Post-Slaughter Physiochemical Properties and Meat Quality Evaluation of Gayal *(Bos frontalis)*

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Contents

Abstract

Gayal (Bos frontalis) is a semi-domesticated bovine species valued for its meat. Yet, there is limited research on its nutritional composition compared to other bovine species. Assessing the proximate and mineral content of Gayal meat can provide insights into its dietary potential and guide its use as a protein source. The study aims to evaluate the proximate composition (dry matter, ash, ether extract, and crude protein) and mineral content (calcium, magnesium, potassium, and phosphorus) across different cuts of Gayal meat. These analyses provide a better understanding of the nutritional differences between cuts and compare Gayal with other commonly consumed cattle species. This study investigates the proximate composition and mineral content of Gayal meat, a valuable yet under-researched protein source. Conducted in Bakalia, Chittagong, Bangladesh, the research focuses on the nutritional properties of various cuts of Gayal (Bos frontalis) meat, including their moisture, protein, fat, and mineral levels. Utilizing standardized methods for proximate and mineral analyses, the study reveals significant differences across cuts, highlighting the loin as a particularly rich source of protein and low in fat, while the rump offers essential minerals such as calcium and phosphorus. The findings underscore the potential of Gayal meat as a nutritious alternative to other bovine species, providing insights into its suitability for human consumption and dietary recommendations. Statistical analyses confirm the significance of these variations, paving the way for future research into the health benefits and market potential of Gayal meat in sustainable food systems. Significant variations in dry matter, fat, protein, and mineral content were identified among the cuts ($p < 0.05$). ANOVA and Kruskal-Wallis tests confirmed statistically significant differences, highlighting the influence of anatomical location on the nutritional profile of the meat. The loin had the lowest protein content (25.1±0.01%) and the lowest fat content (0.49±0.03%), making it a suitable choice for lean meat consumers. The brisket showed the highest fat content (0.84±0.02%). Mineral analysis revealed that the rump contained the highest calcium (0.6±0.06%) and phosphorus (3.5±0.06%) levels, while the chuck was richest in potassium (1.7±0.06%). These results indicate substantial differences in nutritional composition across the cuts. The differences in protein and fat content between cuts align with known patterns in other bovine species, where loin cuts generally contain more protein and less fat. The higher mineral content in the rump, particularly calcium and phosphorus, is likely due to its proximity to bones and its role in supporting muscle function. These findings suggest that Gayal meat offers a nutritionally rich alternative to other cattle species, particularly in terms of protein and essential minerals. Gayal meat presents a valuable nutritional option, especially for consumers seeking high-protein, low-fat meat. The loin cut is especially rich in protein, while the rump offers high mineral content. Future studies should investigate the fatty acid and amino acid composition of Gayal meat to further explore its health benefits. Sensory analysis and consumer preference studies could also provide insights into its market potential. This study contributes to a broader understanding of underutilized livestock species and their role in sustainable food production systems.

Keywords: Proximate, Mineral content, Mithun, Beef, Semi-domestic

Chapter 1: Introduction

The Gayal, standing between 140-160 cm (55-63 inches) tall at the shoulder, is smaller than the gaur and has shorter legs. Male Gayal can weigh up to a ton, which is 20–25 percent more than females. Unlike the gaur, the Gayal lacks the prominent shoulder hump and has a shorter, wider, and flatter skull. Both males and females have horns that extend from the sides of their heads, which are larger but shorter than those of the gaur. A prominent double dewlap is present around the chin and throat. Females are brown-black, while males are black, and both sexes feature white stockings (Estes et al., 1998).

The Gayal, also called the "Hill cow" or "Forest cow," has become an important livestock in the Chattogram Division, where it has been raised commercially for over a decade due to its substantial meat production. This heavy-weight animal has gained popularity for its high meat yield, making it a valuable resource for farmers in the region. Originally considered a wild animal, the Gayal was reclassified as cattle in 1964, marking a significant shift in its status and paving the way for its domestication and commercial breeding. This reclassification has allowed the Gayal to be more widely utilized in agriculture, contributing to the livelihoods of those who raise it (Faruque, 2023).

Mithun is predominantly found on the southern slopes of the Eastern Himalayas and is considered rare compared to other cattle. According to Bhattacharyya et al. (2016), small populations of Mithun have been observed in the mountainous regions of Myanmar, Bangladesh, China, Bhutan, and India. Geographically, these animals inhabit areas ranging from low to high altitudes, preferring cooler climates with temperatures between 20°C and 30°C. The Gayal, on the other hand, is geographically restricted to the Yunnan province of China, Bangladesh, Myanmar, Bhutan, and the Northeastern hilly regions of India (Mukherjee et al., 2018).

Gayal are mainly reared for meat production. The weights of mature male and female Gayal differ. Male Gayal are heavier than female Gayal, with mature male Gayal weighing 700-800 kg and adult female Gayal weighing 400-600 kg.

Although the quality of both meat and milk of Gayal is excellent but milking is still not practiced. Farmers are preferred for meat purposes due to the rapid growth of Gayal. Gayal cows usually yield less milk than indigenous cows. Gayal's udder is invisible from the outside. Unlike indigenous cows, Gayals' udders do not swell even during pregnancy. Female cow teats are also smaller than those of indigenous cows. Gayal calf is permitted to consume all of mother gayal's milk (Chakma,S. 2023).

Farmers prioritize the growth rate of Gayal, a meat-producing animal. With adequate nutrition, Gayal can grow between 300 to 600 grams per day, which is comparable to cattle and buffalo growth rates. Notably, Gayal has a significantly higher plasma growth hormone concentration (30-90 ng/ml) than any other domesticated animal (Mondal et al., 2004, 2005d, 2006a, 2006c, 2006d). Gayal efficiently converts forest biomass into high-quality meat, which is tender and superior to other meat sources. The meat is also healthy, being low in fat, and is highly preferred by indigenous tribes. To maximize meat yield, it is optimal to slaughter Gayal at the age of 4-5 years, with a dressing percentage typically ranging from 58-62% (Mondal et al., 2014). Mature Gayal males generally weigh between 600 to 700 kg, while females weigh between 400 to 500 kg. The average daily milk production of Gayal is reported to be 305±30.5 mL/d (Giasuddin et al., 2003a). Although Gayal produces around 1-1.5 kg of milk per day, its milk is not commonly consumed (Nath and Verma, 2000). However, Gayal milk is nutritionally superior, containing 3.4–17% fat, 6.8–22.2% SNF, and 4.4–9.8% protein, and is used to create various delicious dairy products. Additionally, Gayal hide and skin are more valuable than cow leather in the tanning industry due to their durability and quality, and are used to make items such as footwear, clothing, bags, coats, purses, decorative ornaments,and furniture covers (Shisode et al.,2009).

The Gayal meat sector is becoming an important contributor to local economies. Gayal meat is known for its low-fat content, higher protein value, and distinctive flavor, making it a sought-after product in niche markets. Moreover, its ability to thrive in non-intensive farming environments makes Gayal an attractive option for sustainable meat production.

While Gayal meat has traditionally been consumed within indigenous communities, there is growing interest from external markets. This rising demand has led to increased efforts to commercialize Gayal farming, especially for meat production. However, there remains a lack of scientific research on the nutritional composition, meat quality, and best farming practices for optimizing Gayal meat production as well as public awareness on gayal meat. Considering the above facts, the present study was conducted to fulfil the following objectives –

1. To assess the proximate and mineral contents of gayal meat.
2. To explore its composition and health benefits in human diets.

Chapter 2: Materials and Methods

Study area

Bakalia, a prominent area in Chittagong, Bangladesh, known for its agricultural pursuits and livestock management, served as the study's location. Southeast Asian wild cattle known as gayal (Bos gaurus), are raised and killed in this region according to tradition, which makes it noteworthy. As a reliable supply of meat samples for research, gayals in Bakalia are usually killed once a week. Gayal beef is regularly available in this area, which is important for understanding its nutritional qualities. For this reason, it was carefully selected as the study site.

Bakalia is an ideal setting for researching gayal meat because of its unique topography and regional livestock management techniques. The community is an excellent place to get high-quality samples because they are accustomed to the slaughtering procedure and the care with which the meat is handled. To better understand the nutritional value of gayal meat and its possible advantages for consumption by both humans and animals, the study concentrated on the meat's proximate composition and mineral content.

Once in the lab, the samples underwent proximate analysis in the department of Animal science and Nutrition, CVASU Animal Nutrition laboratory, which included evaluations of the contents of ash, fat, protein, and moisture. To fully comprehend the meat's fitness for consumption, proximate analysis is necessary to ascertain the meat's overall nutritional worth. To guarantee accuracy and dependability, the methodologies used in this investigation followed established protocols.

In addition to proximate analysis, the mineral content of the Gayal meat samples was evaluated in the department of Physiology Biochemistry and Pharmacology Laboratory CVASU. Minerals play a vital role in animal nutrition, contributing to various physiological functions and overall health. The examination of mineral content included identifying essential minerals such as calcium, phosphorus, iron, and phosphorus, which are crucial for both animal health and human nutrition. Understanding the mineral composition of Gayal meat can help determine its potential benefits and its role in dietary recommendations.

Sample collection:

Samples were collected for this investigation early in the morning, at approximately 4 AM, following the Gayal's slaughter. The early morning time was selected to guarantee the meat samples' freshness, which is essential for precise analysis. Quickly moving the samples reduces the chance of spoiling and guarantees that the meat's qualities are maintained for additional analysis.

It took a CNG car about thirty minutes to get to Bakalia from my university, where the study location was located. Timely sample collection was made possible by this effective means of transportation, which made it easier to stick to the research schedule. Once here, I worked with the cattle farmers in the area to arrange for the collection of Gayal meat as soon as it was killed. The collaboration of regional partners proved to be extremely beneficial during this procedure, as their proficiency and understanding guaranteed that the specimens were treated in accordance with optimal methodologies.

To avoid contamination, the samples were put in sterile containers after they were collected. After that, they were returned to the Animal Nutrition Lab at the Chittagong Veterinary and Animal Sciences University, where they were put straight into a freezer to stop any biochemical reactions that would change their characteristics. In particular, when examining the nutritional components of meat samples, proper storage conditions are essential to preserving their integrity.

Proximate analysis

Estimation of Dry Matter

To determine the dry matter of a meat sample, start by preparing a representative sample of known weight. First, weigh the fresh meat sample (W1) using an analytical balance and record this weight in grams. Place the sample in a crucible and then into a drying oven set at 105°C (221°F), allowing it to dry for 24 hours or until it reaches a constant weight, which indicates that all moisture has evaporated. After drying, remove the crucible and let it cool in a desiccator to prevent moisture absorption. Finally, weigh the crucible with the dried sample (W2) and record this weight. The dry matter content can be calculated as a percentage by dividing the final weight (W2) by the initial weight (W1), then multiplying by 100.

Estimation of Crude Protein by Kjeldahl Method

First, use concentrated sulfuric acid (H_2SO_4), copper sulfate ($CuSO_4$), and potassium sulfate (K_2SO_4) to digest the sample in a Kjeldahl flask to assess the nitrogen concentration. Ammonia can be released from the solution by neutralizing it with sodium hydroxide (NaOH) after digestion. Distil the ammonia into a typical acid solution after that. Lastly, use NaOH to titrate the residual standard acid to determine the nitrogen content.

Estimation of Ash

Start by using a hot air oven to clean and dry the crucible. After it has dried, weigh the crucible after cooling it in a desiccator. 5–10 g of the sample should be added to the crucible. Burn the sample, making sure no smoke is released. The sample should be cooled after burning before being placed in a muffle furnace. For 6–8 hours, ignite the sample between 550 and 600°C until white ash develops. After the procedure is finished, move the crucible to a desiccator and cool the furnace to 150°C. To finish the process, weigh the ash while it's still warm.

Estimation of Ether Extract by Soxhlet's Apparatus

To get rid of the moisture, first dry the sample. Weigh precisely the dry extraction flask. Once the sample weighs two to three grams, put it in a thimble. Cover the top of the thimble with cotton after inserting it into the extractor. Pour in the remaining solvent after halfway filling the extractor with solvent. Heat the device to 40–60°C for 6–8 hours to start the extraction process. Disassemble the flask and put it in a hot air oven to dry after the extraction is finished. Once the flask reaches a consistent weight, heat it to 100°C. To measure the ether extracts, chill the flask in a desiccator and weigh it.

Minerals

Potassium

For the potassium determination procedure, set the wavelength to 630 nm using a red filter (Hg623). Begin by adding 1.0 mL of potassium reagent (L1) to each test tube. For Value B, add 0.02 mL of deionized water; for Value S, add 0.02 mL of potassium ion standards; and for Value T, add 0.02 mL of the sample. Mix all solutions thoroughly and incubate them at room temperature for 5 minutes. Within 15 minutes, measure the absorbance of the standards and the test sample against the blank to obtain the necessary readings.

Magnesium

To begin the procedure, bring all reagents and samples to room temperature. Next, pipette the reagents into labeled test tubes, ensuring one tube contains the R1 reagent samples and the other contains the CAL standard. Mix the contents of the tubes and let them stand for 2 minutes at room temperature. After the waiting period, read the absorbance of both the samples and the standard at 520 nm, using the reagent blank as a reference. Note that the color remains stable for at least one hour, allowing ample time for measurements.

Calcium

Procedure

Calibrate the spectrophotometer according to the manufacturer's instructions, setting the wavelength to 570 nm for O-cresolphthalein or to another specified wavelength as required by different methods. Before testing, ensure that all reagents and samples are brought to room temperature. Thoroughly mix the reagents, then pipette the appropriate volumes into separate test tubes or cuvettes for the sample, standard, and blank, typically using 500 µL of reagent 1 (Calcium reagent) along with 50 µL of the patient sample, standard, or blank (which is usually deionized water). Mix the contents well to ensure proper reaction.

Phosphorus:

Procedure

To prepare for phosphate determination, start by preparing a series of standard phosphate solutions by diluting a stock solution of known concentration (e.g., 1000 µg/mL KH_2PO_4) to create a calibration curve with concentrations such as 0, 10, 20, 30, 50, and 100 µg/mL. Next, prepare the molybdate reagent by mixing a solution of ammonium molybdate in sulfuric acid, ensuring it is freshly made for optimal results. If using a reducing agent like ascorbic acid, prepare that solution as well. Collect water or soil samples for phosphate determination, and if the sample is solid, digest it to extract the phosphates. For each sample and standard solution, add a fixed volume of the molybdate reagent (usually 1-2 mL), and if necessary, include the reducing agent to develop the color. Allow the reaction to incubate for a specific period (e.g., 10-30 minutes) at room temperature or in a water bath if heating is needed. Finally, set the UV-Vis spectrophotometer to the appropriate wavelength, typically around 880 nm for the phosphomolybdate complex, and measure the absorbance of the standards and samples in cuvettes against a blank (distilled water or a blank sample without phosphate) Plot the absorbance of the standard solutions against their concentrations to create a calibration curve.

Statistical Analysis

Firstly, the collected data were entered into Microsoft Office Excel 2016, data were then cleaned. Next, it was transferred to the R program (version 4.33) for the purpose of data analysis. For summary statistics, the mean and standard error were calculated. The data were checked to determine if the distributions were normal. For variables with a normal distribution, a one-way ANOVA was conducted, followed by Tukey's Post Hoc test if a significant P value was found. Otherwise, for variables without a normal distribution, the Kruskal-Wallis's test was conducted, followed by Bonferroni multiple comparison test, when a significant relationship was identified. The P-value was considered significant, if $P < 0.05$.

Chapter 3: Results

Table 1: Proximate parameters of gayal meat.

Parts	Proximate components				
	DM (Mean±SE)	**Ash (Mean±SE)**	**EE (Mean±SE)**	**CP (Mean±SE)**	**NFE (Mean±SE)**
Brisket	30.0±0.01^{a}	1.33±0.001^{b}	0.84±0.02^{a}	26.0±0.02^{b}	41.80±0.03^{b}
Chuck	29.0±0.01^{a}	1.33±0.003^{b}	0.70±0.04^{b}	25.5±0.03^{c}	43.50±0.06^{ab}
Loin	27.9±0.02^{b}	1.32±0.003^{b}	0.49±0.03^{d}	25.1±0.01^{d}	45.20±0.02^{a}
Round	29.8±0.01^{a}	1.37±0.002^{a}	0.65±0.01^{bc}	25.9±0.04^{b}	42.2±0.03^{b}
Rump	29.8±0.03^{a}	1.38±0.001^{a}	0.55±0.01^{cd}	26.4±0.03^{a}	41.90±0.04^{b}
Anova p- value	-	-	<0.001	<0.001	-
Kruskal Wallis p-value	0.01	0.01		-	0.01

Values with different superscript letters within the same column differ significantly (P<0.05).

Gayal meat from the loin region had a considerably lower dry matter (DM) content ($p \leq 0.05$) than meat from other locations, including the chuck, round, rump and brisket (Table 1). In a similar vein, the ash content ($p \leq 0.05$) of the round and rump was higher than the chuck, loin, and brisket (Table 1). The loin's ether extract (EE) value ($p \leq 0.05$) is likewise substantially lower than the brisket's (0.84±0.02%) and the other regions' EE values, which ranged from 0.55% to 0.84% (Table 1). The loin's crude protein (CP) concentration ($p \leq 0.05$) was significantly lower than that of the other parts, and rump had the highest crude protein (Table 1). The loin had the highest nitrogen-free extract (NFE) ($p \leq 0.05$) which was substantially higher than the NFE in the round, rump, and brisket (Table 1).

Table 2: Minerals of gayal meat.

Parts	Minerals			
	Ca (Mean±SE)	**Mg (Mean±SE)**	**K (Mean±SE)**	**P (Mean±SE)**
Brisket	0.32 ± 0.01^{a}	0.31 ± 0.01^{a}	0.95 ± 0.01^{c}	2.9 ± 0.01^{b}
Chuck	0.26 ± 0.01^{b}	0.18 ± 0.01^{b}	1.70 ± 0.06^{a}	2.5 ± 0.01^{c}
Loin	0.31 ± 0.01^{a}	0.17 ± 0.01^{b}	1.10 ± 0.06^{c}	2.9 ± 0.06^{b}
Round	0.27 ± 0.01^{b}	0.18 ± 0.01^{b}	1.30 ± 0.06^{b}	2.9 ± 0.06^{b}
Rump	0.6 ± 0.06^{c}	0.15 ± 0.01^{b}	0.95 ± 0.01^{c}	3.5 ± 0.06^{a}
Anova p-value	-	-	-	<0.001
Kruskal Wallis p-value	0.013	0.022	0.013	-

It was found that the different cuts of Gayal beef had significantly different calcium contents. There was a significant difference in the amount of calcium in the chuck cut and the rump cut. There is a statistically significant difference ($P \leq 0.05$) between the rump and chuck, suggesting that the rump has a higher calcium concentration. There was also a substantial ($P < 0.05$) decrease in the calcium content of the round cut compared to the rump. The amount of magnesium in the rump and brisket slices differed considerably. It was found that the rump had the lowest magnesium content ($P < 0.05$) while the brisket had the greatest. The amounts of potassium in the chuck, rump, and brisket cuts varied significantly from one another. It was evident that there was a significant difference in the potassium level of the chuck and the brisket ($P < 0.05$). Also, the potassium level of the rump cut was considerably ($P < 0.05$) lower than that of the chuck. The amount of phosphorus in each cut of Gayal beef also differed considerably. Phosphorus concentration varied greatly between the cuts; chuck cut had the lowest level ($P < 0.05$) and brisket had the highest. Moreover, there was a statistically significant difference between the chuck and loin in terms of phosphorus concentration. Phosphorus content was also found to differ significantly ($P < 0.05$) between the round and chuck cuts. Phosphorus content in the rump was the greatest of all the slices, and it differed from the chuck and loin by a considerable margin ($P < 0.05$). Because it has a higher phosphorus content than other cuts, the rump is highlighted as being especially rich in phosphorus.

Chapter 4: Discussion

This study provides significant insights into the proximate composition and mineral content of Gayal meat, revealing key differences across various cuts. These findings can be compared with other studies on bovine species, offering a deeper understanding of the nutritional value of Gayal meat and the possible reasons behind these variations.

The DM content was significantly lower in the loin compared to the other cuts, with brisket showing the highest DM. Similar patterns have been observed in beef and buffalo, where higher moisture content is generally found in the loin, contributing to a juicier and more tender meat texture (Hossain, M., et al., 2010). The higher moisture in the loin enhances the sensory qualities that consumers value in tender meat products (Troy & Kerry, 2010). These results agree with studies that found similar patterns of DM variation in other cattle breeds, supporting the notion that anatomical location plays a significant role in influencing moisture and fat content (Troy & Kerry, 2010).

The lower ash content in the loin compared to brisket suggests a low mineral presence in the loin. This is comparable to findings in other bovine species, where the loin cut has been shown to have higher mineral content due to its proximity to the skeletal system (Guerrero, et al., 2013). Minerals such as calcium and phosphorus, which are found in greater concentrations in the loin, contribute to bone strength and muscle function. These findings disagreed the present finding by studies in Yunnan Yellow Cattle, where similar trends in ash content were observed as like previous studies (Huque et al., 2001). Here some reasons for the difference in my opinion there may be less mineral deposition in the less active muscles of the gayal, which explains the reduced ash concentration in the brisket and loin. The ash level varies throughout research because to differences in genetics, muscle composition, and diet and different geographical region.

The ether extract (EE), or fat content, was significantly lower in the loin and highest in the brisket and rump. This variation is consistent with findings from other studies, where different anatomical regions show substantial differences in fat deposition (Wood et al., 2008). The loin, being a less active muscle, accumulates less fat compared to the brisket, which is more involved in locomotion and support. This result aligns with previous studies in which loin cuts of various cattle species were found to be leaner, while brisket and other active cuts had higher fat content (Wood et al.,2008). Fatty acid composition in Gayal meat has also been reported to differ from other cattle species, potentially making it a healthier alternative due to lower saturated fat levels (Mao et al., 2005).

The crude protein (CP) content was lowest in the loin and highest in the brisket, with significant differences across the cuts. This disagreed with studies on beef and other bovine meats where loin cuts are often found to be richer in protein (Shin et al., 2011). Protein content is a key indicator of meat quality, particularly for consumers who prioritize lean, high-protein diets. The low protein content in the loin suggests that this cut could be particularly valuable for those seeking high-quality, low-fat protein sources (Hoffman & Wiklund, 2006).

The outcomes also fulfill with research from other ruminant species, which suggests that muscles with lower levels of activity typically store more fat and glycogen, leading to a greater NFE. Research on buffalo and cattle, for instance, has shown comparable patterns, with the loin exhibiting a larger NFE than muscles involved in movement (Johnson et al., 2017). Because the loin is under less mechanical strain.

In comparison to the chuck and round, the rump had a noticeably higher calcium (Ca) concentration. Due to their proximity to bones, weight-bearing muscles like the rump are frequently richer in calcium. This pattern is congruent with the known distribution of minerals in bovine muscles (Pearson & Young, 1989). Because they are involved in both structural support and mobility, cuts nearer the skeleton, like the rump, have similarly been demonstrated to contain higher quantities of calcium in other bovine species (Pearson & Young, 1989). This discovery aligns with findings from research on Gayal and other regional breeds, which demonstrate that calcium distribution is not constant between cuts and is strongly impacted by bone closeness and muscle function (Mao et al., 2005).

The brisket had the highest magnesium (Mg) level, whereas the rump had a much lower magnesium content (0.15±0.006%). Studies on cattle have shown similar results, with magnesium levels varying across cuts because of variations in muscle metabolism and mineral retention (Warris, 2010). Brisket is a great way to get magnesium as it's necessary for both muscular contraction and enzymatic reactions. This is especially true for people who need more magnesium in their diet. These findings are in keeping with studies on other cow breeds, where brisket and comparable slices involved in increased movement exhibit higher magnesium levels (Kamra, 2005).

Potassium (K) content was highest in the chuck, while it was much lower in the rump (0.95±0.006%) and brisket (0.95±0.012%). Potassium is necessary for maintaining fluid balance and healthy muscular function, and research on cows have frequently shown that its levels vary between cuts (Lorenzo et al., 2014). Because of its high potassium content, chuck is an especially nutrient-dense cut that is important for preserving electrolyte balance. Higher potassium levels are necessary for the muscles employed for sustained exercise muscle contraction and nerve function, such as the chuck, according to earlier research (Huque et al., 2001). This finding is consistent with such research. The significant variations in potassium content across cuts reaffirm the notion that muscle activity level influences mineral accumulation, which is well documented in the literature.

The chuck had the lowest Phosphorus content whereas the rump had the highest. Phosphorus is essential for healthy skeletal development and energy metabolism; cuts nearer the bone, such as the rump, typically include higher amounts of phosphorus (Pearson & Young, 1989). Similar patterns have been observed in other cow species, with the phosphorus concentration of more active muscles or those close to bones being higher (Swanek et al., 1999). This result is in line with previous research that emphasizes the significance of anatomical location in the distribution of minerals in various beef cuts (Mao et al., 2005).

Chapter 5: Conclusion

Lesser known, gayal is a semi domesticated cow that is prized in some areas for its flesh. The necessity for this study was brought about by the paucity of research on its nutritional makeup. When evaluating Gayal meat's potential as a protein source in relation to other bovine species, it can be helpful to understand its nutritional profile.

Significant variations in the proximate composition and mineral content of Gayal meat between different slices are shown by this investigation. A great choice for people looking for lean, high-protein meat, loin stands out for its high protein and low-fat content. As expected for a muscle with greater activity, the brisket, on the other hand, had the highest fat level. The significance of anatomical location in affecting the distribution of fat and moisture is demonstrated by these data.

The results of the mineral study showed that the chuck had the highest potassium content, which is important for sustaining fluid balance and promoting muscular contractions, while the rump had the highest levels of calcium and phosphorus, which are critical for bone health and muscle function. These results align with general trends seen in other bovine species, where muscle function and proximity to bones affect mineral dispersion.

Recommendation:

Gayal meat (*Bos frontalis*) is an excellent subject for research due to its impressive nutritional profile, offering lower fat content and higher protein like conventional red meats. It is rich in essential amino acids, making it a valuable protein source for muscle development and overall health. Additionally, gayal meat provides significant levels of important minerals like Calcium, Potassium, and Magnesium, Phosphorus which support immune function, antioxidant activity, and red blood cell production and bone growth. With its leaner composition and higher nutrient density, gayal meat also presents potential health benefits such as improved heart health due to lower cholesterol levels.It represents a healthier and more environmentally friendly meat source, particularly in its native regions of Southeast Asia and Northeast India. The further research is also recommended to asses the details composition of gayal meat including vitamin and micro elements contents.

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