Study of Qualitative Characteristics and Properties of Horse Meat

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Abstract: One of the main principles of state policy is to define the process of nutrition as a function of the relationship of a person with the environment. Nutrition should promote human adaptation to adverse environmental conditions. In this regard, the functions of nutrition are not only to meet the physiological needs of the body for nutrients and energy, but also to improve human health, prevent alimentary-related diseases associated with nutrition.

The aim of the research was to develop the technology of meat products to create innovative technologies of functional products from meat for public catering.

Keywords: Water activity, microstructure, meat color, structural and mechanical properties, shear stress.

INTRODUCTION

The modern concept of creating a sustainable food base of the country is based on the need to find and use reserves of economy of meat raw materials and its rational use. A necessary condition for solving such problems is the use of protein and fatty additives with consistently high functional properties in meat products technology, which creates prerequisites for increasing the yield and improving consumer properties of products.

The rational and economical use of raw materials is an important factor in the development of the food industry, saving raw materials, in particular meat. The result is a saving of raw materials and produce a product with targeted (targeted) dietary and prophylactic properties. These properties of products are mainly determined by the intensity and direction of biochemical and microbiological processes, the useful properties of protein food additives and technological methods of processing semi-finished products.

In our country, a new concept of healthy nutrition began to develop relatively recently. The food industry of Kazakhstan has been given the task of meeting the physiological needs of the population for high-quality, biologically high-grade and environmentally friendly food products with certain functional properties.

MATERIALS AND METHODS

Determination of color intensity. Determination of the color intensity of the product was performed by a method based on the extraction of meat pigments with an aqueous solution of acetone. The magnitude of the optical density of the extract at a wavelength of 540 nm is proportional to the concentration of the pigment and is an indicator of the intensity of color.

The determination of the moisture-binding capacity of meat compositions and finished products was carried out using the pressing method developed by R. Grau and R. Ham, modifications by V. Volovinsky and B. Kelman; Grau, R. (2004). Meat and meat products, Food industry, M. (VZS).

Determination of shear stress. The determination of the structural-mechanical properties was carried out on an Instron-1140 testing machine (USA) with various attachments.

Determination of water activity. The determination of water activity was carried out according to the method of Rogov I.A., Chomanov U.Ch. and others.

Microstructural studies of muscle tissue. The method of histological examination is an important addition to the overall picture of meat changes during processing.

RESULTS AND DISCUSSION

The color of meat is an important indicator for both meat producers and consumers. In appearance, color and smell of meat, the buyer determines its quality and freshness. In the international market, color is used as an indicator of meat quality.

When assessing the color of meat, the most objective method is to determine the color in the system of primary colors. In order to establish whether

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a raw material belongs to a quality group, it is sufficient to have color change boundaries that can be expressed in relative units such an indicator is the ratio of the color characteristics of two similar in color samples, expressed in arbitrary units (from 0.5 to 1.5).

It is known that the color of meat is due to the presence of a complex of derivatives of the muscle pigment myoglobin and partly the blood pigment of hemoglobin. In bloodless meat, the proportion of hemoglobin derivatives may be from 10 to 30% or more of the total pigment content.

The method of determining the color coordinates of a product in a color space is widespread. Color in this system is characterized by such parameters as lightness (L), tone (H), saturation (S), described by coordinates L, a, b, as follows:

$$L = + \text{arc td } b/a; \quad (1)$$

$$S = a^r + b^r. \quad (2)$$

Greater information content is provided by filming spectral reflection curves on recording spectrophotometers. In this case, either the entire spectrum is recorded in the wavelength range of visible light from 400 to 750 nm, sometimes with coverage and part of the ultraviolet region, or indicators of the reflection coefficients at certain wavelengths characteristic of heme pigments derivatives. The most commonly used measurement is the so-called isobest points which is at 525 nm, as well as in the spectral regions of individual derivatives of the pigment.

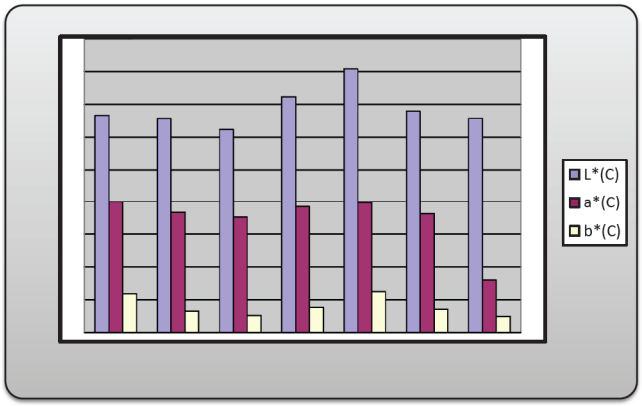

Figure 1: The control version and prototypes of horse meat.

It can be seen from the figure that in the first 24 hours of exposure in meat, the stage of rigor mortis sets in, which leads to a reduction in muscle fibers, an increase in their diameter and interfiber space, which leads to an increase in the fraction of scattered light, therefore, the color perceived by the device appears less intense. It should be noted that the color intensity of the samples with and without brine does not have a significant difference. In further exposure, this difference is smoothed out.

For finished products after heating using this method, no significant difference in the color indices has been established. Almost the value of T is close to unity. Apparently, this is due to the intensive loosening of the structure in the process of massaging and the best distribution of the curing ingredients throughout the product, which contributes to a more complete carrying out of the reaction of nitro-formation.

To assess the suitability of horse meat for industrial processing, freezing and culinary purposes, the strength properties and water-binding capacity of muscle tissue, which depend on the state of the meat to be directed, are crucial. The nature of the changes occurring in horse meat, determines its corresponding technological properties. The peculiarity of biochemical transformations in horse meat during cooling is associated with its chemical composition. In time, these changes in horse meat proceed much more slowly than under appropriate conditions in beef. We have made an attempt to characterize the change in the moisture-binding capacity and structural and mechanical properties of horse meat of higher, middle and lower average fatness (NSU, VU, SU) in the process of autolysis based on literature data and the results of our own research. The results obtained indicate a significant dependence of the moisture-binding capacity on the intensity and depth of glycolytic processes. Experimental data presented in table 46 show that the least moisture-binding capacity in the paired state has lower-average meat, and this indicator remains almost unchanged during the period of storage at the temperature of 0 - 2 ° C to 120-168 h.

Table 1: Changes in the Moisture Binding Capacity of Horse Muscle Tissue During Autolysis in Percents

Duration of autolysis, h	Horse meat		
	WU	ARE	NSU
1	85,32±0,47	84,82±0,87	61,20±0,23
24	83,58+0,38	79,32±0,59	59,31±0,54
48	83,60±0,29	74,10±0,32	52,35±0,62
72	84,54±0,46	75,86±0,83	51,4810,66
96	84,55+0,14	77,41±0,82	51,0610,71
120	85ДО±0,52	78,15±0,77	52,00 ±0,37

For meat of medium fatness, a high moisture-binding ability is characteristic in a paired state with a minimum value of 48-72 hours, corresponding to the maximum mortality of rigor mortis, with the subsequent resolution of which an increase in muscle tissue hydration occurs.

The least changes in moisture-binding capacity are expressed in the post-slaughter period in fatty meat of the slave. Apparently, this is primarily due to shallow changes in myofibrillary proteins in the process of autolysis due to the absence of a pronounced stage of post-mortem mortality, as well as a low concentration of hydrogen ions, which contributes to a higher ionization of protein macromolecules.

These data indicate the possibility of practical use of meat above average fatness for industrial processing in the early stages of autolysis, which will reduce losses during ripening and the cost of cooling and storing meat. An important conclusion can be made in relation to the meat of lower average fatness, which is characterized by low moisture-binding ability, which with the course of autolysis practically does not increase. This situation gives grounds to recommend the use of meat below average fatness after 24 hours from the moment of slaughter, which will also give the opportunity to reduce losses during storage, as well as the cost of cold. It is known that such meat loses a large amount of moisture during refrigerated storage.

Thus, the results obtained on the study of moisture-binding capacity of three qualitative groups of meat confirm the data on the solubility of myofibrillary proteins.

In the production of meat products, the greatest interest is the change in the structural and mechanical characteristics of meat - plasticity and shear stress. Hard meat and meat products are not tasty, do not cause appetite, the human body reacts to them with reduced secretion of digestive juices, as a result they are poorly digested. Not by chance, therefore, many ways to eliminate the stiffness of meat have been proposed.

Structural and mechanical properties characterize the behavior of a product under stress conditions and allow you to relate stresses, strains or strain rates to each other during the application of force.

Meat has a number of structural and mechanical properties: hardness, plasticity, elasticity, etc., which characterize the consistency of raw materials.

The consistency is one of the important parameters characterizing the elastic properties of the product. According to the magnitude of the maximum shear stress, the consistency of the product can be assessed most objectively.

The method for determining the shear force is based on measuring the pressure required to destroy a sample by shear. The shear force characterizes the strength and rigidity of the system, which are closely related to the qualitative composition of the product.

Also in the course of the work, the elastic modulus of meat products was investigated (Figure **2**)

From Figures **2**, **3** it can be seen that in the process the modulus of elasticity of meat products increases, with a force of 90-100 N it is 4.2-4.5 E. That indicates a direct influence on the structure of the main processes (microbiological and biochemical) occurring during salting.

Thus, the results of studies of the mechanical properties of meat products have shown the role and significance of the wide limits of its humidity, as well as the protein suspension that forms of its structure. The amount of water determines the direction and speed of formation of the product structure.

Structural and structural-mechanical properties of experimental and control samples, such as shear stress, thermodynamic indicator - water activity were investigated depending on the humidity of the products. The initial moisture content of meat products was 81-86%, Aw = 0.97-0.98. A straightforward dependence of the shear stress at high values of humidity was established.

The nature of the change in water activity from the moisture of products from horse meat basically corresponds to the nature of the change in the stress of the cut.

When the moisture content of meat products decreases below 45% and Aw = 0.8-0.9, the structure of the products is strengthened, since microcapillary moisture is removed, and the mobility of water molecules gradually decreases.

With a further decrease in humidity, the value of the cutoff voltage increases sharply, intermolecular structural moisture remains in the products, which gradually decreases and product shrinks due to the convergence of macromolecules, the mobility of which is limited. This period is characterized by a rectilinear

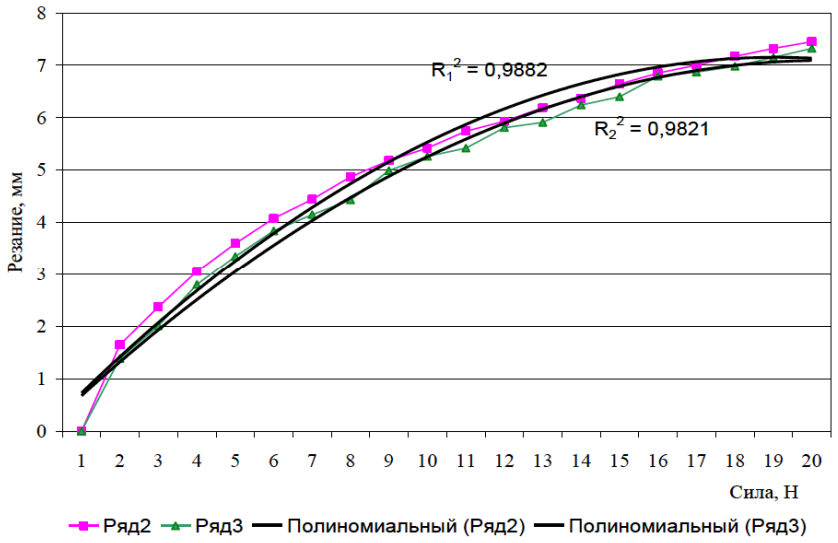

Figure 2: Variation of the voltage cutoff depending on the force.

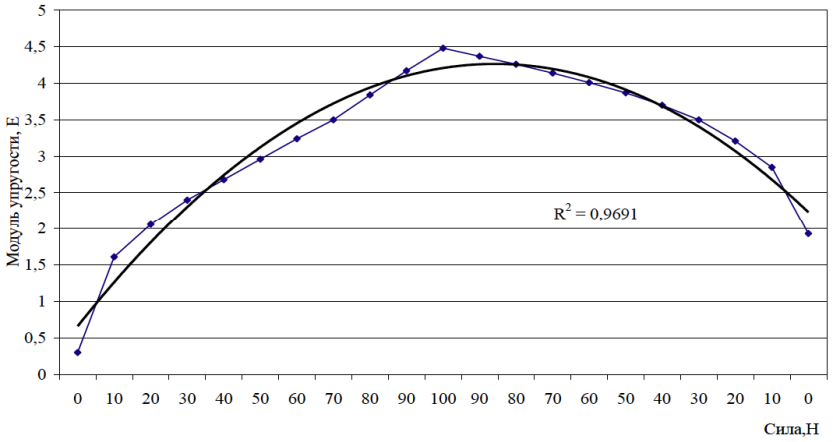

Figure 3: Modification of the elastic modulus depending on the force.

Table 2: Changes in Water Activity and Moisture of Horse Meat, Depending on the Duration of Mechanical Processing

Carry on strength MO, hour	Water activity, Aw		Humidity, W,%		Heat of moisture binding, Δr · 103 J / kg	
	Experience	control	experience	control	experience	control
0	0,988	0,965	87,3	75,4	0,5	0,5
1	0,976	0,960	82,7	73,8	0,9	0,7
2	0,968	0,956	78,1	72,6	1,6	1,3
3	0,960	0,951	76,0	72,1	1,9	1,4
4	0,954	0,947	74,9	71,8	2,3	1,9
5	0,947	0,943	74,2	71,1	2,5	2,0
6	0,940	0,938	73,6	70,4	2,6	2,3

dependence of water activity on humidity. A decrease in humidity leads to a sharp decrease in the amount of water activity and, accordingly, an increase in the binding energy of moisture.

The dynamics of changes in water activity depending on the moisture content of horse meat products mainly correspond to the dynamics of change in the voltage of the slice.

The microstructure of the experimental product. Meat samples with a size of 1.5x5x0.5 mm are fixed in a 20% aqueous solution of neutral formalin, then celloidin blocks are made from them and sections of 7–

10 microns thick are cut and stained with hematoxylin-eosin (Skalinsky E.I., Belousov A. BUT.,).

The microstructure of muscle tissue in a product made from raw meat is characterized as follows: muscle fibers have a curved shape, which are quite swollen and often fragmented or contain multiple transverse slit-like integrity. The nuclei retain their oval shape, but are stained worse than in raw materials.

Structural changes in the elements of the connective tissue of the skeleton in the muscle tissue are more significant than in the samples of the control products, manifested in the swelling and loosening of the collagen fibers contained in it. Between the muscle fibers and the elements of the connective tissue there is a slightly more significant amount of fine-grained protein mass, which gives the product better mechanical and organoleptic characteristics.

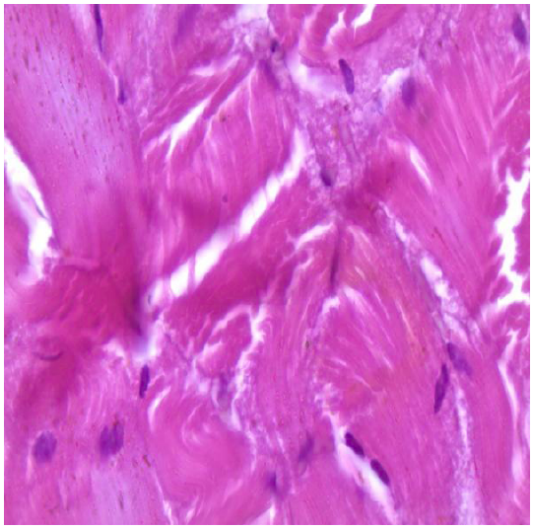

Figure 4: The microstructure of the muscle tissue of horse meat.

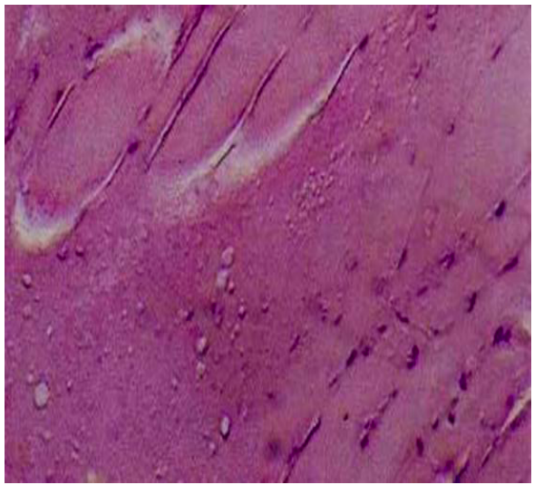

Figure 5: The microstructure of the experimental product.

The results of production tests showed the feasibility of electromechanical processing of raw materials, allowing to increase the yield and get a quality product.

Thus, on the basis of the qualitative and microstructural studies carried out on the characteristics of the tissue components of raw meat subjected to heat treatment with preliminary exposure to brine, we can come to the following conclusions:

- short-term effects on the meat of plant-protein brine leads to moderate microstructural changes of a destructive nature, reminiscent of the initial autolytic changes in meat during its maturation.

- as a result of the study of the microstructure, the high quality stability of the studied data and the increase in the morphological manifestations of the autolytic process and the thinning of muscle fibers were determined, which once again confirms the feasibility of using selected prototypes of raw meat.

CONCLUSION

On the basis of the above comprehensive studies, technological schemes have been developed for the production of semi-finished products from horse meat using intensive biotechnological methods for processing raw materials.

Microstructural (scanning and transmission electron microscopy) studies have demonstrated the features of the fine structure of the muscle tissue of the longest and semi-tendinous muscles of horse and mutton, as well as the characteristics of the structure of meat products obtained from these muscles.

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