Effect of prunes on organoleptic and technological properties of minced meat

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Abstract. At the present time, the search for natural ingredients that improve characteristics of minced meat products, and reduce the amount of synthetic food additives is going on. Plant components are the most popular. Most often they are recommended to be added in the powder form. This helps to improve technological properties of minced systems, as well as reduce the cost of products. In the article the possibility of applying prunes in the composition of minced beef is considered. The effects of prunes on an increase in water-holding capacity of minced meat to 54.4 % in a sample with 20% prune content, a decrease in water loss during 10 days of storage in a frozen state by 4.4 % in the same sample, an increase in the yield of finished products during thermal processing by 8.9 % are shown. It was found out that the color of finished products is within the acceptable range when decreasing the proportion of sodium nitrite to 0.003 % in the recipe, and even at its absence.

1. Introduction

Modern meat industry is a highly developed production that allows obtaining high-quality products and providing for the market needs. However, the stability of meat products parameters is not always achievable. This is associated with various properties of raw materials being treated, high responsiveness of processing to external factors. A number of problems can be solved by synthetic food additives easy to use. The consumer is interested in purchasing products similar to natural ones. That is why researchers frequently search for natural additives to meat products as these allow obtaining products with desired parameters. The most popular are plant ingredients, they increase the yield of products, improve organoleptic properties, and enrich products with valuable nutrients.

Thus, in researches of S. P. Merenkova and A. A. Lukin (2016) the effect of such plant additives as buckwheat and flaxseed flour, carrot powder was determined. The authors found that the high proportion of added components had led to an increase in protein content, minerals and vitamins, dietary fibers, and, in the case of adding flaxseed, fat component. Biological value of lipid component increased due to the content of polyunsaturated fatty acids. In addition, favorable effect of plant additives on such properties of minced systems as moisture- and fat-holding capability was noted, which finally led to products with a more juicy consistence. At the same time, taste parameters of cutlets made from experimental minced meat samples containing more that 10 % of buckwheat and flax flour were unacceptable [1].

To improve technological properties of minced systems is possible by introducing starchy components into them, for example, legume flour. Bronnikova V. V. et al. (2018) [2] in their work used bean grain flour as a bread substitute in minced meat. The pattern of increasing moisture-holding
capacity (MHC) with an increase in the proportion of the latter was noted. Fat-holding capacity (FHC) did not change so significantly. The following disadvantages of bean flour were named: excessive stickiness of minced meat, its high losses on the equipment walls, and, correspondingly, the difficult molding of products.

The effect of Jerusalem artichoke powder is explained by its stabilizing properties, as well as high inulin content resulting in autolytic processes in minced meat. T. P. Akhmedova and A. S. Lobanov found an insignificant increase of pH to 6.5 at adding Jerusalem artichoke powder instead of meat components [3].

Many authors explain the increase of MHC of minced meat by changing pH environment. At adding radish homogenate in an amount of 10 to 50% to the total weight of minced meat of different kinds (beef, pork, chicken), the pH level increased, on average, from 5.9 to 6.43. At the same time, an increase in MHC by 12 percentage points in minced beef, by 18 percentage points in pork, and by 10 percentage points in chicken was observed. Additional stabilizing factors were fiber and pectin substances of black radish [4].

When the pH value is close to isoelectrical point of muscular tissue proteins, meat possesses the least moisture-binding ability. When germinated sea buckthorn seeds flour (pH 7.1) was added to the mince systems, a high activity of mince fermentation process was observed, which naturally resulted in the manifestation of more pronounced taste and flavor, a delicate texture of sausage products [5]. Examination of ground beef properties with different degree of grinding showed an inverse relationship between the pH value and the moisture-binding ability of minced meat. The authors concluded that this might be associated with the destruction of muscle cells [6].

Microorganisms preparations actively effect on technological properties of mince systems. Mince from bold pork, rabbit and category 2 co-products was subjected to biomodification by starter cultures. Bifidobacteria and lactic acid streptococci were in the composition of microorganisms. The use of bacterial preparations together with vegetable supplement of mung beans contributed to a stable increase in moisture-binding ability during the maturation and salting of minced meat [7].

When treating poultry meat with starter cultures in the composition of model mince, on the 25th day of the storage a pH decrease, and an increase in the amount of lactic acid microflora to a value $2.5 \cdot 10^7$ per 1 g compared to control $7.2 \cdot 10^3$ were noted. When producing dry-cured sausages, starter cultures contributed to a more intensive pH decrease during the drying, and the shortening of technological process [8].

Of much importance are mince characteristics which allow a longer shelf life of meat products. The range of plant ingredients with preservative and antioxidant properties is quite wide. They are garlic, mustard, ginger root. The use of licorice root and oat extract was proven. The authors from the Institute of Meat and Dairy Industry of Belarus [9] developed compositions with above numbered components which allow slowing the growth of the number of mesophilic aerobic and optional anaerobic microorganisms (KMAFAnM), and reducing oxidative damage to minced meat systems. The negative effect of proposed compositions on organoleptic properties of finished products has not been found out.

Rosemary extract manifested itself similarly in minced systems. When producing fermented lamb sausages, its introduction in the amount from 0,015 to 0,045 % allowed obtaining products of a more intensive and stable coloration. At the same time, in the experimental samples significant yellowing of bacon during storage was not noted. The value of water activity in samples with rosemary extract was the lowest at the end of the storage (90 days) [10].

There are data about the effect of various doses of prunes (from 10 to 20 % in increments of 5 %) in the composition of minced semi-finished products – chicken zrazy – on their characteristics. The introduction of minced prunes did not effect on the total bacterial content and shelf life of products. At the same time, the authors noted an increased content of carbohydrates, certain vitamins and minerals with a decreased energy value of products. Prunes are rich in beta-carotene, vitamin C, fiber, simple carbohydrates, and organic acids [11].
Considering the above, the suggestion was made that the prunes introduction into minced meat can result in the high quality stabilization of coloration with a decreased amount of sodium nitrite in the sausage, as well as an increased yield of finished products.

2. Objects and methods of research
The research was carried out in Yaroslav-the-Wise Novgorod State University, in the Food Technology Department (TPP) laboratories.

The research object was ground beef with prunes additives.

Moisture-holding capacity (MHC) of minced meat was defined by the Grau and Hamm method.

Determination of the moisture total amount was made while drying in an oven by the accelerated method.

For the research, two experimental samples with a prune content of 13 % (sample II) and 20 % (sample III) were prepared. Sample I was a control. The preparation was carried out as follows: beef was minced using a MIM-100 meat grinder with a grid diameter of 2-5 mm. After a short moisture-heat treatment at a temperature 80-85 °С, prunes were cooled and minced to fractions of 2-3 mm in size. A viscous plastic mass was obtained. The minced meat was mixed for 15 minutes until the components were evenly distributed.

3. Results and discussion
The research was carried out in several stages. First, the moisture content and the MHC of the mince at the stage of making were defined. Next, the mince was packed in a polymer film and stored in a cooled state (temperature 2-4°С, humidity in the chamber 90%) for 48 hours. The second batch of the mince was frozen and stored at a temperature minus 18 °С and humidity in the freezing chamber 85%. Parameters were determined in 10 days of storage.

The results of determination of humidity and moisture-holding capacity of the mince are presented in table 1.

| Sample № | At stage of making | after 48 hours (t 2-4 °С; W 85 %) | after 10 days (t minus 18 °С; W 85 %) |
|----------|-------------------|-----------------------------------|--------------------------------------|
|          | W, %              | MHC, %                            | W, %                                 | MHC, %                              |
| I        | 59.00±0.97        | 41.60±0.41                        | 40.00±0.97                           | 21.20±0.17                           | 38.00±1.95 | 27.64±0.20 |
| II       | 60.00±0.97        | 48.40±0.45                        | 49.00±1.95                           | 44.20±0.35                           | 46.00±2.57 | 37.57±0.14 |
| III      | 61.00±1.70        | 54.40±0.42                        | 53.00±3.40                           | 48.80±0.35                           | 51.00±1.95 | 42.72±0.85 |

According to above data, it was found that prunes additives contributed to increased moisture-holding capacity of both freshly prepared mince and mince stored in cooled and frozen state.

The dynamics of changing the humidity of control and experimental samples can be seen in figure1.
The analysis of the data in Figure 1 shows that the storage of mince meat in both cooled and frozen state results in moisture loss. But the lower is the intensity of decreasing moisture, the higher is the proportion of prunes in the mince. The difference between the control and the third sample after storage of frozen mince was 13 percentage points. This is explained by high content of dietary fiber in prunes (9%), which do not undergo serious changes during storage in a cooled and frozen state.

A similar dependence is also traced in the analysis of the MHC data (figure 2). For this parameter, the decrease is 10.83 percentage points in sample № 2, 11.68 in sample № 3. However, this difference is within the statistic error. We can confidently say that the proportion of prunes in the recipe (13 or 20%) does not effect on the degree of decrease in moisture-holding capacity during storage.

When comparing with the control sample, it was noted that in ground beef without prunes storage for 10 days in the frozen state resulted in a decrease in the MHC by almost half (19.2 percentage points). An analysis of these results allows us to conclude that it is possible to use prunes in the composition of minced systems in the production of cooked sausages, pastes, frozen meat semi-finished products.

Figure 1. Results of determining moisture content.
Figure 2. Results of determining moisture-holding capacity of minced meat.

At the following stage, the assessment of capability of prunes to stabilize the coloration of meat products was made. Three recipes of minced meat (two experimental and control) were developed, their composition is presented in Table 2.

Table 2. Composition of model minced systems with prunes.

| Raw materials           | Control | Experimental 1 | Experimental 2 |
|-------------------------|---------|----------------|----------------|
| Beef removed, premium   | 100.0   | 87.0           | 87.0           |
| Ground prunes           | –       | 13.0           | 13.0           |
| Dietary table salt      | 3.5     | 3.5            | 3.5            |
| Sodium nitrite          | 0.007   | 0.003          | –              |
| Granulated sugar        | 0.2     | 0.2            | 0.2            |

In experimental sample 1, beef was replaced with ground prunes, and the amount of introduced sodium nitrite was decreased to 0.003 %. The second experimental sample was produced without sodium nitrite. The prepared minced meat was cooled to t 4 °C and stored at this temperature in closed containers for 48 hours at a humidity of 85 %. Next, the products were molded in the form of cutlets, and they were heat treated (steamed) until ready. The color of the product at the fault was defined visually using a color scale.

The color was defined as “light red-brown” in the control samples, and as “brown” in the experimental ones, the reddish tint in them was less pronounced. However, experts noted that color differences between samples are negligible. This may be due to the fact that the composition of prunes includes flavonoids which change coloration into brown when heated.

The determination of weight of products before and after thermal processing showed an increased yield of the finished product (on average, 81.1 % versus 73.9 % in the control).
4. Conclusion
As a result of the research, the effect of various doses of prunes in the composition of minced beef systems on moisture losses during storage, and moisture-holding capacity was determined. A lower drying rate was revealed in the sample with a 20% prunes content (10.83 percentage points), and a maximum drying rate was revealed in the control. Dynamics of changes in moisture-holding capacity was similar, though it did not depend significantly on the prunes proportion.

The beneficial effect of prunes in the composition of minced meat products on products yield and their color characteristics was proven. The absence of sodium nitrite in the recipe did not result in significant deviations in the color of finished products. The addition of 13% of prunes to the minced meat allowed increasing the yield of steamed meat products by 8.9%.

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