PROXIMATE COMPOSITION OF GREEN OFFAL (STOMACH AND INTESTINE) FROM CATTLE, SHEEP, GOAT, AND CAMEL

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ABSTRACT
The study assessed the proximate composition of green offal (stomach and intestine) from cattle, sheep, goat, and camel to evaluate their nutritional value and potential for dietary applications. Samples of the stomach and intestine were obtained, cleaned to remove debris, boiled, and analysed for proximate composition following standard AOAC methods. Data were statistically analysed using the general linear model procedure, and significant differences were compared using Duncan's multiple range test. The results revealed significant variations in proximate composition influenced by both animal species and offal parts. Among the species, goat and camel offal exhibited the highest protein content (27.81 and 27.50%, respectively), while sheep offal showed the highest lipid content (7.74%). Conversely, the lowest protein (22.43%) and lipid content (5.01%) were recorded in sheep and cattle offal, respectively. The stomach had higher dry matter (48.14%), lipid content (8.84%) and crude protein content (25.59%) compared to the intestine with values of 45.82%, 6.70% and 25.01%, respectively. Intestine contained higher nitrogen-free extract (4.92%) compared to the stomach (4.39%). Ash content was not significantly different (P>0.05) across the offal parts. The study concludes that goat and camel offal were superior in protein, nitrogen-free extract contents, while sheep and goat offal exhibited the highest lipid levels. The stomach generally contained higher dry matter, lipid and protein contents than the intestine. Hence, efforts should be directed on promoting the utilization of green offal, particularly goat and camel offal, as a sustainable and affordable protein source.
Keywords: Green offal, Nutritional value, Proximate composition, Red meat animals, Sustainable protein sources

DESCRIPTION OF PROBLEM

The proximate composition of meat and offal varies significantly across animal species and specific organs, which influences their nutritional value and suitability for dietary applications. Edible offal, which can constitute up to 40% of an animal's carcass weight, is recognized as a rich source of high-quality proteins, vitamins, and minerals, often surpassing skeletal muscle in nutrient density (Fuerniss *et al*., 2024). Despite its nutritional potential, offal consumption remains limited in many regions due to cultural preferences and a lack of awareness (Alao *et* al., 2018; Llauger *et al*., 2021).

Research has demonstrated marked differences in the chemical composition of offal across species and organ types. For example, veal, beef, and lamb offal exhibit variations in nutrient content, with organs like the liver and kidneys being particularly rich in essential minerals such as iron and zinc (Biel *et al*., 2019; Latoch *et al*., 2024). Additionally, a nutrient analysis of beef offal, reveals that each organ is a good or excellent source of essential nutrients, contributing to a balanced diet (Alao *et al*., 2018). The processing methods applied to offal further influence its proximate composition, affecting parameters such as moisture, protein, fat, and ash content (Fuerniss *et al*., 2024). Studies on calves under different production systems indicate that both organ type and production conditions significantly impact chemical composition and nutrient profiles (Muzzo *et al*., 2025).

Green offal, specifically the stomach (tripe) and intestines of red meat animals, are recognized for their nutritional value and are consumed in various culinary traditions. Tripe, the stomach lining of ruminants such as cows, sheep, and goats, is an inexpensive and sustainable protein source rich in essential nutrients. A 3-ounce serving of tripe was reported to contain approximately 10 grams of protein, crucial for muscle health, immunity, and overall body functions (Latoch *et al*., 2024).

Additionally, tripe is high in collagen, beneficial for skin elasticity, bone density, and joint health, and provides significant amounts of vitamin B12, calcium, phosphorus, and zinc, supporting various aspects of health (Lupu *et al*., 2020). Despite their nutritional benefits, green offal are often underutilized in many regions due to cultural preferences, lack of awareness and limited information. Given the observed nutritional potential of offal and variations across species and organ types, there is paucity of information on green offal of the animal species. Hence, the study aims at comparatively evaluating proximate composition of processed green offal from different red meat animal species.

MATERIAL AND METHODS

Experimental site

The study was conducted at the Animal Products and Processing Laboratory of the Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State. Zaria is located in the Northern Guinea Savannah zone, located on longitude 11°09' 01.78'' N and 7°39'14.79''E at an altitude of 671m above sea level (Ovimap, 2024). The climate is characterized by well-defined dry and wet seasons.

Source and processing of green offal

Samples (I kg each) of green offal (stomach and intestine) from cattle, sheep and goat was obtained from Central Abattoir, Kano. The collected samples were transported to the Animal Products and Processing Laboratory, Department of Animal Science, Ahmadu Bello University, Zaria for processing. The offal parts were trimmed, rinsed and washed thoroughly with clean water. The stomach and intestine were separated, cut into pieces, thoroughly rinsed and cooked by boiling. The products were analyzed for dry matter content, crude protein, lipid and ash content using the procedures of AOAC (2010)

Data analysis

All data obtained from the study were statistically analysed using the General Linear Model Procedure of Statistical Analysis Systems software package (SAS, 2002) while significant differences between treatment means was separated using Duncan Multiple Range Test (DMRT).

Results and Discussion

The results in Table 1 showed the proximate composition of processed red meat animals' green offal (stomach and intestine) across different species. The results showed that there were significant differences ($P<0.05$) in dry matter, crude protein, lipid and nitrogen-free extract content while ash was consistent across the species and offal parts.

Dry Matter (DM)

The dry matter content varied significantly among species, with goat offal showing the highest DM (51.06%), followed by camel (49.02%) and cattle (48.60%) while sheep (44.88%) had the least DM. The higher DM in goats, camels and cattle indicates greater nutrient concentration and less water content, potentially enhancing storage and preservation suitability. Among offal parts, the stomach had a significantly higher DM (48.14%) compared to the intestine (45.82%). These results align with the findings of Fuerniss *et al.* (2024), who reported that offal parts with higher DM are often preferred for their improved shelf stability.

Crude Protein (CP) Content

Goat and camel offal recorded the highest crude protein (CP) content (27.81% and 27.50%, respectively), followed by cattle (25.46%), while sheep had lower CP (22.43%). This highlights the superior protein quality of goat and camel offal, making them a valuable source of essential amino acids. The stomach showed slightly higher protein levels (25.59%) than the intestine (25.01%), aligning with findings by Lupu *et al.* (2020), who noted that stomach tissues often contain higher protein concentrations due to their structural composition.

Lipid Content

Lipid or ether extract content differed significantly across species and offal parts. Sheep offal had the highest lipid content (7.74%), followed by goats (6.19%), camels (5.15%), and cattle (5.01%). The stomach exhibited significantly higher lipid content (8.84%) compared to the intestine (6.70%), suggesting its potential as an energy-dense food source. Latoch *et al.* (2024) emphasized the role of fat-rich offal in contributing to dietary energy and flavour. However, higher lipid levels may necessitate moderation in consumption for individuals with dietary fat restrictions.

Table 1: Effect of Animal Species and Green Offal Parts on the Proximate Composition of Processed Red Meat Animals

	Dry Matter (%)	Protein (%)	Lipid (%)	Ash (%)	NFE (%)
Species (S)					
Cattle	48.60^{b}	25.46^{b}	5.01^{b}	5.39	9.71^{a}
Sheep	44.88^{c}	22.43^{c}	7.74^{a}	7.33	4.00^{b}
Goat	51.06^{a}	27.81^{a}	6.19^{ab}	6.01	8.00^{a}
Camel	49.02^{b}	27.50^{a}	5.15^{b}	6.25	7.54^{a}
SEM	1.03	0.95	1.22	0.88	1.68
Offal parts (P)					
Stomach	48.14^{a}	25.59^{a}	8.84^{a}	6.16	4.39^{b}
Intestine	45.82^{b}	25.01^{b}	6.70^{b}	6.32	4.92^{a}
SEM	0.31	0.26	0.34	0.16	0.25
Interaction					
S x P	NS	NS	NS	NS	NS

^{abc}Means with different superscripts along the same row are significantly ($P<0.05$) different, NFE: nitrogen-free extract, SEM: standard error of means, NS: not significant.

Nitrogen-Free Extract (NFE)

The nitrogen-free extract, which represents carbohydrates and soluble non-protein compounds, varied significantly. Cattle offal had the highest NFE (9.71%), though not significantly different from goats (8.00%) and camels (7.54%) offal while sheep had lower NFE (4.00%). The intestine (4.92%) showed slightly higher NFE than the stomach (4.39%), indicating more non-protein energy sources in the intestines. These findings are consistent with Muzzo *et al*. (2025), who observed higher carbohydrate fractions in certain offal types.

These variations in proximate composition suggest that green offal from different species and parts can serve diverse nutritional and functional roles. Goat and camel offal, with their high protein and moderate fat levels, are suitable for high-protein diets. Sheep offal, with higher lipid content, may cater to energy-dense dietary needs, while cattle offal provides a balance of macronutrients and higher carbohydrate content.

These findings are supported by existing literature, such as Fuerniss *et al*. (2024), who emphasize species-specific differences in offal composition, and Latoch *et al*. (2024), who highlight the nutrient density of edible offal. These results also align with Lupu *et al*. (2020), who noted the structural differences in offal parts affecting nutrient composition.

CONCLUSION AND APPLICATION

The study demonstrates significant variations in the proximate composition of green offal (stomach and intestine) from different red meat animal species. Goat and camel offal were superior in protein content, while sheep offal exhibited the highest lipid levels. The stomach generally contained higher dry matter, lipid and protein contents than the intestine. Hence, efforts should be directed on promoting the utilization of green offal, particularly goat and camel offal, as a sustainable and affordable protein source.

REFERENCES

Alao, B. O., Falowo, A. B., Chulayo, A. and Muchenje, V. (2018). Consumers' Preference and Factors Influencing Offal Consumption in Amathole District Eastern Cape, South Africa. *Sustainability*, *10*(9), 3323. https://doi.org/10.3390/su10093323.

AOAC, (2010). Official Method of Analysis, 15th Edition. Association of Analytical Chemists. Washington D.C.

Biel, W., Czerniawska-Piątkowska, E. and Kowalczyk, A. (2019). Offal Chemical Composition from Veal, Beef, and Lamb Maintained in Organic Production Systems. *Animals: an open access journal from MDPI*, *9*(8), 489. https://doi.org/10.3390/ani9080489.

Fuerniss, H. F., Gifford, C. L., Mortensen, E. G., Belk, K. E., Engle, T. E., & Woerner, D. R. (2024). Nutrient Analysis of Raw United States Beef Offal Items. *Nutrients*, *16*(18), 3104. https://doi.org/10.3390/nu16183104.

Latoch, A., Stasiak, D. M. and Siczek, P. (2024). Edible Offal as a Valuable Source of Nutrients in the Diet—A Review. *Nutrients*, *16*(11), 1609. https://doi.org/10.3390/nu16111609.

Llauger, M., Claret, A., Bou, R., López-Mas, L., & Guerrero, L. (2021). Consumer Attitudes toward Consumption of Meat Products Containing Offal and Offal Extracts. *Foods (Basel, Switzerland)*, *10*(7), 1454. https://doi.org/10.3390/foods10071454.

Lupu, M. A., Gradisteanu Pircalabioru, G., Chifiriuc, M. C., Albulescu, R., & Tanase, C. (2020). Beneficial effects of food supplements based on hydrolyzed collagen for skin care (Review). *Experimental and therapeutic medicine*, *20*(1), 12–17. https://doi.org/10.3892/etm.2019.8342.

Muzzo, B. I., Ramsey, R. D., & Villalba, J. J. (2025). Changes in Climate and Their Implications for Cattle Nutrition and Management. *Climate*, *13*(1), 1. https://doi.org/10.3390/cli13010001.

Ovimap (2024). Ovimap location: ovi earth imagery date 23th January, 2024.

Statistical Analysis System. (2002). SAS Institute Inc. SAS/STATTM Users Guide, Release 6.0 Ed.