Research Of Functional And Technological Properties Of Sausages With The Use Of Vegetable Raw Materials

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Abstract:
Food products, particularly meat, play a crucial role in the human diet by providing essential nutrients to the body. The rapid advancements in technologies and scientific research in the food industry have made it possible to enhance the quality and nutritional value of food products, which is a pressing need today. In this scientific article, we present the results of a physicochemical analysis of experimental sausage samples with the addition of purslane and various meat ingredients. The samples demonstrated a high moisture content, contributing to the product's juiciness and improved texture. Significant protein content was also observed, making these sausages highly nutritious. The analysis of the protein fraction composition revealed the presence of water-soluble and alkali-soluble proteins, which play an important role in nutrient absorption and bone health. These results support recommending these sausages for use in functional nutrition, aimed at promoting overall health and well-being.
Keywords: meat, sausages, processnig, nutritional value, amino acid composition

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1. Introduction

Research into food products enriched with functional ingredients is being actively pursued worldwide. In particular, the addition of purslane to food products has garnered attention due to its rich content of biologically active substances such as antioxidants, vitamins, and minerals. Purslane is known for its high concentration of water-soluble, salt-soluble, and alkali-soluble proteins, which can significantly affect the texture, structure, and nutritional value of the final product. Previous studies have demonstrated that adding purslane can enhance the protein composition of foods, making them more nutritious. Moreover, the moisture, fat, and protein content of a product are key factors that influence its taste, texture, and overall nutritional value. Therefore, the analysis of these components in sausage samples is essential for determining their nutritional profile. Strength characteristics, such as shear stress and limiting shear stress, are also important as they impact the texture and consistency, influencing consumer satisfaction.

In recent years, a range of meat products based on goat and sheep meat has entered the market, including smoked, fried, dried, and minced products. Minced meat products, such as meatballs and sausages, have grown in popularity due to their taste and convenience. Global trends show an increasing demand for goat meat, particularly favored by the older generation, while younger consumers exhibit a more complex perception of its qualities. While younger people tend to rate the quality of goat meat negatively, they do recognize its potential to address environmental, social, and health concerns associated with red meat consumption and production. Given the rise of health-conscious consumers and the movement toward circular bioeconomy, goat meat, being lean and low in fat, could carve out a special niche in the red meat industry. The nutritional quality of goat meat can also be enhanced by adjusting goat diets to increase nutrients and bioactive phytochemicals such as polyunsaturated fatty acids (PUFA), tocopherols, and phenolic metabolites.

Small livestock farms contribute to cost-effective animal production by utilizing natural, municipally-owned pastures, leading to higher financial returns. Goats are particularly favored in these settings for their affordability and adaptability to small-scale farming. Goat Meat Extract (GME) has emerged as a novel dietary supplement with potential benefits for enhancing physical performance and preventing fatigue, especially in elderly or frail individuals. A study demonstrated that supplements containing 2-3 times the GME content significantly improved the grip strength and endurance of laboratory animals, suggesting potential extrapolation of these benefits to humans.

The aim of our study was to analyze the physicochemical and strength characteristics of sausages with the addition of purslane and various types of meat. The results will allow us to assess the impact of purslane and the choice of meat ingredients on the nutritional value and quality of the products, which may be useful for developing new food products and enhancing their nutritional value.

2. Materials and Methods

The objects of the study were boiled sausages made with the addition of chicken fillet and dry purslane (1.2% by weight of minced meat). The sausages were produced according to standard sausage production technology. Purslane powder was incorporated during the mincing process at a rate of 1.2% by weight of the meat. Heat treatment was applied until the internal temperature of the sausage loaf reached 72°C.

The quality of the meat products was determined by standard methods in accordance with the following regulations: GOST 25011-2017: Meat and meat products. Methods for determining protein content [11]. GOST 9793-2016: Meat and meat products. Methods for determining moisture content [12]. GOST 23042-2015: Meat and meat products. Methods for determining fat content [13].

The moisture-binding and moisture-retaining properties of the sausages were determined using the Grau-Hamm method.

The fractional composition of the protein component was investigated by examining the dynamics of changes in the protein fractions, based on comparative studies of the sarcoplasmic protein ratios. This was accomplished by extracting sarcoplasmic proteins from muscle tissue using a buffer solution of low ionic strength, followed by the separation of water-soluble, salt-soluble, and alkali-soluble protein fractions. The amounts of these fractions were determined using the Kjeldahl colorimetric method in accordance with GOST 25011-81, including the identification of non-protein nitrogen, peptide nitrogen, and residual nitrogen.

3. Results and discussion

The study of physicochemical properties plays a crucial role in ensuring quality, safety, and innovation in the food industry. It aids both producers and consumers in making informed decisions about food products, thereby contributing to the overall development of the food sector. Detailed results of the physicochemical analysis are presented in Table 1.

Table 1 – Physico-chemical parameters of the studied sausage samples with the addition of purslane

indicators	Unit of measurement	results		
		control	Sample 1	Sample 2
Mass fraction of moisture	%	69.7±7.2	72.7±7.3	70.6±7.1
Mass fraction of fat	%	6.0±1.0	8.1±1.2	6.7±1.0
Mass fraction of protein	%	13.01±2.01	13.41±2.01	15.31±2.30
Mass fraction of carbohydrates	%	-	3.0	4.4

As shown in the table, both samples exhibit a relatively high moisture content compared to the control sample, with values of 72.7% and 70.6%, respectively, versus the control at 69.7%. This

indicates a positive impact of the addition of chicken fillet and other meat ingredients on the moisture content, which contributes to retaining the product's juiciness and improving its texture.

The results also show that the protein content in sample 2 is higher (15.31%) compared to the control sample (13.01%) and sample 1 (13.41%), making sample 2 more attractive from a health perspective. With its high protein content and low fat content (6.7%), sample 2 is particularly nutritious, making it suitable for health-conscious consumers. The ratio of protein to fat in these sausages suggests their suitability as dietary products.

To further analyze the protein composition, the fractional composition of the proteins in the finished product was studied. The data on protein fractions are provided in Table 2.

Table 2 – Fractional composition of sausages with the addition of purslane powder

indicators	Unit of measurement	results		
		control	Sample 1	Sample 2
Water-soluble proteins	%	2.86	2.94	3.08
Salt-soluble proteins	%	0.50	0.52	0.58
Alkali-soluble proteins	%	9.12	9.68	11.48

A sample of sausage with chicken fillet and purslane contains 2.94% water-soluble proteins, while the sample with the addition of alternative meat and purslane contains 3.08%. Water-soluble proteins are important for the body because they are easily absorbed. As is well known, bones are composite materials consisting of minerals and collagen. The amount of alkali-soluble proteins, 9.68% and 11.48%, respectively, indicates that the product contains sufficient amounts of collagen and elastin. The presence of these proteins helps strengthen bones, which is particularly beneficial for the growing body. Furthermore, the fractional composition of proteins plays a crucial role in water retention in meat. Larger proteins can retain more moisture, which is important for preserving the juiciness of the product. The functional, technological, and nutritional properties of meat products are largely dependent on the fractional composition of proteins. One of the most important characteristics of the functional and technological properties of meat products is their ability to retain and bind moisture in the muscle tissue. The water retention capacity (WRC) and water binding capacity (WBC) of meat are directly related to the fractional composition of proteins, as proteins play a key role in binding water and forming the structure of meat. Proteins with higher molecular weight, such as myosin, myoglobin, and collagen, can form larger

aggregates and retain more water, contributing to the juiciness and texture of the product. These results positively demonstrate the product's ability to maintain high levels of moisture, which enhances both the sensory qualities and nutritional value of the sausages. Data on WRC and WBC for the final products are shown in Figure 1.

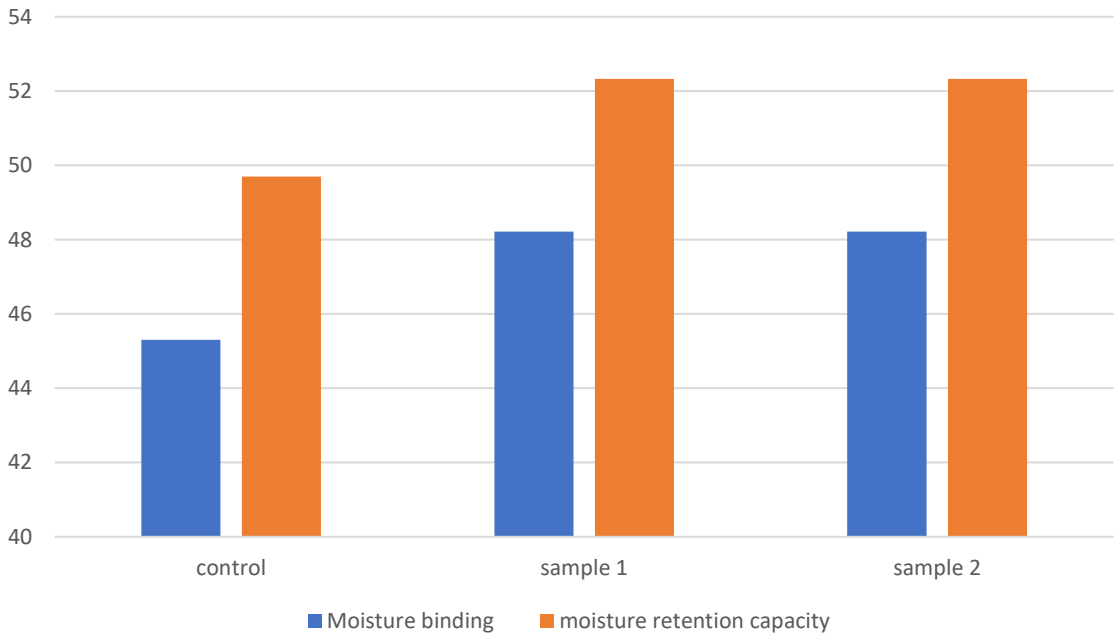

Figure 1 – Moisture binding and moisture retention capacity of the finished product

Proteins with a lower molecular weight, such as myosin and myoglobin, tend to form smaller aggregates and retain less water. This is directly supported by the data obtained, where a relatively high content of the alkali-soluble fraction in the product containing alternative meats corresponds to higher values of water retention capacity (WRC), exceeding those of the poultry-based product by more than 10%. This demonstrates that the fractional composition of proteins is a key factor in determining the water retention capacity of meat. Larger proteins can form larger aggregates and hold more water, while smaller proteins form smaller aggregates and retain less water.

The strength properties of muscle tissue depend on various factors, such as the age of the animal, housing conditions, and feed quality. However, the most significant factor is the protein content in the muscle tissue. The higher the protein content, the greater the tissue's strength.

The cut-off voltage refers to the maximum stress that meat can withstand when cut. This parameter is influenced by various factors, including the type of meat, its age, and cooking

method. Alternative meat, generally, has a higher cut-off stress compared to poultry meat. This is due to the lower protein and fat content in poultry, which gives it less strength and resistance to destruction during cutting.

The ultimate shear stress, a value that characterizes the meat's ability to withstand slicing pressure, is another key indicator. The higher this value, the stronger the meat.

The results of the strength characteristics of the final product, as indicated by these measurements, are presented in Table 3. This demonstrates the overall resilience and texture integrity of the products, further supporting their suitability for functional and nutritious food applications.

Table 3 – Strength characteristics of sausages

indicators	Unit of measurement	results		
		control	Sample 1	Sample 2
Cutoff voltage	kPa	32,3 ± 0,10	31,4 ± 0,13	37,6 ± 0,11
Limiting shear stress	Pa	459 ± 0,17	463 ± 0,15	760 ± 0,21

The ultimate shear stress of alternative meat is higher than that of other meat types, such as poultry, due to its higher collagen content, which contributes to increased strength. The results for the control sample were similar to those for sample 1, highlighting the impact of alternative meat on the composition of the prototypes. Additionally, this type of meat is rich in fatty acids and proteins, further enhancing its durability. The research confirmed that the product containing alternative meats demonstrated significantly higher strength characteristics. The study of these properties revealed that the product made with alternative meats had both a higher cut-off stress and a greater shear stress limit compared to the poultry-based product. This finding underscores the superior quality and structural durability of this product, making it a robust option in terms of texture and strength.

4. Conclusion

Thus, the conducted studies confirm that sausages with the addition of purslane and various meat ingredients possess excellent nutritional, functional, and technological properties, making them highly attractive for consumption. Additionally, the product containing alternative meats

demonstrates superior strength characteristics, further highlighting its high quality. These findings can be valuable for the food industry and healthy eating initiatives, contributing to the development of nutrient-rich products with outstanding taste and texture qualities.

5. Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, au-thorship or otherwise, that could affect the research and its results presented in this paper.

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