, 103 – 109.

[7] Dongmo, T. J., Ngoupayou D. N. and Duplaix, M. P. 2000. Use of some local animal protein sources in the feeding of broilers. *Tropicultura,* 18: 122-125.

[8] Tabinda, K., Sohail, H. K., and Noor, N. A. 2007. Effect of different level of blood meal on broiler performance during two phase of growth. Int. J.Poultry Sc. 6(12), 860 – 865.

[9] Hansen, P. I. E. and Olgaard, K. 1984. Some microbiological aspects of inedible rendering processes, Zentrablatt fur Bakteriologie Mikrobiologie und Hygiene. I. Abteilung Originale B, 1(80), 3 - 20.

[10] Batterham, E. S., Darnell, R. E., Herbert, L.S. and Major, E. J. 1986. Effect of pressure and temperature on the availability of lysine in meat and bone meal as determined by slope-ratio assays with growing pigs, rats and chicks and by chemical techniques, Brit. J. Nutri. 5(5), 441-453.

[11] Marichal, M. D. J., Carriquiry, R., Pereda, R. and Martin, S. 2000. Protein intestinal digestibility of blood meals: comparison of two processing methods. Degradabil. Animal Feed Sc. and Tech. 88, 91 – 101.

[12] Gea-Hernanzez, A. C., Madoz, P. B., Carles, A., Alvarez-Urturiand, C. and Poca, M. 2009. Hymodynamic changes and transfusion strategies in cirrhotic patients with acute variceal bleeding, Hepatolog. 50:403A.

[13] McDonald, P. Edwards, J. and Greenhalgh, F. D. 1992. Animal Nutrition. 4th Edn. Published in the United States with John Wiley and Sons. Inc. NewYork. P. 455-483.

[14] National Research Council (NRC) 1994. Nutrient Requirement for Poultry. 9th Edn., National Academy Press,Washington DC, USA.

[15] American Protein Corporation (APC) (2003). Aquaculture information. APC Europe S. A., Barcelona, Spain. P. 34

[16] National Research Council (NRC) 1993. Nutrient requirement of fish. Washington D. C., National Academy Press. P. 148.

[17] Association of Official Analytical Chemist, 1990. Official Methods of Analysis, 15th Edition.*AOAC*, Washington, D. C. P. 56 – 87.

[18] Pearson, P. 1976. Chemical analysis of foods (6th edition). Churchhill, London, P. 6 -9.

[19] Aletor, V. A., Oshodi, A. A. and Ipinmoroti, K. O. 2002. Food chemistry, 78(1), 63 – 65.

[20] Minzava, N. A. 1997. Comparing nutritional values of exotic and indigenous vegetables. In: Proceedings of a workshop on indigenous vegetables. Limbe Cameroon, P. 67-99.

[21] Adubiaro, H. O., Olaofe, O. and Akintayo, E. T. 2011. Chemical composition, calcium, zinc and phytate interrelationships in *Albizia lebbeck* and *Daniellia oliveri* seeds, Oriental J. Chemistry, 27 (1), 33-40.

[22] Duarte, R. T., Sinoes, M. C. C. and Sgarbieri, V. C. 1999. Bovine blood components fractionation, composition and nutritive value. J. Agric. And Food Chem. 47 (1), 231 – 236.

[23] DeRouchey, J. M., Tokach, M. D., Nelssen, J. L., Goodband, R. D., Dritz, S. S., Woodworth, J. C., Webster, M. J. and James, B. W. 2003. Effects of blood meal pH and irradiation on nursery pig performance. J. Animal Sc. *81*(4), 1013-1022.

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