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Article

Developing new recipes for goat offal soup and mushroom-enriched products

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Abstract
This study evaluated the chemical composition, sensory attributes, fatty acid profile, and microbiological quality of pasture-raised goat offal soup and mushroom-enriched products. Product formulations were optimized through sensory evaluation. Trained panelists rated the offal soup containing 8% liver as the most palatable (93/100), while the formulation with 50% mushrooms (F3) achieved the highest acceptability. The offal soup and mushroom-enriched products contained 68.0 vs. 70.6% moisture, 18.5 vs. 19.2% protein, 7.7 vs. 2.9% fat, 1.3 vs. 1.2% ash, 4.5 vs. 6.0% carbohydrates, and 424 vs. 670 mg/100 g salt, respectively. Total saturated fatty acids (SFA) accounted for 54.73% in the soup and 30.2% in the mushroom product; monounsaturated fatty acids (MUFA) were 42.28% vs. 32.1%, and polyunsaturated fatty acids (PUFA) were 3.62% vs. 37.3%, respectively. The predominant fatty acids were oleic (39.6%), stearic (27.9%), and palmitic (21.9%) in the soup, and linoleic (34.2%), oleic (30.0%), and palmitic (17.2%) in the mushroom product. Microbiological counts remained below 10^3 CFU/g during a six-month storage period, confirming product safety. These findings demonstrate that both products are nutritionally balanced, microbiologically stable, and represent sustainable food innovations for the meat industry. Moreover, it can be products that meet the healthy and natural food choices prioritized by modern consumers.

Keywords: goat meat, by-products, offal, sensory evaluation, fatty acids

Introduction

Given current global food consumption trends, consumers are increasingly seeking foods rich in essential nutrients that promote health and longevity [1]. Numerous studies have reported a growing preference for natural products and the avoidance of chemically synthesized food additives. In this context, edible by-products and offal represent nutrient-dense and inexpensive sources of high-quality proteins, vital minerals such as iron, zinc, and phosphorus, essential vitamins, and bioactive peptides [2].
Goat meat, also known as chevon, is lean meat that is high in protein and essential amino acids and lower in fat and cholesterol than beef and lamb [3]. It has a distinct flavor and aroma and tends to be darker red and coarser in texture compared to other types of animal meat. Goat meat possesses a nutritional and biological value comparable to other meat types, being a good source of essential minerals such as iron, zinc, and B vitamins [3].
Collagen, the main component of connective tissue, predominates in the total protein content of several internal organs, including the tripe, stomach, and intestines. Collagen-derived peptides have been shown to support gastric and intestinal health [4]. Dietary collagen, in the form of collagen peptides or hydrolysates sourced from bovine, porcine, marine, or poultry materials, is widely recognized for its positive effects on skin hydration, joint, bone, and muscle health, for exercise recovery, particularly among athletes [5]. However, the use of internal organs or offal is often limited due to concerns about high energy content, unfavorable fatty acid profiles, and undesirable flavors. Developing recipes that incorporate robust and aromatic ingredients, with precise formulation, may help overcome these limitations. Mongolia has a long-standing tradition of utilizing animal by-products and offal efficiently, with minimal waste.

In recent years, however, industrialized food production has become more widespread.
As of the end of 2024, Mongolia's livestock population reached 57.6 million heads, of which 15–20 million are slaughtered annually to meet domestic demand. In 2023, meat exports reached a record high of 80.4 thousand tons. Considering that edible by-products and offal account for 20–30% of an animal's live weight [6,7], approximately 250 thousand tons of offal are produced annually. Nevertheless, only 19% is consumed domestically, while the remainder is discarded. In addition, small lean meat trimmings obtained during deboning and portioning processes are valuable by-products that could be repurposed into new products to minimize waste. Offal soups are popular traditional dishes worldwide, made from edible internal organs of animals such as the heart, liver, kidneys, tongue, tripe, and intestines. Traditionally, the offal soup is typically cooked with water, salt, onions, and garlic. However, there are specific other varied ingredients used in world regions. The negative impact of offal on the product's properties is associated primarily with its unpleasant taste, smell, and unfamiliar texture [8]. Thus, some spices and seasonings could be used in the formulation of offal soup to fix those negative sensory properties.
Several studies have demonstrated that incorporating mushrooms into meat products offers both technological and nutritional advantages. Mushrooms provide an inexpensive source of bioactive compounds, dietary fiber, antioxidants, and antimicrobial substances that can enhance shelf life. They possess a distinct umami flavor [9] and improve oxidative stability through phenolic compounds, which act as natural preservatives and can serve as functional additives in meat products [10–13].
To maximize the use of available protein resources and promote sustainable food innovation, collaboration among producers and stakeholders is essential. In Mongolia, the application of innovative technologies for processing offal and by-products into biologically active food ingredients has been limited [14]. Therefore, value-added, shelf-stable goat products could be developed to add value to the animals to contribute to market-based incentives of sustainable grazing. Here, the development of mushroom-enriched products based on goat meat will be an opportunity not only to make the food more nutritious but also to add to ecological sustainability. The present study aimed to evaluate the chemical composition, fatty acid profiles, microbiology, and sensory evaluation of newly developed seasoned, ready-to-eat goat offal soup and mushroom-enriched meat products.

Materials and methods

In this study, 3-year-old Mongolian native goats (n=8) with 17.0 ± 1.4 kg of carcass weight were slaughtered at the slaughterhouse of "Trust Trade" LLC.6. Offal was cleaned and soaked in cold water for 12 h to remove the smell. Cleaned offal was boiled at 100°C for 10 min, then long and thin strips of offal were added to a seasoning solution. Seasoned offal cooled after soaking at 85°C for 20 min. The soup was packaged in a three-sided sealed bag (PET/AL/BOPA/PE) and sterilized at 110°C for 10 min, then cooled.
The edible oyster mushrooms (*Pleurotus ostreatus*) were prepared from university-affiliated mushroom plants and dried. Cleaned mushrooms boiled and cooled. Mushrooms were cut into 5 mm^3. The boiled goat meat was cooled, then cut into 5mm^3 cubes. The goat meat, mushrooms, and spices are mixed well. Packed in 20 g portions in a foil packaging bag and heated at 108°C for 10 min. Then, it was cooled and packaged. Three different formulas (control, F1, F2, and F3) of the products were prepared. Out of the 3 formulas, choose the one with the highest acceptability of the sensory evaluation.
Research carried out at the Meat Research and Technology Laboratory of the Technology Transfer Center of MULS.

Proximate analysis

Moisture content was measured by the oven drying method (standard GB 5009.3-2016). The fat content was analyzed using the Soxhlet extraction method (GB 5009.6-2016), whereas protein content was determined by the Kjeldahl method (GB 5009.5-2016). Ash content was determined using the drying sample at 550°C method (GB 5009.4-2016). Carbohydrate levels were determined using a calculation.

Calculation formula: total carbohydrates (%) = 100% - Moisture% - Protein% - Fat% - Ash% - Dietary Fiber% (if determined). NRV% value calculated by GB 28050-2011, as a reference.

Sensory analysis.

Sensory evaluation was conducted by twenty trained panelists, including teachers and students from the School of Animal Science and Biotechnology, MULS, according to protocols [15] with minor modifications. The attributes of color, flavor, tenderness, salt, and overall acceptability of products are assessed using a 100-point hedonic scale. Quantitative descriptive analysis was applied for sensory analysis.

Sodium content

Sodium content determined by Flame atomic absorption spectrometry with sodium hollow cathode (GB 5009.91-2017). The following parameters for instrumental analysis: wavelength was 589.0 nm, Flame Type: Air-Acetylene, lean (oxidizing, blue) flame, acetylene flow was 1.5-2.0 L/min, air flow was 8.0-10.0 L/min. Aspirate 1% nitric acid as the blank to zero the instrument. Sodium content calculated as mg/100g = (C - C0) * V * DF / m * K

Fatty acid profile

The fatty acid profile was carried out according to the standard (GB 5009.168-2016). Fatty acids extracted from samples via petroleum ether were hydrolyzed with HCl. Extracted fatty acids are derivatized into fatty acid methyl esters using methanol and a catalyst. The fatty acid profile was analyzed by GC (Agilent, Model 7820A, Santa Clara, CA, USA) equipped with a flame ionization detector (FID). Fatty acids were separated on a capillary column 100 m x 0.25 mm x 0.20μm). Carrier gas was Helium (1.0 mL/min). Split ratio was 10:1-50:1. Fatty acids were identified by comparing retention times with those of fatty acid methyl ester standards and internal standards (Supelco 37 Component FAME Mix, Bellefonte, PA, USA). Fatty acid content calculated as mg/100g.

Total bacteria count

Determined using standard ISO 4833-1:2013. Microbiology of the food chain - Horizontal method for the enumeration of microorganisms. The number of microorganisms per gram or per milliliter of the test sample is calculated from the number of colonies obtained in the plates containing fewer than 300 colonies.

Statistical Analysis.

All experiments were performed 3 times, with 3 replicates per experiment. The results were analyzed using one-way analysis of variance (ANOVA). $p < 0.05$ was considered significant.

Results and Discussion

Offal soup is a diverse category of dishes featuring edible animal organs such as tripe, intestines, liver, heart, and lungs cooked in a broth with spices. Three distinct product formulas (F1, F2, and F3) were developed. The differentiation among these formulas was based on the varying ratios of internal organs incorporated into their respective recipes/in total offal (Table 2).

Table 1.

Recipe of ready-to-eat meat products, 100 kg

Recipe of goat offal soup	Quantity	Recipe of meat products enriched with mushrooms	Quantity
Raw materials		Raw materials	
Offal, kg	50.0	Goat meat, kg	40.0
Meat of head, kg	30.0	Mushrooms, kg	50.0
Goat fat, kg	10.0	-	
Vegetable oil, kg	8.0	Vegetable oil, kg	9.4
Seasoning: Salt, sugar, white pepper, red pepper, soy, and ginger, kg	2.0	Seasoning: seasoning, ingredients, salt, sauce, white sesame, and starch, kg	0.6
Total	100		100

In this study, a 100-point scale was used for customer ratings of product quality (Figures 1 and 2). It provided a more comprehensive understanding of consumer satisfaction. The results of sensory testing showed that a recipe containing 15% liver (F1) produced an unpleasant, bitter taste due to its organ-specific natural compounds. The intensity of this flavor can be too strong for many consumers. Thus, the amounts of the liver and intestine gradually decreased to 10% (F2) and 8% (F3).

Table 2.

Formulation (%) of goat offal soup, 100 kg

Formulation	Goat offal					Sensory evaluation
	Tripe	Intestine	Liver	Heart	Lung	
F1	25%	15%	15%	15%	30%	Greasy, bitter taste, liver easily breaks apart, with a liver taste
F2	25%	15%	10%	15%	35%	Less greasy, reduced bitterness, fewer broken pieces of liver
F3	30%	10%	8%	15%	37%	Moderate grease, no bitterness, liver in optimal condition

Overall acceptability, taste, and odor scores indicated that consumers mostly liked the soup's flavor. Other parameters were also at an acceptable rate. Out of the 3 formulas, we chose the F3 formulation with the highest acceptability of the sensory evaluation (Figure 1). Consumers accepted the taste and tenderness ($p<0.05$) of the F3 formulation, and the overall acceptability of the F3 formulation was significantly higher ($p<0.05$) than F1 and F2 formulations. Therefore, the main product was created using an "F3 " recipe, and this product underwent the following quality research.

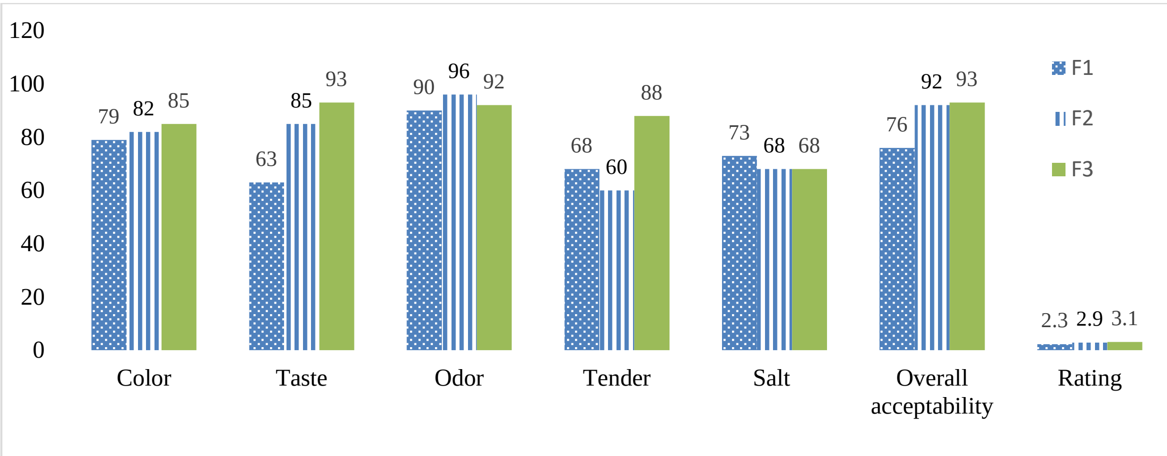

Figure 1. Consumers' ratings for offal soup quality (100 points)

[1)] Color rating: 0 (not acceptable) to 100 (acceptable). [2-3)] Flavor (taste and odor) rating: 0 (dislike extremely) to 100 (like extremely). [4)] Tenderness rating: 0 (not tender) to 100 (very tender). [5)] Salt 0 (not salty) to 100 (very salty). [6)] Overall acceptability: 0 (dislike extremely) to 100 (like extremely). [7)] Rating: 1, unsatisfactory; 2, good everyday quality; 3, better than everyday quality; 4, premium quality.

The results of sensory testing showed that a recipe containing 46% mushrooms (F2) produced a pleasant, umami taste due to the mushrooms. Consumers preferred this product for their moderate mushroom flavor, good umami taste, appealing color, non-greasy texture, and mild spiciness (Table 2). Consumers liked the taste and color ($p<0.05$) of the F2 formulation. The overall acceptability and rating score of the F2 formulation were significantly higher ($p<0.05$) than the other formulations (Figure 2). Therefore, the main product was created using an "F2 " recipe, and this product underwent the following quality research.

Table 2.

Formulation (%) of ready-to-eat mushroom-enriched products, 100 kg

Formulation	Mushroom-enriched products				Sensory evaluation
	Mushroom	Goat meat	Vegetable oil	Seasoning	
F1	60%	30%	5%	5%	Strong mushroom flavor, good umami taste, reddish color, insufficient meat aroma, greasy, too spicy
F2	46%	50%	2%	2%	Moderate mushroom flavor, good umami taste, appealing color, not greasy, mildly spicy, most preferred by consumers
F3	38%	60%	1%	1%	Weak mushroom flavor, strong meat taste, noticeable gaminess, unappealing color, no spiciness

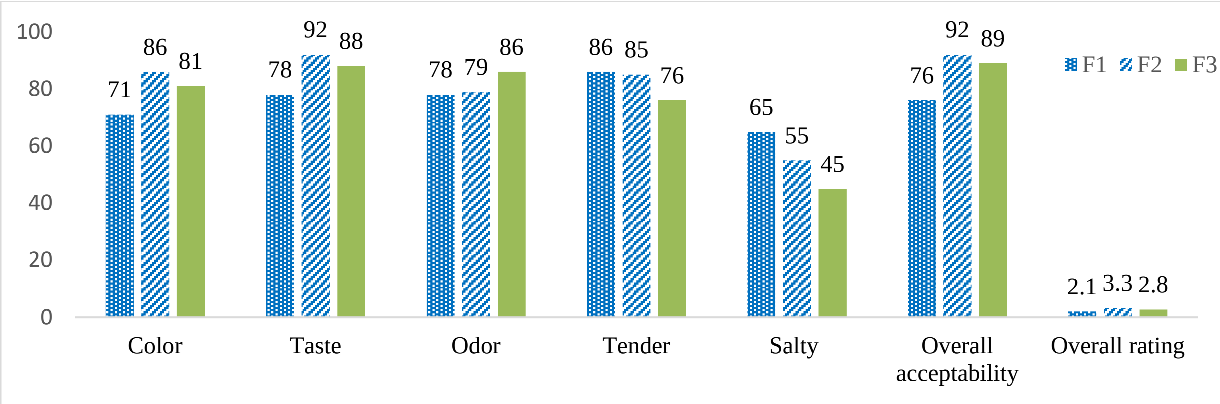

Figure 2. Consumers' ratings for meat products enriched with mushroom quality (100 points)

Moisture content of the soup was 68%, protein was 18.5%, minerals were 1.3%, and carbohydrate content was 4.5% respectively (Table 3). However, the fat content was 7.7%, and the salt was 4%.

The proximate composition of mushroom-enriched meat products is presented in Table 3. Depending on product recipes, the moisture content of the product was 70.6%. The fat content was 2.9%, while the protein content was 19.2%. The ash content was 1.2% and the total carbohydrate concentration was 6.0%. Nutrient amounts may be shown in metric units and/or as a percentage of an NRV in one or more quantities of food, such as 100 g or 100 ml, or a described portion size [16].

Table 3.

The chemical composition of the goat offal soup and mushroom-enriched products

Characteristics	Offal soup	NRV%	Meat products enriched with mushrooms	NRV%
Moisture, %	68	-	70.6	-
Protein, %	18.5	31	19.2	35
Fat, %	7.7	13	2.9	5
Mineral (ash), %	1.3	-	1.2	-
Carbohydrates, %	4.5	2	6.0	2
Salt, mg/100g	424	21	670	34
Calories, kJ/100g	676	8	366	4

NRV% value calculation methods and formats refer to GB 28050-2011, as a reference

Pasture-bred goat meat is raised in Mongolia, with a unique flavor and smooth texture. However, some internal organs or offal have been associated with negative concerns regarding unpleasant flavor. The basic meat flavor is related to protein degradation and formation of heterocyclic compounds, lipid oxidation, and degradation [17]. The flavor of soup is a complex attribute influenced by numerous factors related to type, amount, and ratio of raw materials, seasonings in the recipe, and heating method. These have different effects on the flavor formation of soups, and satisfactory results have been achieved. Fat content in by-products influences physical, chemical, sensory, and nutritional properties. Araújo Cordeiro et al., [18] reported that fat percentages in goat edible by-products present a greater variability (<2% to >17%). Higher values of fat are found in the visceral fat and heart (>5.68) and in the lungs and kidneys usually < 5%. The liver and kidney organs contain negligible amounts of carbohydrates, 5% carbohydrate values for the liver, and lower values for other organs [18].

Calories of meat products enriched with mushrooms were lower (366 kJ/100g). It is known that mushrooms tend to deposit lower levels of fat, which explains the variability. Moreover, the mushrooms contain more carbohydrates. Mushrooms provide an inexpensive source of bioactive compounds, dietary fiber, polysaccharides (especially beta-glucans), and phenolic compounds, which have antioxidant effects [9, 10].

Total saturated FAs of products were 54.7%, MUFA 42.2%, and polyunsaturated FAs 3.6% respectively. Oleic (39.6%), stearic (27.9%), and palmitic (21.9%) acids were the most dominant in the soup. Similar results were reported that in the fatty acid profiles of by-products, there are higher concentrations of saturated fatty acids, especially palmitic and stearic acids [18].

However, total PUFAs were 37.3%, MUFAs were 32.1%, and SFAs were 30.2% in mushroom-enriched products, respectively. In general, the major fatty acids found in the mushroom-enriched products were linoleic acid (34.2%), followed by oleic acid (30.0%), palmitic acid (17.2%), and stearic acid (10.3%). Similar results were documented that oyster mushrooms have lower fat content [19]. The main fatty acid present in oyster mushrooms was linoleic acid [20], and another fatty acid common in mushrooms, known as oleic acid. Moreover, the relatively high concentration of linoleic acid is one of the reasons that mushrooms are considered a nutritionally healthy food [21, 22]. Stearic acid is neutral toward total cholesterol levels in humans, while monounsaturated fats are thought to lower total cholesterol and reduce the risk of heart disease [18].

Table 4.

The fatty acid profile of products, %

№	Lipid Numbers	Common name	Offal soup	Meat products enriched with mushrooms
1	C10:0	Capric	0.131	0.059
2	C12:0	Lauric	0.097	0.049
3	C14:0	Myristic	2.080	1.22
4	C14:1	cis-9-Tetradecenoic acid	0.0458	0.045
5	C15:0	Pentadecanoic	0.562	0.299
6	C16:0	Palmitic	21.90	17.20
7	C17:0	Margaric	1.850	0.692
8	C18:0	Stearic	27.90	10.30
9	C20:0	Arachidic	0.214	-
10	C21:0	Heneicosanoic acid	-	0.033
11	C22:0	Docosanoic acid	-	0.238
12	C24:0	Tetracosanoic acid	-	0.085
13	C14:1	Myristoleic	0.045	-
14	C16:1	Palmitoleic	1.990	1.180
15	C18:1	Oleic	39.60	30.00
16	C20:1	Cis-11-Eicosenoic	0.568	0.678
17	C22:1	cis-13-Docosenoic acid	-	0.014
18	C18:2n9 c/t	Linoleic	2.850	34.20

19	C18:3n3	α-Linolenic	0.772	3.070
20	C20:4n6	all cis-5,8,11,14-Eicosatetraenoic acid	-	0.054
21	C20:5n3	cis-5,8,11,14,17-Eicosapentaenoic acid	-	0.017
	Total SFA		54.734	30.217
	Total MUFA		42.193	32.109
	Total PUFA		3.622	37.341

Lipids, particularly the proportion of unsaturated fatty acids, are crucial for the unique and species-specific flavor of meat soup because they break down during cooking to form a variety of potent aroma compounds [23]. The lipid oxidized/degraded aldehydes, heptanal, octanal, and nonanal are among the major oxidation/degradation products of oleic acid (C18:1n-9). The pleasant fruity, fatty, and sweet flavors in cooked meat come from various aldehydes, ketones, esters, and furanones, which are primarily produced through a combination of the Maillard reaction and lipid oxidation [24, 25]. Furthermore, lipid-derived aldehydes, including pentanal, hexanal, (E)-2-heptenal, (E)-2-octenal, (E)-2-nonenal, and (E, E)-2,4-decadienal, are formed from the oxidation of linoleic acid (C18:2n-6) [26, 24].

Table 5.

Microbiological assessment of products

Storage days	Storage temperature	Offal soup	Meat products enriched with mushrooms
7 d		$7x10^1$	6*101
14 d		$<10^1$	
28 d	37^0C	$<10^1$	<101
42 d		$<10^1$	
56 d		$<10^1$	
3 mon (90d)		$8x10^1$	8*101
4 mon (120d)	RT,	$<10^1$	<101
5 mon (150d)	25^0C	$6x10^1$	6*101
6 mon (180d)		$1x10^1$	8*101

The specific interval for a microbiological assessment (such as on days 7, 14, 28, 42, and 56) is a standard procedure used to evaluate a product's shelf life. The results showed that the total bacterial count of the products was at an acceptable rate after 56 days of incubation at 37 °C and storage for 180 days at room temperature. According to standards, the maximum authorized levels of microorganisms in food, the total bacterial count in meat products should be 10^3 CFU/g. The products met safety standards. The products showed no detectable bacterial growth even at 6 months, attributed to their sterilization process. This confirms that product goat meat products maintain microbial stability, supporting their shelf-life stability for up to 6 months under proper storage conditions.

Conclusion

Cost-effective technology for utilizing goat offal and by-products has been successfully developed. Sensory evaluation indicated high overall acceptability, with favorable scores for taste and odor, demonstrating consumer preference for the product's flavor. The chemical composition and microbiological parameters of the products were within acceptable ranges. In offal soup, the total saturated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA) were 54.7%, 42.2%, and 3.6%, respectively, with oleic (39.6%), stearic (27.9%), and palmitic (21.9%) acids as the dominant fatty acids. In mushroom-enriched products, total PUFA and MUFA were 37.3% and 32.1%, respectively, with linoleic acid followed by oleic acid as the most abundant fatty acids.

This research demonstrates that mushroom fortification and seasoned offal soup not only improve nutritional balance but also provide a scalable model for managing issues such as overgrazing and diet-related diseases. These also offer a novel strategy for value-added goat meat products and sustainable pasture.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' contribution

L.J, D.D., B.M., and Z.E. conceived and planned the experiments. L.J., Z.E., and B.M. carried out the experiments. L.J. and HX contributed to the interpretation of the results. L.J. and D.D. took the lead in writing the manuscript. All authors contributed to the final manuscript and approved the submitted version.

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References

[1]. G. Kennedy et al., "Considering the food environment can help promote the consumption of aquatic foods as part of a healthy diet," Frontiers in Sustainable Food Systems, vol. 7, Art. no. 1241548, 2023. https://doi.org/10.3389/fsufs.2023.1241548.

[2]. M. Florek et al., "Chemical composition and inherent properties of offal from calves maintained under two production systems," Meat Science, vol. 90, pp. 402–409, 2012. https://doi.org/10.1016/j.meatsci.2011.08.007.

[3]. R. Sheridan, L. C. Hoffman, and A. V. Ferreira, "Meat quality of Boer goat kids and Mutton Merino lambs. 2. Sensory meat evaluation," Animal Science, vol. 76, pp. 73–79, 2003. https://doi.org/10.1017/S1357729800053339.

[4]. M. Abrahams et al., "Effect of a daily collagen peptide supplement on digestive symptoms in healthy women: A two-phase mixed methods study," JMIR Formative Research, vol. 6, no. 5, Art. no. e36339, 2022. https://doi.org/10.2196/36339.

[5]. A. León-López et al., "Hydrolyzed collagen—Sources and applications," Molecules, vol. 24, no. 22, Art. no. 4031, 2019. https://doi.org/10.3390/molecules24224031.

[6]. A. Irshad and B. D. Sharma, "Abattoir by-product utilization for sustainable meat industry: A review," Journal of Animal Production Advances, vol. 6, pp. 681–696, 2015. https://doi.org/10.5455/japa.20150626043918.

[7]. A. Mullen and C. Álvarez, "Offal: Types and composition," in Encyclopedia of Food and Health, Elsevier, pp. 152–157, 2016. https://doi.org/10.1016/B978-0-12-384947-2.00501-8.

[8]. S. Stajic and B. Pisinov, "Goat meat products," IOP Conference Series: Earth and Environmental Science, vol. 854, Art. no. 012092, Environmental Science, vol. 854, Art. no. 012092, 2021. https://doi.org/10.1088/1755-1315/854/1/012092.

[9]. T. Jayakumar et al., "In vitro and in vivo antioxidant effects of the oyster mushroom Pleurotus ostreatus," Food Research International, vol. 44, no. 4, pp. 851–861, 2011. https://doi.org/10.1016/j.foodres.2011.03.015.

[10]. E. A. Decker and Y. Park, "Healthier meat products as functional foods," Meat Science, vol. 86, no. 1, pp. 49–55, 2010. https://doi.org/10.1016/j.meatsci.2010.04.021.

[11]. P. Manzi et al., "Nutrients in edible mushrooms: An inter-species comparative study," Food Chemistry, vol. 65, pp. 477–482, 1999. https://doi.org/10.1016/S0308-8146(98)00212-X.

[12]. A. Perez-Montes et al., "Edible mushrooms as a novel trend in the development of healthier meat products," Current Opinion in Food Science, vol. 37, pp. 118–124, 2021. https://doi.org/10.1016/j.cofs.2020.10.004.

[13]. C. Grangeia et al., "Effects of trophism on nutritional and nutraceutical potential of wild edible mushrooms," Food Research International, vol. 44, 2011. https://doi.org/10.1016/j.foodres.2011.03.006.

[14]. B. Enkhtuya et al., Study on the Meat Quality of Mongolian Pasture-Raised Livestock, Project Report TA8960 MON, MUST, Ulaanbaatar, Mongolia, 2021. https://sudalgaa.gov.mn/belcheeriyn-mongol-malyn-makhny-chanaryn-sudalgaa-zm3

[15]. I. H. Hwang et al., "Demographic and design effects on beef sensory scores given by Korean and Australian consumers," Australian Journal of Experimental Agriculture, vol. 48, pp. 1387–1395, 2008. https://doi.org/10.1071/EA05113.