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PROXIMATE COMPOSITION AND MINERAL ANALYSIS OF GOAT'S LIVER, COW'S PANCREAS AND THEIR MEAT STOCK

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ABSTRACT

The study was carried out to determine the proximate composition as well as the concentration of Na, K, Ca, Mg, Fe, Zn, Mn, Cu, Ni and Pb in goat's liver, cow's pancreas and their meat stocks as few or no researches have been conducted for the samples under investigation. The standard procedures of AOAC (1990) were followed to determine the proximate composition while the mineral analyses were carried out using Atomic Absorption Spectroscopy (AAS). The mean moisture content for goat's liver, cow's pancreas, stock from goat's liver and stock from cow's pancreas ranged between 19.66±0.20, 19.17±0.14, 12.00-19.66 % while the protein content is in the range of 40.38-51.2 %, also 26.1-32.26 % for crude fat and lastly 2.35-15.05 for ash content. Crude fibre and carbohydrate were absent in the meat sample. The level of the minerals in the meat products ranged between 38.30 -144 mg/kg for Na; 95.60-182.50 mg/kg for Ca; 21.20-77 mg/kg for K; 4.51-4.94 mg/kg for Mg; 2.00-30.00 mg/kg for Fe; 0.32-5.95 mg/kg for Cu; 0.97-1.54 mg/kg for Mn; 1.83 -6.25 mg/kg for Zn; 0.01-0.30 mg/kg for Pb and 0.01 mg/kg Ni for all the four samples. The results indicate that goat's liver, cow's pancreas and their meat stock contains high level of protein and fat. The concentrations of the trace elements were below tolerance limit. Therefore, it was concluded that the meat product has high nutritional value and safe for human consumption.

KEYWORDS: Cow's Pancreas, Goat's Liver, Mineral Composition, Proximate Analysis.

INTRODUCTION

Meat and meat products are very rich source of nutrients, including the necessary trace elements needed for the functionality of the body system. The nutritional content and chemical composition of meat and their products varies amongst the same breed depending on the type and rate of feeding [1].

The liver and pancreas of a mammal are generally classified as meat. The liver is particularly useful for the evaluation of animal's status in relation to cobalt, copper, manganese, and selenium [2], [3]. Liver is characterized with a wide spectrum of vitamins, minerals, proteins and fat. It is an embodiment of key nutrients that help keep human brains healthy.

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Some of the essential fatty acids in liver are EPA (eicosapentaenoic acid), DHA (docasahexaenoic acid), and AA (arachidonic acid), as well as vitamin B12 [3].

Disorderliness of the nervous system may be attributable to vitamin B12 deficiency causing diverse illnesses and behaviors. The consumption of liver as a good choice of vitamin B12 provides solution to a person experiencing vague symptoms such as difficulty in thinking and remembering, panic attacks, weakness, loss of balance, numbness in the hands and feet, or agitated depression. Vitamin B12 is only well absorbed from animal sources, with liver being the most concentrated source [4].

According to the free dictionary, the pancreas of a cow is classified under beef which is succinctly defined as flesh of various bovine animals, especially the cow, when killed for eating. Beef is a good source of complete protein and minerals such as zinc, selenium, phosphorus and iron, and Vitamin B. Pancreas as an example of an organ meat contains high level of pentose nucleic acids, approximately two times their contemporary organ meat. It was observed that the nucleic acids in pancreas can act in loco as in diffusible, strongly buffering substances, capable of preventing rapid changes in the reaction of the gland during secretion [5].

Meat stock is a food material produced from simmering meat of animals such as beef, mutton etc. as well as their bone in water. In other words, meat stock can also be called bone stock or broth [5]. Goat's liver and cow's pancreas stock are perfect example of meat stock. Meat stock is a good source of gelatin and free amino acids, like proline and glycine. These amino acids, along with the gelatinous protein from the meat and connective tissue, are particularly beneficial for healing and strengthening connective tissue found in the lining of the gut, respiratory tract, and blood/brain barrier.

The major component of meat stock is gelatin and it assists in the proper digestion of proteins ensuring optimal growth in infants and children. Gelatin accentuates collagen, which is reflected in the improved appearance of the skin as well as in the lessening of digestive tract inflammation. Although gelatin is not a complete protein, containing only the amino acids arginine and glycine in large amounts, it acts as a protein sparer, helping the poor stretch a few morsels of meat into a complete meal [6]. Meat stock contains minerals such as calcium, magnesium, phosphorus, silicon, sulphur and some trace minerals in an easily digestible form. It contains the broken down material from cartilage and tendons-stuff like chondroit in sulphates and glucosamine, now sold as expensive supplements for arthritis and joint pain [7].

Minerals are inorganic nutrients required in small quantity with a variation of 1 to 2500 mg per day depending on the mineral. As with vitamins and other essential food nutrients, mineral requirements vary with animal species. However, humans and other vertebrates need large amounts of calcium for construction and maintenance of bone and normal functioning of nerves and muscles [8].

Minerals may be broadly classified as macro elements and micro elements. The macro-elements include sodium(Na), potassium(K), calcium(Ca) etc., while micro-elements include chromium (Cr), cobalt (Co), copper (Cu), iodine (I), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se), zinc (Zn) etc [9]. The distinguishing factor between micro or "trace" minerals and macro minerals are based strictly on the amount required in the diet in line with metabolic needs [10].

The nutritional value of these various minerals cannot be over-emphasized if present at an acceptable limit but it is otherwise harmful above this critical limits. Zn is essential for normal functioning of cells including protein synthesis,

carbohydrate metabolism cell growth and cell division [8]. Calcium is a constituent of bones and teeth and it functions as a regulator of nerve and muscle function. Potassium helps to transfer of phosphate from ATP to pyruvic acid and also pivotal in many basic cellular enzymatic reactions. Potassium concentration above critical level in the serum causes hyperkalaemia which ultimately lead to Addison's diseases and other related diseases [11]. Sodium is the most important cation in intracellular fluids and above critical level in the serum results into a disease called hypernatraemia [8]. Copper facilitate the absorption of iron and it's a major constituent of enzymes like cytochrome c oxidase, catalase, peroxidase etc. [6].

The objective of this study is to present the proximate composition and determine the mineral content of goat's liver, cow's pancreas and their meat stock.

MATERIAL AND METHOD

- **SAMPLE COLLECTION AND PREPARATION**

A total of two meat samples comprising of goat's liver and cow's pancreas were purchased from a local market (Oja Oba) in Akure, Ondo State of Nigeria. The samples were thoroughly washed under running water in order to remove the debris and blood attached to it. About 500g of each sample were placed in a separate clean stainless pot and then boiled at 105°C using a hot plate. The resulting stocks from each meat samples were separated from the meat samples into two different containers, followed by decantation, subsequent evaporation to dryness and placement into an air-tight container. The boiled meat samples were sun-dried for 72 hours. The dried samples were pulverized separately using porcelain mortar and pestle and are then placed in an air-tight container and kept in the refrigerator alongside the dried meat stock until they are required for analysis.

- **PROXIMATE ANALYSIS**

Proximate analysis of the meat and their meat stocks which includes crude protein, water, fat, ash, crude fibre and the carbohydrate determination by difference was done using AOAC methods (1990). All analysis was done in triplicate.

- **MOISTURE DETERMINATION**

3g of each of the samples were weighed into dried crucible of known weight. The samples were introduced into an oven at 105°C and heated for 6 hours. The dried samples were placed into desiccators, allowed to cool and reweighed. The process was repeated until constant weight was obtained. The difference in weight was calculated as a percentage of the original sample and moisture content was determined.

- **ASH DETERMINATION**

3g of each of the samples were weighed into crucible, heated in an oven for 3hours at 100°C. The resulting samples is then transferred into a muffle furnace at 550°C until light grey ash result. The samples from the furnace were placed in a desiccator, allowed to cool and reweighed. The weight of the residual ash was then calculated as:

$$\text{Ash content} = \frac{\text{Weight of the ash}}{\text{Weight of original sample}} \text{x } 100$$

- **CRUDE FAT DETERMINATION**

3g of the sample was wrapped with a filter paper and put into the thimble which was fitted to a round bottom flask containing 120ml of petroleum ether in a Soxhlet apparatus. The sample was heated with a heating mantle and allowed to reflux for 5hours. The heating was stopped and the spent sample was air-dried and later weighed. The difference in weight was received as mass of fat and is expressed in percentage.

Crude Fat = $\frac{W1 - W2}{W1}$ x 100

W_1 = Weight of the sample before reflux

W_2 = Weight of the sample after reflux

- **PROTEIN DETERMINATION**

The protein content was determined by Kjedahl method as described by AOAC (1990). 2g of the sample was added to 10ml of concentrated H_2SO_4 in a heating tube. One tablet of selenium catalyst was added to the solution in the tube and then heated inside a fume cupboard. Some volume of distilled water was added to the digestate and 10ml of the resulting mixture was added to 25ml of 45% NaOH solution and poured into a kjeldahl distillation apparatus. The mixture was distilled and the distillate was collected into 4% boric acid solution containing 3 drops of methyl red indicator. A total of 50ml distillate was collected and titrated as well. The sample was duplicated and the average value taken. The Nitrogen content was calculated and multiplied with6.25 to obtain the crude protein content.

- **MINERAL COMPOSITION DETERMINATION**

The ash from each sample under analysis was dissolved in 20 mL of 10% HNO_3 and made up to the mark 100mL standard flask with distilled water. The solutions were then filtered using filter paper and the filtrates which contain dissolved minerals were transferred into 120 mL polyethylene bottles for analyses. The mineral contents of the samples were analyzed with the aid of Atomic Absorption Spectrophotometer (AAS-Bulk Scientific 210VGP) and Flame Photometer (FP 902PG) in analysis of Na and K.

- **STATISTICAL ANALYSIS**

One way analysis of variance (ANOVA) was carried out on the data obtained in other to determine any significant difference in the proximate and mineral composition in the various meat and their stock.

RESULTS AND DISCUSSION

The results of proximate composition of cooked goat's liver, cow's pancreas and their stocks are summarized in Table1.

Table 1.Proximate composition of goat's liver, cow's pancreas and their meat stock

Parameters (%)	Goat liver	Cow pancreas	Goat liver stock	Cow pancreas stock
Moisture content	19.66±0.58^{b}	19.17±0.70^{b}	12.00±0.31^{a}	12.15±0.26^{a}
Crude fat	30.26±1.74^{a,b}	26.10±0.85^{a}	32.26±1.95^{b}	31.00±0.57^{b}
Ash content	2.35±0.15^{a}	3.51±0.10^{a}	15.05±1.55^{b}	14.89±0.27^{b}
Crude protein	47.68±1.19^{b}	51.20±0.26^{b}	40.38±2.63^{a}	41.47±0.50^{a}

Values are expressed as mean ± SEM (n = 3); Values with different superscripts across the rows are significantly different from each other at p≤0.05.

- **MOISTURE CONTENT**

From the result of the analysis as expressed in Table 1, it was observed that moisture content is highest in the goat's liver (19.66 %) followed by cow's pancreas (19.17 %), cow's pancreas stock (12.15 %) and lowest in goat's liver stock. There is a significant difference ($p<0.05$) in the moisture content between the meat products (goat's liver and cow's pancreas) and their meat stocks. The value for cow's pancreas is lower than that reported by[12], (56.21%) while [13] reported higher value of 74.4 % for goat's liver. The difference in feed, breed and sample processing may be attributed to the disparity. The low moisture content of the goat's liver is of storage advantage because high moisture content aids microbial growth and decay of food material[14].

- **CRUDE FAT**

The percentage crude fat for the samples varied from26.1% to 32.26%. Goat's liver has the highest fat content (32.26%) while cow's pancreas has the lowest fat content (26.1%). There is a significant difference ($p<0.05$) in the fat content between the meat products and their meat stocks This result is higher compared to the fat content of goat's liver reported by [13] 3.41 % while [12] observed a close value of 26.29% for cow's pancreas. The result implies that an obese person should not or minimally consume this organ meat and their stock due to the high fat content.

- **ASH CONTENT**

The ash content for goat's liver and cow's pancreas are 2.35% and 3.51% which showed similar ash concentration. The ash content in goat's liver stock and stock from cow's pancreas are 15.05% and 14.89% with similar content which is relatively higher than their corresponding meat sample. There is no significant difference ($p<0.05$) between goat's liver and cow's pancreas but they significantly decrease with their meat stocks. The ash composition of cow's pancreas and goat's liver is higher than that reported by [13] 1.48 % and [12] 0.87 % respectively. The dissimilarity may be attributed to the difference in feed and breed of animals

- **CRUDE PROTEIN**

This study showed that the protein content is highest in cow's pancreas (51.2%) followed by (47.68%) in goat's liver, (41.47%) in cow's pancreas stock and lowest (40.38%) in goat's liver stock. There is a significant difference ($p<0.05$) in crude protein between the meat products and their meat stocks. The value is higher than 18.43 % reported for goat's liver [13] and [12] also reported a lower value of 13.38% for cow's pancreas. This study is in agreement with the established fact that meat products are highly proteinous [5]. The high protein content in the organ meats and their meat stock conferred on them usability in the formulation of infant feeds [15].

The result of mineral composition (mg/kg) of the goat's liver, cow's pancreas and their meat stocks are presented in Table 2.

Table 2.Mineral analysis of goat's liver, cow's pancreas and their stocks

Parameters	Goat liver	Cow pancreas	Goat liver stock	Cow pancreas stock
Sodium (Na)	456.30 ±0.265^{a}	544.00 ±1.732^{c}	533.90 ±3.637^{b}	454.70 ±0.265^{a}
Calcium (Ca)	167.30 ±0.265^{c}	182.50 ±0.5^{d}	102.30 ±0.1^{b}	95.60 ±0.265^{a}
Potassium (K)	1007.20 ±0.1^{a}	1500.00 ±2.645^{d}	1450.80 ±0.2^{c}	1200.80 ±0.7^{b}
Iron (Fe)	13.00 ±0.265^{c}	30.00 ±1.732^{d}	4.55 ±0.043^{b}	2.00 ±0.1^{a}
Magnesium (Mg)	4.65 ±0.132^{b}	4.51 ±0.045^{b}	4.94 ±0.026^{c}	4.17 ±0.027^{a}
Copper (Cu)	50.83 ±0.026^{c}	2.32 ±0.036^{a}	50.83 ±0.052^{c}	5.95 ±0.017^{b}
Manganese (Mn)	6.00 ±0.173^{c}	1.05 ±0.036^{a}	5.54 ±0.026^{b}	1.20 ±0.044^{a}
Zinc (Zn)	1.83 ±0.026^{a}	2.74 ±0.010^{b}	6.25 ±0.017^{d}	5.06 ±0.027^{c}
Nickel (Ni)	0.01 ±0.001^{a}	0.01 ±0.003^{a}	0.01 ±0.002^{a}	0.01 ±0.002^{a}
Lead (Pb)	0.01 ±0.002^{a}	0.20 ±0.022^{c}	0.30±0.026^{d}	0.1 ±0.010^{b}

Values are expressed as mean±SEM (n = 3); Values with different superscripts across the rows are significantly different from each other at $p<0.05$.

The result of the Analysis of Variance (ANOVA) of mean concentrations of the metals in goat's liver, cow's pancreas and their meat stocks showed significance differences ($p\leq0.05$) in the various

metals analysed between the four samples with exception of Nickel (Ni) which showed no significant difference ($p<0.05$) in the meat and meat products under study as presented by Table 2. This is as discussed below;

- **SODIUM**

The sodium (Na) content is highest in cow's pancreas (544 mg/kg) followed by meat stock from goat's liver stock (533.90 mg/kg) while goat's liver and cow's pancreas stock have 456.3 and 454.70 mg/kg respectively. The value for goat's liver is lower than 665.15 mg/kg reported by [13]. [12] reported a higher value of 730.85 mg/kg for cow's pancreas. It can be inferred that the meats products are good sources of Na. There is no permissible limit for sodium in human body. As an important cation in the body, it plays a great role in maintaining transmembrane potential [16].

- **CALCIUM**

The concentration of Ca in goat's liver, cow's pancreas and stocks from goat's liver and cow's pancreas are 167.30, 182.50, 102.30 and 95.60 mg/kg respectively. This study showed that calcium is highest in cow's pancreas and lowest in its stock. This is in agreement with value reported by [12] (130.4 mg/kg) for cow's pancreas and (142 mg/kg) for goat's liver [13].There is also no permissible limit for calcium. It is an essential mineral and the most important intracellular cation as it acts as a second messenger in various signal transduction cascades[16]. The meat samples can be used to supplement calcium deficient feed/food.

- **POTASSIUM**

The composition of potassium found in the samples varied between 1500 mg/kg to 1007 mg/kg. This research showed that cow's pancreas has the highest potassium concentration while goat's liver has the lowest potassium concentration. The value is lower compared to 2910 mg/kg and 2533.42 mg/kg reported for goat's liver and cow's pancreas respectively [13], [12]. The disparity may be as a result of the difference in breed and feed intake of the animals. They are hereby recommended for a hypertensive person due to their high potassium concentration [17].There is no permissible limit for potassium.

- **MAGNESIUM**

Magnesium (Mg) showed a relatively low composition in the entire samples with concentration ranging from 4.17mg/kg - 4.94 mg/kg respectively. This showed that all the four samples have similar Mg concentration. The values are not comparable with that reported for goat's liver (190 mg/kg) and 159.97 mg/kg for cow's pancreas [13], [12]. Foods that are high in fibre have high magnesium concentration [18]. Hence, the low content of Mg in the meat samples may be attributed to the absence of fibre. They are required in the body in good quantities for proper metabolism[8].

- **IRON**

Cow's pancreas has relatively high iron (Fe) content with a value of 30 mg/kg compared to goat's liver, goat's liver stock and cow's pancreas stock with value of 13, 4.55, and 2.00 mg/kg respectively. Iron (Fe) concentration is lower compared to 202.8 mg/kg and 313.68 mg/kg reported for goat's liver and cow's pancreas respectively [17], [20]. The variation may be attributed to difference in breed, feed intake of the examined animals and in sample preparation. Fe in all studied samples fell within the recommended tolerable levels. The upper tolerable intake level of Fe in children (up to 8 years) and adults (14-70 years) is between 40-45 mg/kg/day, respectively [21].

- **COPPER**

Goat's liver and its stock have relatively higher copper content with 50.83 mg/kg compared to

cow's pancreas and its stock which have 2.32 and 5.95 mg/kg respectively. This is in agreement with 51.4 mg/kg reported by [17] for goat's liver while [12] reported a close value of 1.65 mg/kg for cow's pancreas. The copper concentration in the organ meats and their stocks are lower than the permissible limit of 200 ppm [21].

- **MANGANESE**

The composition of manganese (Mn) in the samples varied from 1.05 mg/kg to 6.00 mg/kg. Goat's liver has the highest Mn concentration while cow's pancreas has the lowest Mn concentration. Manganese (Mn) concentration is similar compared to 6.5 mg/kg for goat's liver and 1.69 mg/kg reported for cow's pancreas respectively [17], [12]. No maximum limit was specified for Mn in foodstuffs [22.

- **ZINC**

The study showed that the goat's liver and cow's pancreas showed relatively low Zn concentration of 1.83 and 2.74 mg/kg compared to their meat stock with goat's liver stock exhibiting the highest concentration of 6.25 mg/kg. This value is lower compared to 34.538 mg/kg and 38.15 mg/kg reported for goat's liver and cow's pancreas respectively The zinc concentration of the studied samples were below the permissible limit (150 ppm) set by [22]. The relatively low zinc content may be due to a zinc deficient soil in which the feed for the examined ruminants grew from.

- **NICKEL**

The concentration of Nickel (Ni) in the meat samples and their corresponding meat stocks are the same showing a value of 0.01 mg/kg. This value is lower than 0.188 mg/kg and 0.213 mg/kg for goat's liver and cow's pancreas respectively [20]. According Codex Alimentarius International Food Standards (CAIFS), the allowable level for Nickel is 0.5 mg/ kg. Hence, the meat products are safe for consumption since their Ni contents are below permissible limit.

- **LEAD**

The lead (Pb) content is 0.01 mg/kg in goat's liver, 0.2 mg/kg in cow's pancreas, 0.3 mg/kg in goat's liver stock and 0.1 mg/kg in cow's pancreas stock. According Codex Alimentarius International Food Standards (CAIFS), the allowable level for lead is 0.5 mg/ kg. This connotes that goat's liver, cow's pancreas and their corresponding stocks are not injurious to human health and wellbeing upon consumption. Pb is known to accumulate mostly in the liver and/or its product [23]. (Oforka et al., 2012).

CONCLUSION

Based on the research in this study, the goat's liver, cow's pancreas and their corresponding stocks has shown to exhibit some varying chemical composition. The aforementioned food products are seen to possess high level of protein and fat which indicate their potential as serving as protein supplement so as to balance human nutrition. All the samples contained high lipid content and are a good source of calories or energy than the carbohydrates. The high fat content in all the sample is also an indication of their potential in causing obesity if consumed at higher rate.

This study has demonstrated similar chemical composition between goat's liver, cow's pancreas and the stock made from them. The similar chemical composition between the meat product and their meat stocks concretized the fact that some mineral and nutrient leached into the cooking liquid during the cooking process. This is an affirmation of the nutritive value of meat stocks and this justifies their usage as soup condiment in Africa, particularly in Nigeria.

The result of the mineral composition of goat's liver, cow's pancreas and their corresponding showed that they are good source of Ca and Na (cow's pancreas) and must be recommended for patients which have deficiency of these

important minerals in their body. The presence of lead (Pb) at an acceptable limit affirms that all the food products are safe for consumption.

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