Changes in the Basic Physical and Chemical Parameters of Raw Materials Under the Influence of the Milk-Protein Complex

E.A Savinkova*

Mari State University, Yoshkar-Ola, Russia

Abstract. Today, the development of competitive food products is of particular relevance. This focus should provide the population with high-quality meat products. A special role in this issue is given to non-traditional, national and innovative products, as well as products for healthy nutrition in the context of import substitution.

1 Introduction

In these circumstances, when production volumes are constantly falling and lead to a decrease in meat consumption, and the population's demand for high-quality products from ecological raw materials and natural ingredients is constantly growing. The researchers come to the conclusion that a certain niche in meat processing should be occupied by national food products. Thereby expanding the ability of the population to consume foods familiar to them from childhood.

Analyzing the work of Y.M. Uzakov and other researchers, we can safely say that the use of multicomponent brines in the technologies of many meat products leads to good indicators. The use of environmentally friendly raw materials, including mutton, as well as the use of natural ingredients, will improve the quality indicators of the finished product. [1, 2]

In this regard, the aim of the work is to study the technology of production of the national product for the residents of Mari El, with the possibility of correlation of the qualitative indicators of the finished product. The recipe of this meat product provides for the use of brine, based on natural ingredients such as milk and egg white, lactose.

2 Objects and methods of production

The object of the study was mutton, as well as brine containing milk-protein complex (MPC) "Milana 100". Raw materials were injected with brine in the amount of 10, 20 and 30% by weight of raw materials, respectively. The control sample was made using traditional brine [3, 4].

* Corresponding author: shalagina-kate@inbox.ru

3 Results and discussion of the results obtained

According to the experimental conditions, the effects of the complex and mechanical action, in the form of massaging, on the properties of salted raw materials were studied. The duration of salting in combination with mechanical massaging affects the uniformity of penetration of all ingredients in the brine throughout the volume of raw materials. Functional and technological properties, as well as the quality and yield of finished products, depend on the modes and conditions of salting. Taking into account all of the above, it follows that the process of salting meat raw materials forms important qualitative properties of meat raw materials, which will ultimately determine its organoleptic characteristics [5-8].

For faster penetration of salting ingredients into the production technology of the mutton product, we used the injection process under cyclic massaging conditions.

The process of changing the mass of salted mutton samples indicates that the mechanical effect on any meat raw material causes its structural changes, which lead to partial destruction of cells and, as a consequence, the inability of the released protein from the structure to additionally retain moisture contained in the brine.

It has been experimentally established that during 50 minutes of processing, meat raw material loses in mass. However, the raw material injected with multicomponent brine in a minimum amount of 10% leads to insignificant changes in mass, compared with the control. At the same time, the product containing MPC increases the mass index by 4.3% by 125 minutes of massing, compared with the control, the indicators of which are at the level of 3%. This gives reason to believe that the milk-protein complex enriches the product with additional protein, which in turn contributes to additional moisture retention in the product.

Mutton injecting in an amount of 20 and 15% to the original mass of mutton leads to an increase in the volume of the product by 4.1 and 4.5%, respectively. An increase in the massaging time in products containing a larger amount of milk-protein complex is associated with a higher concentration in brine. Further mechanical action on the raw materials leads to destructive changes and, as a consequence, to a decrease in the mass of all samples.

Special attention was also paid to the color formation reaction taking place during the massaging process in salted samples of injected mutton, based on the determination of the content of NO-pigments and residual sodium nitrite.

Table 1. Residual sodium nitrite content in salted mutton and the level of nitrosopigments

Samples	**Content NO-pigments, %**	**Sodium nitrite content мг%**
Control	74 ,3 ±0,52	3,06±0,19
Experiment 1	75,8 ±0,41	2,50±0,24
Experiment 2	77,4 ±0,34	2,25±0,12
Experiment 3	79,1 ±0,18	2,17±0,18

The transformation of nitrosopigments depends on the depth of change of meat pigments in the presence of nitrite. In the course of research, it was found that the content of injected brine of the milk-protein complex “Milana 100” in the composition leads to an increase in the amount of NO-pigments in salted raw materials. According to Table 1, it can be seen that when 10% brine is introduced (Experiment 1), the content of nitrosopigments in the samples is 1.5% higher than the control. Further increase in the amount of the complex in the brine composition also leads to an increase in NO-pigments in the samples under study. In experiments 2 and 3, this indicator is at the level of 77.4 and 79.1%. These indicators are characterized by the fact that the lactose contained in the brine contributes to

a greater conversion of sodium nitrite, and as a consequence, an increase in nitrosopigmens in the samples studied.

These data indicate that most of the sodium nitrite goes to the color formation reaction, and as a result, its residual content in the finished product decreases.

The reaction of color formation qualitatively affects the color of the finished product, therefore, this indicator was also studied using the spectrocolorimetric method for evaluating small color differences in the equal-contrast CIELa*b* system.

The data presented in Table 2 indicate that samples containing a certain amount of the complex in the composition of the syringe brine increase the ratio of these redness (a*) and lightness (L) to varying degrees. When injecting meat raw materials with the smallest amount of milk-protein complex in the brine, minimal indicators are noted according to these signs, compared to other experimental samples. At the same time, the yellowness index (b*) varies slightly and ranges from 12.85 to 14.64 units in experiment 3. As can be seen from the results given in Table 2, the "redness index" a */ b* increases with an increase in the level of brine administration and an increase in the proportion of milk-protein complex "Milan 100" in it, these data are also confirmed in chemical and physical indicators confirming a higher level of pigment formation.

Table 2. Change in pigments of salted mutton samples

Samples	**L lightness**	**a^* redness**	**b^* yellowing**	**H color tone**	**a^*/b^***	**Color stability, %**
Control	42,28±0,43	14,94±0,13	13,58±0,16	0,4425±0,11	1,10±0,11	72,59±0,63
Experiment 1	44,62±0,27	15,28±0,21	12,85±0,23	0,4606±0,12	1,19±0,17	75,13±0,82
Experiment 2	46,03±0,33	17,18±0,17	13,36±0,12	0,4741±0,17	1,28±0,20	77,67±0,77
Experiment 3	48,34±0,64	19,61±0,35	14,64±0,24	0,4838±0,15	1,34±0,18	78,62±0,85

By applying data on changes in physical, chemical, physico-chemical, it makes it possible to fully evaluate the qualitative characteristics of the finished product, as well as to improve the technological process of its production.

Microstructural changes of salted mutton under the influence of the milk-protein complex will be able to complement the picture of the qualitative characteristics of the finished product.

Histological studies were carried out by fixing samples in a 10% aqueous formalin solution according to a generally accepted method. The material was cut on a micro-volume cryostat “MIKROM – HM 525” (Germany).

Microstructural changes of mutton injected with brine in an amount of 10% to the initial mass of raw materials are characterized mainly by straightened fibers, less often convoluted (Fig. 1). Liquid is enclosed between the fibers. Myofibrils are mostly in a state of loosening, which leads to a decrease in noticeable changes in muscle fibers.

Fig. 1. Histological changes in salted raw materials (10% brine) (longitudinal section x20)

On the histological section, the muscle fibers are rounded compared to the initial parameters (Fig. 2.). Staining the muscle fibers with histological dyes allows you to clearly see the nuclei that have an oval shape.

Blood vessels and nerve fibers located in the intermuscular space are clearly visible.

The ingredients in the brine are not marked with histological dyes. At the same time, the raw material is characterized by an expanded intercellular space, capturing both endomysial and perimysial spaces.

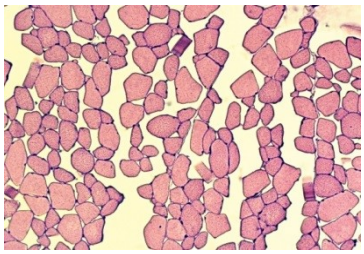

Fig. 2. Histological changes of salted raw materials (10% brine) (cross section x20)

When injecting the raw materials with brine in an amount of 10% by weight of unsalted raw materials (Experiment 1), histological changes in the structure allowed us to establish (Fig. 3) that a straight shape with clearly visible boundaries with a whole shell characterizes the muscle fiber. The study of mutton subjected to injection under a light microscope in an amount of 20% to the original the mass of raw materials is characterized by the fact that muscle fibers have a straightened or corrugated shape (Fig. 3).

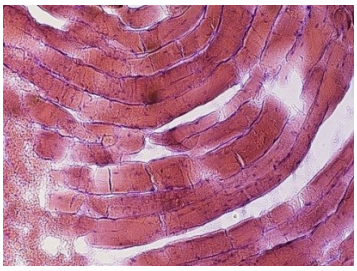

Fig. 3. Histological changes of salted raw materials (20% brine)(longitudinal section x20)

The ingredients of the milk-protein complex are distributed confusingly and combined into bundles mainly at the places of their introduction. The intermuscular space is spread apart and is not stained with histological dyes.

4 Conclusions

According to the results of the conducted studies, the main modes of cyclic massaging of raw materials using different levels of multicomponent brine were fixed.

Thus, the amount of milk-protein complex "Milana 100" in the composition of the syringe brine directly affects the process of massaging raw materials in the following way: the higher the level of brine administration, the longer the massaging process.

The degree of transition of meat pigments to NO-form is indicated by the level of residual sodium nitrite content in the samples under study. The results of the study showed that the higher the level of the introduced brine in the raw material containing the milk-protein complex “Milana 100” in its composition, the less the residual content of sodium nitrite was recorded, and the better the reaction of the formation of the coloring of salted products. These data are confirmed by the color characteristics of salty samples.

Thus, the color stability of the prototypes is 2.7 – 7.9% higher compared to the control, which is confirmed by the data and the high proportion of the formation of pigments of meat raw materials in the salting process using a milk-protein complex.

As a result, the data obtained give reason to believe that the color tone of the studied samples increases with an increase in the content of MPC "Milana 100" in the composition of the syringe brine, which indicates that the color of the samples is mixed into a pink-red area.

Based on the microstructure indicators, it was found that the ingredients contained in the multicomponent brine are mainly concentrated at the places of their introduction. This is especially noticeable on the proteins of the sarcoplasmic group, the particles of which do not penetrate even into the perimysium zone. The water-soluble components of the brine are evenly distributed both in the endomysium zone and in the perimysial spaces.

References

1. State Programme for the Development of Agriculture and the Regulation of Markets for Agricultural Products, Raw Materials and Food 2013-2020.
2. Decree of the Government of the Russian Federation of October 25, 2010 N 1873-p «On the basis of the State policy in the field of healthy nutrition of the population of the Russian Federation for the period up to 2020».
3. L. S. Kudryashov, E. A. Shalagina, Nutritional value of boiled-smoked lamb with milk-protein mixture, Meat industry, **10** (2011).
4. L. S. Kudryashov, E. A. Shalagina, The use of milk-protein complexes in the production of lamb products, Meat industry, **1** (2011).
5. T. V. Kabanova, M. V. Dolgorukova, S. I. Okhotnikov, E. V. Tsaregorodtseva, S. Y. Smolentsev, E. A. Savinkova, A. V. Onegov, The influence of fermented mare’s milk processing under pressure ogaseous nitrogen on the quality of koumiss, International Journal of Research in Pharmaceutical Sciences, **11(2)**, 2350-2354 (2020).
6. T. V. Kabanova, S. Yu. Smolentsev, E. A. Savinkova, E. V. Tsaregorodtseva, E. G. Shuvalova, O. Yu. Petrov, Effectiveness of effect of antioxidant of new generation on oxidizing processes in the containing collagen raw materials of the poultry-processing industry, IOP Conference Series: Materials Science And Engineering, **01200** (2018).
7. N. N. Kuzmina, O. Y. Petrov, E. A. Savinkova, I. V. Guseva, Development of technology lamb boiled in the skin with the use of milk-protein complex. Research Journal of Pharmaceutical, Biological and Chemical Sciences, **7(3)**, 839-846 (2016).

8. N. N. Kuzmina, O. Yu. Petrov, E. A. Savinkova, Influence of natural antioxidants on quality indicators of semi-finished products from meat of broilers, IOP Conference Series: Earth and Environmental Science. Conference proceedings. Krasnoyarsk science and technology city hall of the russian union of scientific and engineering associations, **22074** (2020).