

Study Of Physico-Chemical And Technological Properties Of Boiled Sausage With The Use Of Purslane

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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

Currently, the world is experiencing a progressive aging of the population. In 2000, there were about 600 million people over the age of 60, and according to WHO forecasts, this number will increase to 1.2 billion by 2025, and to 2 billion by 2050. In the Republic of Kazakhstan, the share of elderly people in the population has also been increasing. As of early 2019, people over the age of 60 accounted for 11.6% of the total population, with 7.5% being over 65 years old. According to the UN classification, a society where more than 7% of the population is over 65 is considered an aging society. Based on this, Kazakhstan is at the initial stage of demographic aging. From 2010 to 2018, life expectancy in Kazakhstan increased from 68.3 years to 73.12 years, though it remains lower than in countries with similar GDP, such as Chile and Turkey, where life expectancy is around 80 years [1].

An analysis of the food market in Kazakhstan shows growth in sectors like baby food, therapeutic, and preventive foods. However, the share of herodietic (therapeutic and preventive) products

remains small, with a limited variety, mostly focusing on dairy, bakery, and a small selection of meat products.

A study on the nutrition of elderly people in Nursultan (Astana) revealed that their diets predominantly consist of proteins and fats of animal origin and easily digestible carbohydrates. These diets are characterized by an excess of saturated fatty acids and a lack of polyunsaturated fatty acids (PUFA), along with deficiencies in essential vitamins like D, A, B1, E, C, biotin, folic and pantothenic acids, as well as calcium and potassium [2,3,4].

Incorporating purslane into meat products can address some of these nutritional gaps. Purslane is rich in vitamins, minerals, and antioxidants, which can significantly contribute to the improvement of general health and well-being. The plant's high content of essential nutrients such as omega-3 fatty acids, vitamin C, and antioxidants can be particularly beneficial for the aging population by helping to combat oxidative stress and inflammation, which are common issues among the elderly. Additionally, purslane's ability to enhance the moisture retention and nutritional quality of meat products makes it suitable for preventive nutrition, promoting better health and well-being in both older adults and the general population.

The inclusion of protein hydrolysate in sausage products, combined with the beneficial properties of purslane, can further improve the functional and nutritional profile of these products, making them ideal for promoting overall health. These products can contribute to a balanced diet by providing essential amino acids, vitamins, and minerals, addressing some of the key deficiencies observed in the elderly population's diet. Thus, these sausages are not only beneficial for the elderly but also for the wider population as part of a preventive diet focused on maintaining health and vitality.

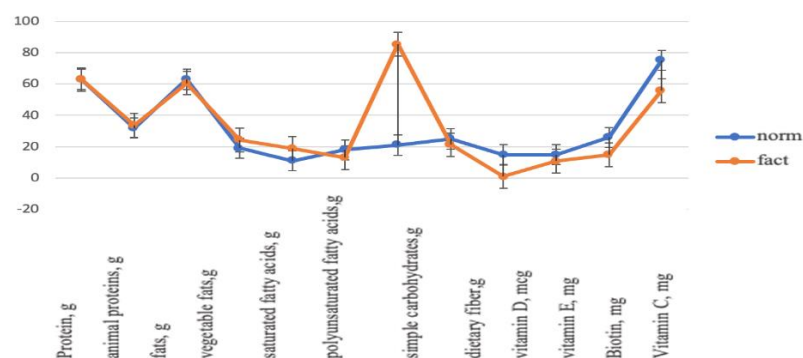


Figure 1 Daily intake of elderly people in Nur-Sultan of food substances in comparison with recommended norms

The study revealed that a significant portion of respondents consume meat and meat products regularly, with 55.2% consuming them daily, 10% once a week, and 4.3% not consuming meat at all. The breakdown of meat types shows that 31.4% consume beef, 29% consume horse meat, 8.1% consume mutton, and 8.6% consume other types of meat [5].

The study also identified deficiencies in key nutrients such as calcium, vitamin D, and potassium. Calcium intake was particularly low, with women consuming an average of 528 mg/day and men 549 mg/day, compared to the recommended intake of 1300 mg/day. Vitamin D intake was also far below the recommended 15 mcg/day, with women consuming 0.92 mcg/day and men 1.15 mcg/day. Potassium intake was similarly inadequate, with women consuming 2681 mg/day and men 2835 mg/day, while the recommended intake is 5000 mg/day.

In addition, the analysis of the antioxidant potential of animal-derived raw materials focused on by-products such as the liver, brain, heart, aorta, and mesenteric lymph nodes of pigs. The liver exhibited the highest antioxidant activity, with superoxide dismutase activity at 1398.3 ± 16.5 U/g and catalase activity at 53.27 ± 1.58 U/g per minute. Antioxidant activity, as measured by the FRAP method, was 4.10 ± 0.16 mmol-eq. dihydroquercetin/g of raw material. The aorta showed the lowest antioxidant activity at 0.36 ± 0.02 mmol-eq. dihydroquercetin/g. Researchers emphasized that meat industry by-products could serve as valuable sources of biologically active components [6,7,8].

The study also demonstrated the positive effect of β -alanine on work efficiency in elderly individuals when included as a dietary supplement. A technology for developing pâtés aimed at elderly individuals, using meat high in connective tissue, was also introduced. The recipe for one version of the pâté included beef trimmings (35%), grade I beef (27%), corn grits (17.5%), oatmeal (7.3%), carrots (2.1%), ridge bacon (10.2%), and soybean oil (0.9%). This product is recommended for elderly individuals predisposed to or suffering from cardiovascular and gastrointestinal diseases. Another recipe, suitable for elderly people with impaired lipid metabolism, consists of grade I beef (36%), cattle head meat (18%), buckwheat (7.2%), carrots (27.4%), ridge bacon (10.5%), and soybean oil (0.9%).

In addition, a boiled sausage product, "Zdravitsa," was developed specifically for the elderly, incorporating cumin, milk thistle oil, and lactulose, which aid digestion and help detoxify the liver [9].

The use of meat raw materials for the production of food products targeting the elderly is both relevant and promising. Meat raw materials provide high-quality animal protein, essential minerals, vitamins, and fatty acids, which support the prevention of diseases like osteoporosis, osteoarthritis, and iron deficiency anemia.

Therefore, the key components for products aimed at elderly individuals include connective tissue proteins, dietary fibers, vitamins, minerals, antioxidants, and phospholipids, all of which contribute to addressing the nutritional needs of this demographic and improving their overall health and well-being.

2. Materials and Methods

The objects of the study were boiled sausages with 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 [10, 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 results of the study of the chemical composition of control and experimental samples are presented in table 1.

Table 1 Physico-chemical parameters of control and experimental samples

Name of samples	Mass fraction, %			
	protein	fat	carbohydrate	moisture
"Beef sausage" (control sample)	18,93	14,90	3,07	56,86
Experiment 1 (with the addition of purslane 1%)	16,65	9,85	2,85	51,31
Experiment 2 (with the addition of purslane 1,5%)	19,29	12,25	3,07	51,10

In conditions of insufficient protein content in the body, the proteins contained in the tissues begin to hydrolyze. For this reason, it is very important to follow the recommended protein intake standards [2]. According to the WHO FAO recommendations, the protein intake rate is 65-100 g per day or 10-15% of the amount of protein consumed in food.

Taking into account the formalized requirements for the composition of herodietic products, the mass fraction of protein of a specialized product should be at least 10%.

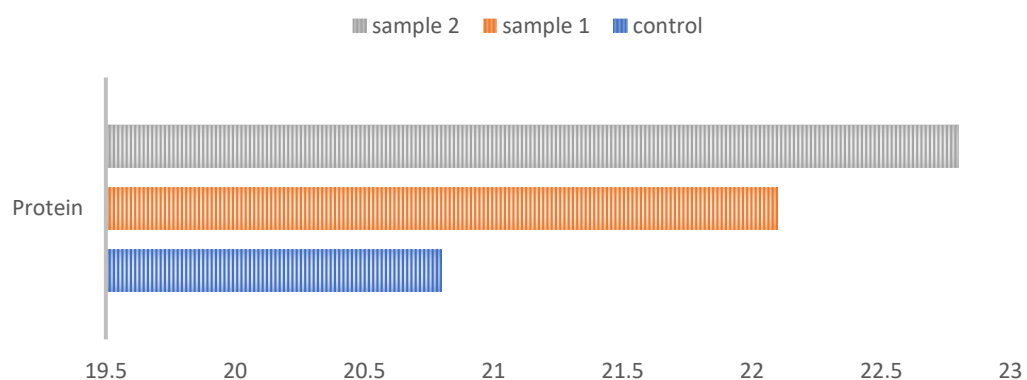


Figure 1 Protein indicators in finished products

One of the main indicators of food quality is the biological value, reflecting the degree of their compliance with the amino acid balance of the body's needs, necessary for the course of physiological processes in the body (Table 2).

Table 2 Amino acid composition of boiled sausages

Name of amino acids	"Beef sausage" (control sample)	Experiment 1 (with the addition of purslane 1%)	Experiment 2 (with the addition of purslane 1,5%)
Mass fraction of amino acids, %			
Arginine	1,477±0,591	1,780±0,712	2,058±0,823
Lysine	2,685±0,913	2,671±0,908	2,743±0,933
Tyrosine	1,193±0,358	1,142±0,343	1,183±0,355
Phenylalanine	1,402±0,421	1,365±0,409	1,320±0,396
Histidine	0,895±0,448	0,801±0,401	0,617±0,309
Leucine+isoleucine	2,238±0,582	2,077±0,540	2,058±0,535
Methionine	0,925±0,314	0,861±0,293	0,857±0,291
Valin	1,939±0,776	2,077±0,831	2,572±1,029
Proline	2,089±0,543	2,522±0,656	2,058±0,535
Threonine	1,387±0,555	1,484±0,593	1,543±0,617
Serin	1,298±0,337	1,484±0,386	1,423±0,370
Alanin	2,238±0,582	2,671±0,694	2,229±0,580
Glycine	2,387±0,812	3,412±1,160	2,401±0,816

The introduction of purslane into meat products can further enhance their nutritional and functional properties. Purslane is a rich source of essential amino acids, antioxidants, vitamins, and minerals, which complement the already balanced amino acid composition provided by the protein hydrolysate. This combination not only boosts the overall nutritional profile of the product but also offers significant health benefits.

Purslane contains high levels of omega-3 fatty acids, such as alpha-linolenic acid, which can improve heart health, reduce inflammation, and support overall well-being. Its antioxidant properties help combat oxidative stress, protecting cells from damage and potentially reducing the risk of chronic diseases. In the context of functional foods, purslane's high content of vitamins

(such as vitamin C and vitamin E) can aid in boosting the immune system and promoting healthy skin.

From a technological standpoint, purslane contributes to the moisture-binding, fat-retaining, and water-retaining capacities of meat products. The presence of antioxidants and bioactive compounds in purslane helps stabilize the emulsions and dispersed systems in which these products are formed, ensuring a more cohesive structure. Additionally, purslane aids in improving the textural properties of the product, enhancing elasticity, viscosity, and overall mouthfeel.

By improving moisture and fat retention in meat products, purslane ensures that the finished product remains juicy, tender, and flavorful for longer periods. These attributes not only enhance the sensory qualities of the product but also contribute to a longer shelf life, making purslane a valuable ingredient in improving both the health benefits and quality of meat products.

Table 3 Basic functional and technological properties of boiled sausages

Name of samples	Indicators, %			
	moisture binding capacity	moisture-holding capacity	fat-holding capacity	Yield of finished products, %
"Beef sausage" (control sample)	73,12±0,36	69,12±0,72	57,18±0,51	107
Experiment 1 (with the addition of purslane 1%)	75,62±0,84	73,37±0,91	59,13±0,83	110
Experiment 2 (with the addition of purslane 1,5%)	79,13±0,62	80,01±0,65	60,05±1,01	114

The addition of purslane to meat products can further enhance the already impressive functional benefits of animal-based proteins. Proteins of animal origin, compared to popular soy protein isolates, exhibit two to three times greater moisture-retaining ability and comparable fat-retaining capacity. This leads to a stronger water-fat emulsion (4-8 times greater in strength), which is essential for maintaining the integrity and quality of sausage products.

Purslane, when combined with these animal-based proteins, can improve these functional properties even further. The plant's rich antioxidant content helps stabilize the water-fat emulsion,

while its natural bioactive compounds further enhance moisture and fat retention. This results in a more stable product with improved texture, juiciness, and overall mouthfeel.

Additionally, replacing soy proteins with animal-based proteins and purslane not only improves the functional and textural properties of sausages but also enhances their nutritional profile. Purslane contributes essential vitamins, omega-3 fatty acids, and antioxidants, making the product healthier. This combination creates sausages that are not only nutritionally superior but also more appealing to health-conscious consumers, offering significant functional benefits for both the food industry and consumers seeking high-quality, nutrient-rich products.

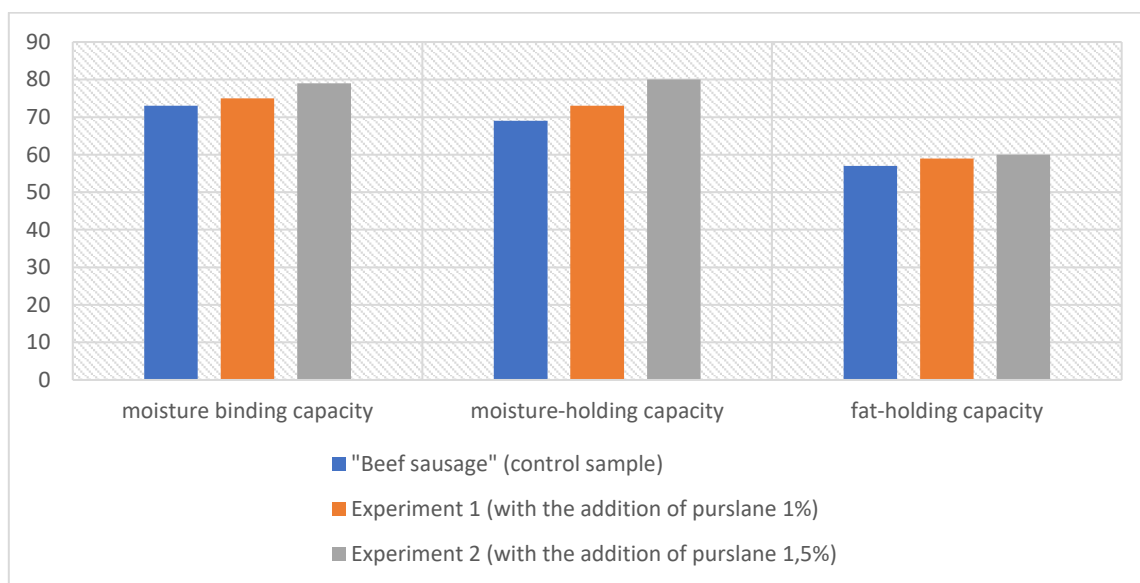


Figure 2 Functional and technological properties of the studied samples

The addition of purslane to meat products can enhance water-binding capacity, which, in turn, leads to a higher yield of the finished product. Similar to the effects observed with other natural meat additives, purslane contributes significantly to moisture retention, helping to maintain product juiciness and texture. In experimental samples with the addition of purslane, the yield increases due to its ability to bind a substantial proportion of moisture. This is attributed to purslane's key functional properties, such as its solubility, emulsifying, and gelling abilities.

These properties of purslane not only support higher product yield but also enhance the overall quality of the product, improving its texture and mouthfeel. The increased yield and enhanced water-binding capacity are valuable for both manufacturers and consumers, as they contribute to product consistency, quality, and economic efficiency. Purslane's natural properties make it a valuable addition to sausage formulations, improving functionality and overall product appeal.

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. Purslane enhances the water-binding capacity, moisture retention, and overall yield, contributing to improved texture and juiciness. Additionally, the product containing alternative meats demonstrates superior strength characteristics, further emphasizing its high quality and durability. These findings are valuable for the food industry and healthy eating initiatives, as they support the development of nutrient-rich products with enhanced taste and texture. The combination of purslane with diverse meat ingredients provides a unique opportunity to create innovative, high-quality sausages that meet consumer demand for functional and health-promoting foods.

5. Conflict of interest

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

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