EFFECT OF STEAM PROCESSING ON THE MINERAL COMPOSITION OF BLOOD MEAL SOURCED FROM CATTLE, GOAT AND SHEEP IN ZARIA, NIGERIA

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Abstract: The study assessed the effect of steam processing on the mineral element content of five composite sample of blood meal sourced from each of cattle, goat and sheep. The mineral composition of five composite samples of blood meal sourced from each of cattle, goat and sheep were analysed for the presence of the following mineral elements: sodium and potassium using flame photometry; phosphorus using colorimetric technique; while calcium, magnesium, iron, manganese, zinc and nickel using atomic absorption spectroscopy respectively for both the steam processed and non-steam processed blood meal. The result indicated that steam processing significant elevate the concentration of sodium, potassium, calcium, phosphorus, magnesium and manganese while zinc and nickel content depreciates but the concentration of iron and copper remains unaffected by steam processing in the various blood meal sourced from cattle, goat and sheep (P<0.05).

Keywords: Blood meal, cattle, goat, mineral composition, sheep, atomic absorption spectroscopy.

Introduction
Blood meal is a product from slaughtered animals like cow, horse, and swine etc. The product is reported to be rich in lysine, arginine, methionine, cystine, and leucine (NRC, 1994). Hence blood meal is being used as supplement to compensate the lysine and methionine usually being deficient in vegetable protein based diets in poultry and fish feeds (McDonald et al., 1992). Blood meal has been prepared using various methods and the common fact among them all is that the product is dehydrated to a very low moisture content, after most of the water has been dried off it is then spread out for more drying using the sun or by means of other artificial heating system before grinding into fine particles (Tabinda et al., 2007). Moreover, the quality of blood meal protein is usually affected by its processing method. Hence, variation in the quality of the products in processing plants is very common (McDonald et al., 1992). For instance an elevation in calcium/phosphorus ratio, acidity, ash content and crude lipid has been reported due to processing of blood meal sourced from cattle and goat (Omoniyi et al., 2013). Processing methods of blood meal is of great importance since blood is a highly perishable product and must be processed as soon as possible to avoid decadence usually by reducing its moisture content to less than 10.0-12.0% moisture and stored in a dry place in order for it not to deteriorate. Other processing methods of blood meal preparation include: solar drying, oven drying, drum drying, flash drying and spray drying among others (Heuze & Tran, 2013). Raw blood has also been stabilized and stored for one week by adding 0.70% sulphuric acid or an equivalent of another acid. Blood can equally be coagulated to aid the removal of water, by the addition of 1.0% unslaked lime or 3.0% slaked lime even though this method of dehydration is usually evidence with an increase in the amount of dry matter losses by about 10.0-15.0%, which may include some of the useful minerals present (Maiga et al., 1996).

Blood meal is used in most occasions as feed ingredient and may be incorporated into animal feed during feed manufacturing processes which may include: grinding of feed ingredients to enable mixing of different ingredients (Peisker, 2008); conditioning and pelleting to agglomerate smaller feed particles with the help of mechanical pressure, moisture and heat to larger particles. This tends to improve animals performance by reducing feed wastage as well as selective feeding and improves palatability (Hacking et al., 1978; Pietzsch 1985); expansion to enhance the flexibility of ingredients usage as well as animal performance (Wilson et al., 1998). Nevertheless, the aim of this study is to assess the effect of steam processing on mineral composition of blood meal sourced from cattle, goat and sheep.

Materials and Methods
Sample collection and treatment
Five composite samples of blood were collected from cattle, goat and sheep at the point of slaughter separately in sterilized beakers at Zango and Yan Awaki abattoirs in Zaria, Nigeria. The samples were preserved in polyethylene buckets packed with ice from the sampling point to the laboratory. A 0.5 liters portion of each of the sample collected were allowed to stand for 6 h, after which the liquid portion was decanted, the solid was then sun-dried and ground to powder. While another 0.5 liters portion of each of the blood from cattle, goat and sheep was processed by steam at a regulated temperature of 100°C for 45 min by means of steam bath. The coagulated solid of each sample was separated from its serum by decantation and sun dried for 72 h before grinding into meals using an agate mortar and pestle (Procter and Meullenet, 1998; Marichal et al., 2000).

Sample digestion for elemental analysis
One gramme of each of the sample of cattle, goat or sheep blood meal was reflux with 30.0 ml aqua regia in a beaker at a temperature of 75°C until brown fumes were completely liberated; the solution was allowed to cool, filtered and made up to 100 ml with distilled water (Jon, 1980; Ehi-Eromosele et al., 2012).

Determination of mineral content
The concentration of the mineral elements: calcium, iron, magnesium, manganese, zinc, copper, and nickel in the blood meal samples were determined by the means of an automated atomic absorption spectrophotometer (Unicam 669) set at the wavelengths of 422.7, 248.3, 285.2, 279.4, 210.0, 213.9 and 228.8 nm.
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213.8, 324.7 and 236.0 nm, respectively while the concentrations of potassium and sodium were determined using the flame photometer (Jenway PFP7).set at the wavelength of 589.0 and 766.0 nm, respectively after acid digestion of the samples. The phosphorus content was determined by means of a colorimeter at a wavelength of 430 nm after colour development with the aid of vanadate molybdate reagent (AOAC, 1990).

Results and Discussion

Sodium

The mean concentrations of sodium in the non-steam processed blood meal sourced from cattle, goat and sheep were 0.224%, 0.222% and 0.228% while in the steam processed blood meal it was 0.801%, 0.730% and 0.775%, respectively as shown in Fig. 1. This indicates that the concentrations of sodium have significantly increased by about three fold at 95.0% confidence limit as a result of steam processing. The higher concentration of sodium may be due to effective concentration of the minerals on dehydrating and effective denaturisation of blood protein which tend to release the mineral from its matrix while heating. The low concentrations of sodium in the non-steam processed blood meal may be due to loss of minerals on decantation of the liquid portion of the blood in order to get it in the dry form.

Potassium

The mean concentrations of potassium were 0.0396%, 0.256% and 0.214% in the non-steam processed blood meal sourced from cattle; goat and sheep while in the steam processed blood meal were 0.186%, 0.408% and 0.452%, respectively as presented in Fig. 1; indicating an elevation in potassium content as a result of processing. The higher concentrations of potassium may be due to effective concentration of the minerals on dehydrating and denaturisation of blood protein with heat. Sodium and potassium are generally required for the maintenance of osmotic balance of the body fluids and retention of protein during growth (NRC, 1989).

Calcium

The average concentrations of calcium in the non-steam processed blood meal from cattle, goat and sheep were 0.0467%, 0.0511% and 0.0431% while in the steam processed product it was 0.796%, 0.869% and 0.831% for cattle, goat and sheep as presented in Fig. 2. The concentration of calcium showed a statistical difference between the steam and non-processed product indicating a higher concentration in the steam processed product implying that steam processing affects the concentration of calcium in the product due to denaturising of blood protein and consequent release of mineral ion in the various samples. The high calcium content of the product alongside other elements like potassium and magnesium will help lower blood pressure as reported in several clinical studies (Osborne et al., 1996; Zewel, 1977).

Phosphorus

The mean phosphorus content of the non-steam processed blood meal from cattle, goat and sheep were 0.0482%, 0.0731% and 0.0688% while in the steam processed blood meal were 0.157%, 0.157% and 0.147%, respectively as presented in Fig. 2; indicating a significant difference in phosphorus content between the steam processed and non-steam processed product. The higher content of phosphorus in the steam processed product may be due to effective release of phosphate ion on steam heating as blood protein gets denatured at elevated temperatures. The presence of abundant phosphorus and calcium would make the steam processed product more useful in proper bone formation (Shills, 1992).

Iron

The mean concentrations of iron in the non-steam processed blood meal sourced from cattle, goat and sheep were 1330 mg/kg, 1715 mg/kg and 1458 mg/kg while in the steam processed blood meal it was 1368 mg/kg, 1352 mg/kg and 1450 mg/kg as presented in Fig. 3. This indicates no significant difference in concentration as a result of processing (P<0.05) between the steam and non-steam processed products. Since the products are rich in iron which is an important component of the haemoglobin hence both the steam and non-steam processed products are essential for blood formation as well as the normal functioning of the central nervous system (Vyas & Chandra, 1984).

Magnesium

The concentrations of magnesium in the non-steam processed blood have their average values as 263.9 mg/kg, 236.1 mg/kg and 231.9 mg/kg while they were 2688 mg/kg, 2521 mg/kg and 3009 mg/kg for the steam processed product samples as shown in Fig. 3, indicating that steam processing significantly elevates the magnesium content of blood meal. The higher content of magnesium of the steam processed product may be due to effective
release of magnesium on dehydrating via steam processing and denaturinof blood protein as a result of heat. Magnesium is also an activator of many enzymes systems and also maintains the electrical potential in nerves (Shills, 1992).

Copper
The mean concentrations of copper in the non-steam processed blood meal sourced from cattle, goat and sheep were 5.84 mg/kg, 9.94 mg/kg and 6.76 mg/kg while they were 4.71 mg/kg, 6.77 mg/kg and 11.7 mg/kg in the steam processed as presented in Fig. 5. There is no significant difference in the concentration of copper between the steam processed and non-steam processed product, indicating that steam processing has no effect in the concentration of copper in blood meal.Copper is required as a co-factor in different oxidative and reductive enzymes. According to Nair et al. (1997), it’s also important for red blood cell formation, mitochondria function and a component of ribonucleic acid (Mielcarzet al., 1997).

Nickel
The mean concentrations of nickel in non-steam processed blood meal sourced from cattle, goat and sheep were 5.88 mg/kg, 6.64 mg/kg and 4.2 mg/kg while they were 1.49 mg/kg, 1.61 mg/kg and 1.78 mg/kg in the steam processed blood meal as shown in Figure 5. This indicates a slight decrease in nickel concentrations in the steam processed product. More than 90% of Nickel taken in is held in the organic form that can be safely excreted (ATSDR, 1999).

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Conclusion

The study reveals that steam processing of blood meal sourced from cattle, goat and sheep significantly elevate the concentrations of phosphorus and manganese by about two fold their initial concentrations; sodium and potassium by about three fold their initial concentrations; calcium and magnesium by about ten times their initial concentrations as a result of the effect of steam processing of blood while zinc and nickel content depreciates by about one fold of their initial concentrations. Nevertheless
the concentration of iron and copper showed no significant change as a result of steam processing in the various blood meal sources (P<0.05).

References