INFLUENCE OF THE NEW MULTICOMPONENT BRINE ON THE QUALITY CHARACTERISTICS OF THE BOILED HORSE MEAT PRODUCT

N. I. Gombozhapova, B. A. Bazhenova*, S. Yu. Leskova, T. M. Badmaeva, and A. M. Danilov

East Siberian State University of Technology and Management, Klyuchevskaya Str. 40v, Ulan-Ude, 670013, Russian Federation

* e-mail: bayanab@mail.ru

Received May 23, 2016; Accepted in revised form September 25, 2016; Published June 29, 2017

Abstract: Currently, as part of import substitution, it is important to effectively use the reserves of animal protein, for example, horse meat, which has dietary properties due to a balanced amino acid and fatty acid composition and high efficiency in the treatment of anemia, hypotrophy and other pathologies. However, ready-made products of meat of adult horses are tough and not succulent; in order to adjust the functional and technological properties of boiled horse meat products, the use of multicomponent brines is promising. A promising ingredient for use in the composition of the stuffing brine is a powdered arabinogalactan, a highly branched polysaccharide, isolated from soft wood. The purpose of the work was to study the possibility of using arabinogalactan in the brine in the technology of whole-muscle boiled horse meat products. The experimental part was carried out in the laboratory of the department "Technology of meat and canned products" of the East-Siberian State University of Technology and Management. The samples of chilled horse meat were tested. These samples were stuffed with a control and experimental brines with a different dose of arabinogalactan with subsequent massaging in a tumbler. In the samples studied, physico-chemical and structural-mechanical characteristics were determined. As a result of the studies, kappa- and iota-carrageenans were selected as ingredients of the stuffing brine with a concentration of 0.8 and 0.2% and the animal protein "Promiat-90" with a concentration of 0.75% of the brine weight basis. The amount of injected arabinogalactan (10%), which provides the necessary density and viscosity of the brine, is experimentally justified. Massaging of salted horse semi-finished products is accompanied by an improvement in their hydrophilic properties, which reach the highest values in 10 hours. The finished experimental product is characterized by better quality and yield (by 6%). Thus, the use of 10% arabinogalactan in a multicomponent brine for horse boiled products makes it possible to improve their functional-technological and taste characteristics.

Keywords: Arabinogalactan, multicomponent brine, horse meat, boiled meat product

DOI 10.21179/2308-4057-2017-1-11-19 *Foods and Raw Materials*, 2017, vol. 5, no. 1, pp. 11–19.

INTRODUCTION

Currently, in accordance with the adopted State Program for the Development of Healthy Nutrition of the Population of the country, one of the main tasks of scientists in the meat industry and meat producers is to provide products not only for everyday demand but also for preventive purposes. At the same time, it is necessary to take into account the specifics of raw materials supply in the meat industry. In the context of import substitution, it is important to use all available animal protein reserves, for example, horse meat as efficiently and effectively as possible.

The horse meat has a pronounced dietary properties due to a well-balanced amino acid and unique fatty acid compositions. It has hypoallergenic properties and high therapeutic efficiency in the treatment of anemia, hypotrophy and other pathologies.

It is known that horse meat has a high content of mineral substances (calcium, phosphorus, iron – more than 20 kinds in all), essential amino acids, vitamins of group A and B. According to the microelement composition, horse meat is close to beef, but contains more iron and copper involved in the process of hematopoiesis, which is a positive factor in the treatment and prevention of anemia, as well as low sodium and many selenium, which strengthens its dietary properties. Horse meat outperforms other types of raw meat by the content of potassium, vitamins A, E, B_1, B_2. A horse is an animal with a unicameral stomach, devoid of the gallbladder, possesses meat that is easily digestible. Horse lipids differ significantly from other types of animal fats in chemical composition and biological value. They are fusible (melting point 28–32°C), rich in fatty acids and vitamin A valuable for human body, contain little cholesterol. However, the finished products from the meat of adult horses are stiff and not succulent, as the muscle fibers of horse meat are larger in comparison with beef fibers of larger diameter and are characterized by a high content of muscle connective tissue [1–5].

To adjust the functional and technological properties (FTP) of boiled products from horse meat, improve their quality and increase yield, the use of multicomponent salting brines is promising [6, 7].

Boiled delicacies, made from whole-muscle pieces of meat, are becoming increasingly popular on the market. To produce such products in order to achieve a gentler consistency, succulence, better slicing – on the one hand, and obtaining additional profit by increasing the yield of finished products – on the other hand, the multi-component brines are used. Due to the peculiarities of its structure and composition delicacy products from horse meat are practically not represented in the consumer market. Multicomponent brines used for the production of whole-muscle meat products are complex disperse systems and the quality and yield of finished products depend on their physico-chemical properties. Their use contributes to the formation of the necessary technological and consumer properties: taste, flavor, softness and color of the finished product. To achieve this effect, and for the purpose of intensifying the brine treatment process, various mixtures containing sugar, spices, sodium nitrite and food acids, phosphates are used. Traditional methods of injecting brines with a high percentage of injection do not allow the finished product to remain marketable, leading to loss of product mass. These disadvantages can be eliminated by increasing the viscosity of stuffing brines due to various additives.

One of the most promising for use in the composition of stuffing brines is arabinogalactan (AG) – highly branched polysaccharide, contained in large quantities in soft wood (TU 9363-021-39094141-08).

The macromolecule of arabinogalactan from larch wood has a highly branched structure; its main chain consists of galactose units linked by glycosidic bonds β-(1→3), and side chains with bonds β-(1→6) from galactose and arabinose units, from single arabinose units, as well as uronic acids, mainly glucuronic acid. The ratio of galactose and arabinose units is approximately 6 : 1. Moreover, AG is mostly extracted from Siberian larch, in which the percentage of this substance is rather high – up to 35%. The resulting compound is an amorphous yellowish white powder, odorless and tasteless. It dissolves easily in water, both hot and cold, does not dissolve in organic solvents and has an average solubility in diluted alcohol. Fig. 1 shows the formula of arabinogalactan.

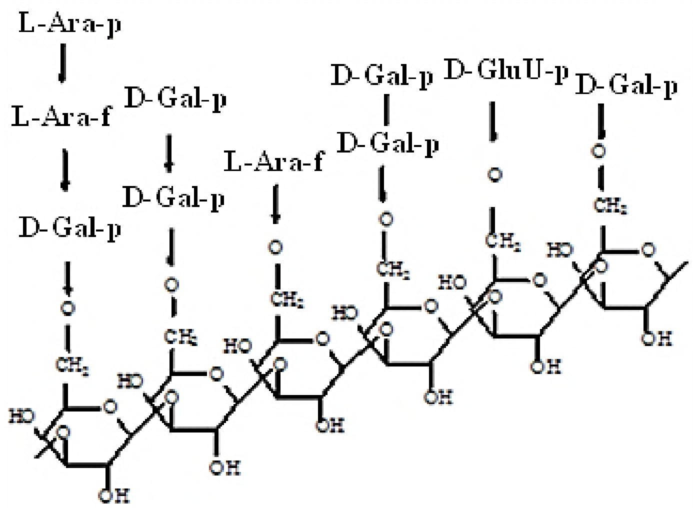

Fig. 1. The formula of arabinogalactan.

In recent years, studies of the biological activity of AG have intensified dramatically [8, 9, 10]. This is facilitated by such properties as high solubility in water, uniquely low viscosity of brines, narrow molecular weight distribution, and also biodegradability.

Arabinogalactan, a water-soluble polysaccharide, is a source of dietary fiber, is characterized by low toxicity and high biological activity (prebiotic, immuno-stimulating, lipid-lowering, gastro- and hepatoprotective). Especially important are its immunomodulating and prebiotic activity, due to which dozens of biologically active additives to human food and feed additives for animals have already been created in the world. In our country these are Fibrolar, Imbalance, Araglin D, Flarabin, Lakbin and a number of others.

Clinical studies have demonstrated not only the prebiotic and immunomodulatory effects of AG, but also a significant reduction in cholesterol in people with hyperlipidemia [11, 12, 13].

Arabinogalactan is registered under the code E409 in the Code of the Expert Committee on Food Additives of the World Health Organization (FAO/WHO) for food products as a stabilizer of emulsions and thickener. In our country, according to the List approved by the Chief Sanitary Doctor of the Russian Federation, an adequate level of human AG consumption is 10 g/day, and the upper permissible level is 20 g/day. It is approved for use in the food industry as a thickener, stabilizer and gelling agent [11, 14, 15].

Areas of AG consumption in the food industry are largely determined by its physico-chemical properties: solubility in cold water, low viscosity of concentrated solutions, ability to bind fat and retain moisture, resistance to heating up to 130°C. In connection with the foregoing, it can be concluded that AG is a food additive with high biological value and functional properties acceptable for use in food production [16].

In connection with the foregoing, the aim of the work was to study the possibility of using arabinogalactan polysaccharide in multicomponent brines in the technology of whole-muscle boiled horse meat products to improve the quality of the finished product.

OBJECTS AND METHODS OF STUDY

The experimental part was carried out in the laboratory of the department "Technology of meat and canned products" of the East-Siberian State University of Technology and Management.

For the studies, chilled horse of II fatness category was used. The weight of the horse meat samples was 150 ± 10 g. Brine was stuffed into the control and test samples by means of a syringe. Injections were made along and across the muscle fibers of the meat. The test samples were stuffed with multicomponent brine and massaged in a laboratory unit operating as a tumbler (10 rpm) for 12 hours (in the following mode: the first hour of continuous massaging, the following hours: 40 minutes – massaging, 20 minutes – rest). Sampling was conducted every two hours.

Then the samples were subjected to heat treatment: The product was boiled in water at a temperature of 80–85°C for 30 minutes and heat treated with steam (steam temperature 100°C) for 45 minutes. The finished products were cooled to a temperature of 4–6°C.

The brine quality was determined by physicochemical methods: The kinematic viscosity was determined with the VPZH-2 capillary viscometer, the brine density was measured with a densitometer, and the active acidity was measured by a potentiometric method.

To determine the relationship between the duration of massage, the composition of multicomponent brine, and the properties of salted semi-finished product, the water-retaining capacity (WRC) of the semi-finished product was studied by pressing, the structural and mechanical properties were determined with the Warner-Bratzler instrument and the losses in the heat treatment of the finished product were analyzed by the difference in mass before and after boiling.

The quality of the finished product was evaluated in accordance with the indicators established by regulatory documents for whole-muscle products. Organoleptic indicators were determined on a nine-point scale; mass fractions of sodium chloride – in aqueous extract from the product by the Mor method; sodium nitrite – using photometric method by measuring intensity of the color formed in the interaction of nitrite with sulfonamide and N-(1-naphthyl)-ethylenediamine dihydrochloride in protein-free filtrate; protein – by Lowry's method; lipids – by Soxhlet method; total phosphorus – by photometric method, which is based on the reaction of phosphorus with ammonium molybdate in the presence of hydroquinone and sodium sulfite to form a colored compound, the color intensity of which is measured photometrically; residual activity of acid phosphatase - photometrically depending on the intensity of the resulting color, expressed by the mass fraction of phenol, the content of arabinogalactan - by gel permeation chromatography in a glass column with dextran calibration.

For conducting experimental studies, the standard salting brine used in the technology of whole-muscle meat products was taken as the starting material [17]. According to the Technical Regulations of the CU 034/2013, meat producers should use salt-and-nitrite mixtures instead of sodium nitrite in their production, so, in addition to sodium chloride, a salt-and-nitrite mixture Solino 0.5/0.6 was added. Thus, the standard brine included: Sodium salt, saline-nitrite mixture 0.5/0.6 and sucrose. As a control, a standard brine was used with the addition of phosphates and sodium erythorbate. For further studies, the dose of control brine and the amount of salting ingredients according to the FTP were chosen: water-retaining capacity and losses during the heat treatment of the boiled product. Brines were introduced by stuffing in an amount of 20 to 80% of the raw material weight. Samples with 40% brine injection had larger WRC and a smaller amount of losses during heat treatment. The content of salting ingredients (kg) per 100 liters of control brine (with injection in an amount 40 %): Table salt – 4 kg, salting-nitrite mixture – 1.5 kg, sucrose – 1.4 kg, phosphate – 0.5 kg, sodium erythorbate – 0.5 kg.

Currently, in the meat processing industry in the production of whole muscle products carrageenans are used as food hydrocolloids. Different types of carrageenans were added to the experimental samples of brines: kappa carrageenan Bengel 270 and iota-carrageenan MB-150F in an amount of from 0.2 to 1.5% of the brine weight. The control was a basic brine (Table 1).

Table 1. Characteristics of brines with carrageenans

Indicators	Brines								
	Control	Test							
		The dose of carrageenans in brines,%							
		Kappa-carrageenan				Iota-carrageenan			
		0.2	0.5	1.0	1.5	0.2	0.5	1.0	1.5
Density, kg/m^3	1056.0	1056.0	1056.0	1056.0	1057.0	1058.0	1061.0	1064.0	1068.0
pH	6.3	7.2	7.4	7.5	7.7	7.1	7.2	7.5	7.8
Kinematic viscosity, mm^2/sec	1.3892	1.4412	1.5892	1.6082	2.0050	1.8794	3.2564	4.6472	24.0615

RESULTS AND DISCUSSION

At the first stage, the properties of brines were studied. The data given in Table 1 indicate that carrageenans increase density and viscosity of brines, but behave differently. Iota-carrageenan, in contrast to kappa-carrageenan, expands in a cold brine and the brine viscosity increases with increasing its dose from 0.2 to 1.5% by a factor of 1.5–12 as compared to brines containing the same amount of kappa- carrageenan, respectively. Increased viscosity of the brine with iota-carrageenan to a certain extent allows to reduce its losses between injection and massaging. On the other hand, a high viscosity of the brine can lead to clogging of the injector needles.

Kappa-carrageenans expand when heated, providing a high WRC in the finished product. The obtained data show that the dose of carrageenans providing satisfactory parameters for density, viscosity and pH of brines for kappa-carrageenans does not exceed 1%, and iota-carrageenans – 0.5%. In the studied brines, the total content of iota-and kappa-carrageenans was taken in an amount of 1% of the brine weight, with recommended doses of inection into meat products from 0.5 to 2%. Analyzing the experimental data on the kinematic viscosity of brines from the technological point of view, the most acceptable is injection of 0.2% of iota-carrageenan; since the total content of carrageenans is taken in the amount of 1%, the kappa-carrageenan content is 0.8%, thus, the kappa-iota-carrageenan ratio is 4 : 1.

The important structure-forming components used in the technology of production of whole-muscle meat products are protein preparations. Soy and animal proteins are most often used for this purpose.

In connection with the foregoing, soy isolate Supro 595 and animal protein Promiat-90, in concentrations not exceeding the maximum levels of their use in the technology of production of meat products, were injected into brines with carrageenans. The analysis of the data showed that all brines are acceptable in their physicochemical parameters. However, a sample injected with brine, which included a soy isolate, received a relatively low organoleptic evaluation because of the characteristic taste of soy.

Currently, producers of meat products are increasingly using brines with proteins of animal origin, as the demand for products containing soybeans has fallen markedly. On the basis of the physico-chemical indices of the experimental brines and the organoleptic evaluation of the final product, the optimal brine formulation was chosen, including the animal protein and carrageenans (Table 2).

One of the main properties of thickeners of different origin (polysaccharides, proteins) is mutual synergism, when the functional activity of the mixture exceeds the sum of the activities of the components. Against the background of carrageenan, protein preparations significantly reduce product losses during heat treatment, and finished products are less susceptible to the process of syneresis.

At the next stage of the study, the influence of the dose of arabinogalactan on the parameters characterizing the brine quality was studied. Such parameters include kinematic viscosity, density and active acidity of brines. In the experimental brines, AG was added in the amount from 5 to 15% (with increment of 5%). The control was the optimum brine composition shown in Table 2. The experimental data are presented in Table 3.

Table 2. Brine formulations

Ingredients, kg per 100 kg of brine	Control	Optimum brine composition
Table salt	4.00	4.00
Nitrite curing mixture Solino 0.5/0.6	1.50	1.50
Sucrose	1.40	1.40
Phosphate	0.50	0.50
Sodium erythorbate	0.50	0.50
Animal protein	–	0.75
Kappa-carrageenan Bengel 270	–	0.80
Iota-carrageenan MB-150F	–	0.20
Water	92.10	90.35
Total	100.00	100.00

Table 3. Characteristics of multicomponent brines

Indicators	Brines			
	Control	Experimental samples containing arabinogalactan, %		
		5	10	15
Density, kg/m^3	1056.00	1082.00	1094.00	1123.00
Kinematic viscosity, mm^2/s	1.4892	1.9876	2.4932	2.8893
pH	7.04	6.04	5.68	5.28

In the study of brines, it was found that when the amount of injected AG is increased, the density of experimental brines increases insignificantly compared to the control brine. The kinematic viscosity increases with increasing content of AG in the brine, however, is at a level allowing injecting brines by means of stuffing, achieving its rapid distribution in the product.

The active acidity of the brine with increasing the AG injection dose is reduced. This is due to the fact that the active acidity of the pure AG solution is in the range of 4.0 to 4.5. It is known that the area of the most effective action of most of the brine ingredients (pH = 6–7). In this regard, to increase the active acidity of the brine and binding of calcium ions, it was decided to increase the dose of phosphate within the acceptable value to 1.2% [18]. This will increase the moisture-binding ability and softness of meat, stabilize the color, inhibit the oxidation of lipids. These changes in the active acidity of brines with AG at a phosphate content of 1.2% of the brine weight are presented in Table 4.

Table 4 shows that the experiment with 10% arabinogalactan and the phosphate content of 1.2% is the most satisfying to these requirements. Thus, for further study, experimental brine 2 with a 10% AG content was selected.

The compositions of the control and experimental brines are presented in Table 5.

When 40% brine containing 10% AG is added to the unsalted meat, the content of AG in the finished product is about 3 g per 100 g of product, taking into account the loss of loosely bound moisture. Physiologically useful effects were established in humans with consumption of 1.5 to 4.5 grams of AG per day [13]. In accordance with the recommendations of the Expert Committee on Food Additives of the World Health Organization (WHO), a product which contains 3 g of dietary fiber per 100 g is considered a source of dietary fiber.

At the second stage, the relationship between the duration of horse meat massaging in the salting process and the quality indices of the salted semi-finished product was studied.

To study the effect of the composition of a multicomponent brine with 10% AG content and the period of massaging, in the salt semi-finished product, the mass fraction of moisture, the moisture-binding capacity (MBS) and WRC-indicators were measured, which are related to the quality and yield of meat products.

Table 4. Brine active acidity

Samples	Amount of arabinogalactan injected, %	pH of brines with a phosphate content of 1.2%
Control	0	8.28
Experiment	5	7.68
Experiment	10	6.82
Experiment	15	5.94

Table 5. Brine compositions

Ingredients, kg per 100 kg of brine	Brines			
	Control	Experiment brines		
		no. 1	no. 2	no. 3
Table salt	4.00	4.00	4.00	4.00
Nitrite curing mixture Solino 0.5/0.6	1.50	1.50	1.50	1.50
Sugar	1.40	1.40	1.40	1.40
Phosphate	1.20	1.20	1.20	1.20
Sodium erythorbate	0.50	0.50	0.50	0.50
Animal protein Promiat - 90	0.75	0.75	0.75	0.75
Kappa-carrageenan MB-150	–	0.80	0.80	0.80
Iota-carrageenan Bengel 270	–	0.2	0.2	0.2
Arabinogalactan	–	5.00	10.00	15.00
Water	90.65	84.65	79.65	74.65
Total	100.00	100.00	100.00	100.00

The analysis of the obtained data showed that the mass fraction of moisture in the salted semi-finished product increases with the duration of massaging from 2 to 12 hours and 10 hours higher than in the initial measurement by 7–14% both in the control and in the test samples. The results of experimental studies of MBC of a salted semi-finished product are presented in Fig. 2.

The results of experimental studies of the water retention capacity of salted horse meat after heat treatment are shown in Fig. 3.

The data in the figures are presented in relative units, in order to exclude the influence of the raw material properties.

The analysis of the obtained data showed that with increasing duration of massaging MBC and WRC of the control and test samples increase and reach the maximum values during massaging for 10 hours, while the difference between the control and the test samples is 5.8% and 6.3%, respectively. The values of MBC and WRC in the control and test samples correlate in the process of massaging the samples. But in test samples with AG these values are higher in comparison with the control due to the complex carbohydrates contained in arabinogalactan and their branched structure. Reduction of MBC and WRC at a longer massaging can be explained by partial denaturation of proteins.

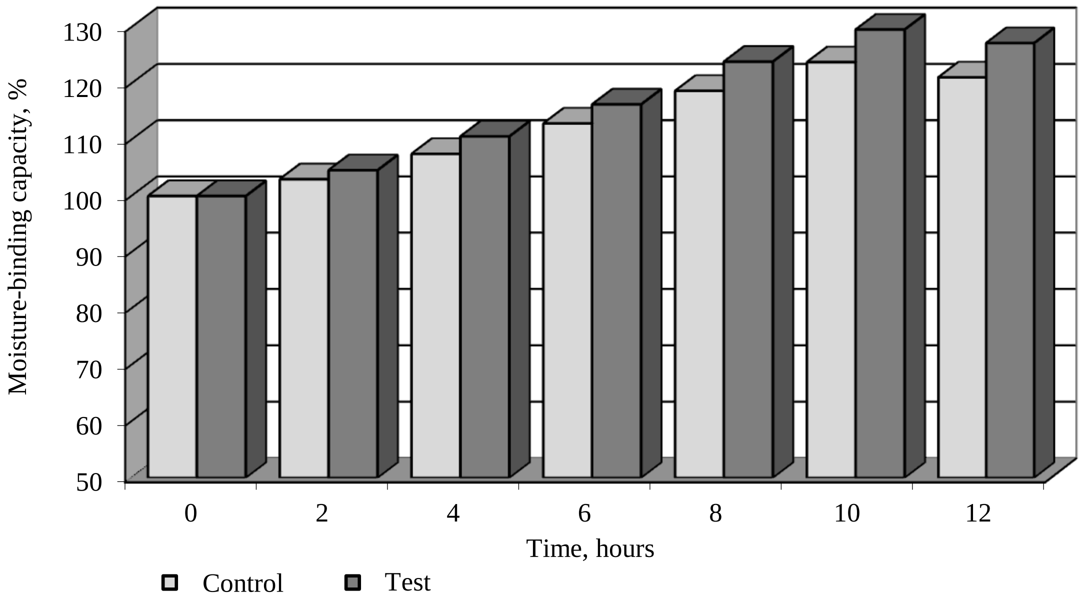

Fig. 2. Dynamics of change in moisture-binding capacity of salted semi-finished product from horse meat.

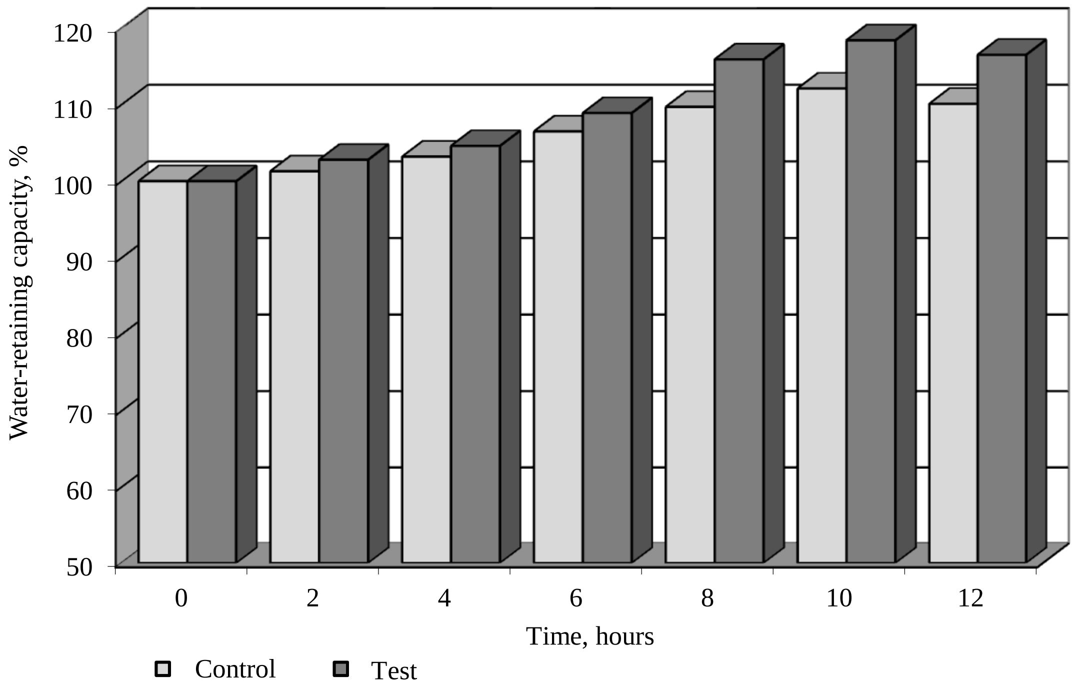

Fig. 3. Dynamics of change in the water-retaining capacity of the finished product.

Based on the FTP of the salted semi-finished product, the duration of mechanical treatment for 10 hours was selected.

The next stage of the study was evaluation of the quality and yield of the finished product. In connection with the task, the quality of the samples was evaluated in accordance with regulatory documents for whole-muscle products. In addition, the FTP and the structural and mechanical properties (SMP) of the control and test samples subjected to massaging for 10 hours were studied (Fig. 4).

An analysis of the results indicates that the best characteristics have the prototype, which has the great plasticity and the less cutting force. The lower the cutting force, the softer the product. The sample has a high WRC and, accordingly, the highest yield after heat treatment – 92%.

The results of study on models allow us to establish the patterns of changes in properties and yield of products when changing recipes, technologies and regimes. The product was boiled in water at a temperature of 80–85°C for 30 minutes and heat treated with steam (steam temperature 100°C) for 45 minutes. The criterion for evaluating the method was the loss during heat treatment. In the course of the conducted studies, it was found out that the losses in cooking with a live steam are lower by 5% than when boiling in water.

The quantitative values of the losses of the finished product during the heat treatment are shown in Table 6.

In the course of the experiment, it was found that after 10 hours of massaging, the losses are reduced in the control sample by 54%, and in the experimental sample by 73%, i.e. the difference between the samples is 19%.

An organoleptic evaluation of the horse meat product with a brine containing 10% AG ("Delicacy horse meat") was carried out on a 9-point scale (Fig. 5).

From the profile record it can be seen that the organoleptic evaluation of the product “Delicacy horse meat” is higher in all indicators, in comparison with the control. Particularly noticeable is the difference in assessment of the consistency, succulency and appearance of the products. In the control sample, the consistency and succulency was evaluated by 6 points, as it was rigid and dry, which correlates with the MBC and the cutting force.

Qualitative parameters of the boiled product “Delicacy horse meat” are presented in Table 7.

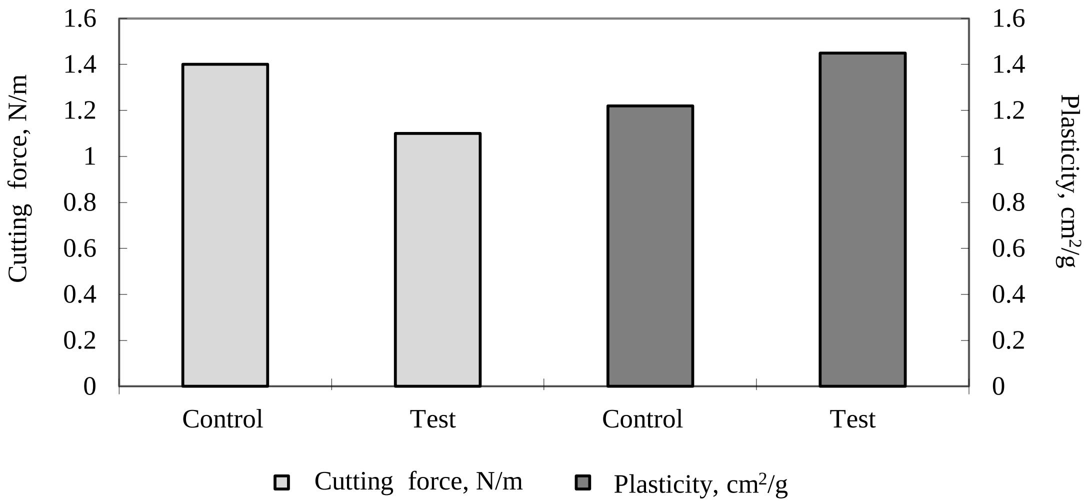

Fig. 4. Structural and mechanical properties of control and test samples.

Table 6. Losses at boiling of salted semi-finished product

Heat treatment losses, %	Duration of massage, hour						
	0	2	4	6	8	10	12
Control	31.9 ± 0.3	23.8 ± 0.6	22.7 ± 0.5	20.1 ± 0.4	17.1 ± 0.7	14.6 ± 0.2	20.3 ± 0.2
Experiment	31.2 ± 0.5	22.8 ± 0.7	18.3 ± 0.5	15.5 ± 0.7	11.2 ± 0.4	8.4 ± 0.4	11.0 ± 0.3

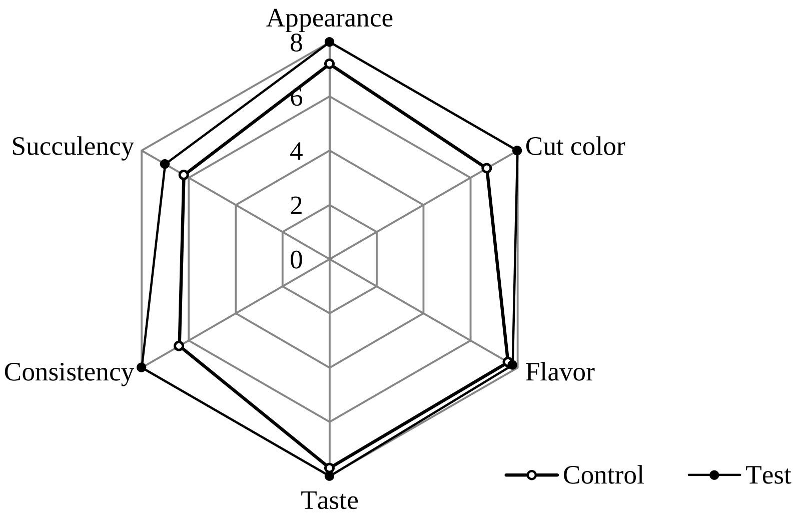

Fig. 5. Profile record of organoleptic indicators of the boiled product "Delicacy horse meat".

Table 7. Qualitative parameters of the boiled product "Delicacy horse meat"

Indicators	Quality requirements as per GOST 32785-2014. Products of horse meat	Horse meat delicacy
Appearance	The surface is clean, dry with no meat scraps, no fringes, spices and bay leaves	The surface is clean, dry with no meat scraps, no fringes, spices and bay leaves
Shape	Rectangular, oval, cylindrical	Rectangular, oval, cylindrical
Consistence	Elastic	Elastic
Cur color	Uniformly colored muscular tissue from light red to dark red	Uniformly colored muscular tissue from light red to dark red
Taste and flavor	A pleasant taste and flavor	A pleasant taste and flavor
Weight ratio of table salt, %	max. 3.0	2.1 ± 0.2
Weight ratio of sodium nitrite, %	max. 0.005	0.0030 ± 0.0001
Weight ratio of protein, %	min. 14	16.5 ± 0.3
Weight ratio of fat, %	max. 12	4.00 ± 0.06
Weight ratio of total phosphorus in terms of P_2O_5, %	max. 0.8	0.300 ± 0.003
Residual activity of acid phosphatase, %	max. 0.005	0.003
Content of arabinogalactan, g/100 g of product	–	3.0

These parameters indicate the compliance of the boiled product "Delicacy hprse meat" with the requirements of regulatory documents for whole-muscle meat products.

CONCLUSIONS

The use of arabinogalactan in brines provides their density and viscosity; the pH level of such a brine is close to the pH level of the most effective action of the brine ingredients. Massaging the salted semi-finished horse meat is accompanied by an improvement in the functional-technological and structural-mechanical properties of horse meat, which reach their maximum values after 10 hours. The finished experimental product is characterized by better quality and yield (by 6%).

It has been established that the use of arabinogalactan in multicomponent brines for cooked horse meat products allows to improve the taste characteristics of the finished product.

REFERENCES

1. Tuleulov E.T. *Proizvodstvo koniny* [Production of horse-flesh]. Moscow: Agropromizdat Publ., 1986. 281 p.
2. Manyukhin Ya.S., Tchernukha I.M., Kovalyov L.I., et al. The study of horsemeat proteins by use proteomic technologies. *Vse o myase* [All about meat], 2014, no. 3, pp. 20–25. (In Russian).
3. Bouwman F.G., van Ginneken M.M., van der Kolk J.H., et al. Novel markers for tying-up in horses by proteomics analysis of equine muscle biopsies. *Comparative Biochemistry and Physiology - Part D: Genomics and Proteomics*, 2010 Jun, vol. 5, no. 2, pp. 178–183. DOI: 10.1016/j.cbd.2010.03.009.
4. Lorenzo J.M., Sarriés M.V., Tateo A., et al. Carcass characteristics, meat quality and nutritional value of horsemeat: a review. *Meat Science*, 2014, vol. 96, no. 4. pp. 1478–1488. DOI: 10.1016/j.meatsci.2013.12.006.
5. Bazhenova B.A., Badmaeva T.M., and Madagaev F.A. Uluchshenie struktury konskogo myasa [Improving the structure of horse meat]. *Sibirskiy vestnik sel'skokhozyaystvennoy nauki* [Siberian Bulletin of Agricultural Science], 2010, no. 4, pp. 98–102.
6. Kolesnikova I.S., Bazhenova B.A., Badmaeva T.M., Danilov M.B. The influence of multicomponent extruded brine on the quality of boiled-smoked horse meat product. *Vse o myase* [All about meat], 2014, no. 6, pp. 40–43. (In Russian).
7. Gombozhapova N.I., Bryanskaya I.V., and Leskova S. Yu. Brines on the basis of whey for horsemeat products manufacturing. *Myasnaya industriya* [Meat Industry], 2015, no. 6, pp. 18–20. (In Russian).
8. Medvedeva E.N., Neverova N.A., Fedorova T.E., et al. Structural transformations of siberian larch arabinogalactan at mechanochemical treatment and biological properties of products. *Khimija rastitel'nogo syr'ja* [Chemistry of plant raw material], 2009, no. 3, pp. 49–56. (In Russian).
9. Zarubaev V.V., Ostroumova L.A., Medvedeva E.N., et al. Antiviral preparations based on larch wood biologically active substances. *Byulleten' Vostochno-Sibirskogo nauchnogo tsentra Sibirskogo otdeleniya Rossiyskoy akademii meditsinskikh nauk* [Bulletin of the East Siberian Scientific Center SBRAMS], 2010, no. 1, pp. 76–80. (In Russian).
10. Babkin V.A., Malkov Yu.A., Medvedeva E.N., et al. Technology of Obtaining Biologically Active Forage Additives from the Wastes of Larch Biomass Processing. *Khimiya v interesakh ustoychivogo razvitiya* [Chemistry for Sustainable Development], 2015, no. 1, pp. 19–24. (In Russian).
11. Medvedeva E.N., Babkin V.A., and Ostroukhova L.A. Arabinogalaktan listvennitsy – svoystva i perspektivy ispol'zovaniya (obzor) [Larch arabinogalactan - properties and prospects of use (overview)]. *Khimija rastitel'nogo syr'ja* [Chemistry of plant raw material], 2003, no. 1, pp. 27–37. (In Russian).
12. Dubrovina V.I., Medvedeva S.A., Aleksandrova G.P., et al. Immunomoduliruyushchie svoystva arabinogalaktan listvennitsy Sibirskoy [Immunomodulating properties of arabinogalactan of Siberian larch]. *Farmatsiya* [Pharmacy]. 2001, no. 5, pp. 26–27. (In Russian).
13. Milo Ohr L. Dobavki arabinogalaktana ochen' polezny dlya zdorov'ya [Arabinogalactan adds more than health benefits]. *Prepared Foods*, 2001, vol. 170, no. 1, pp. 55.
14. Malkov Yu.A., Medvedeva E.N., and Babkin V.A. *Sposob polucheniya arabinogalaktana* [Method for the preparation of arabinogalactan]. Patent RF, no. 2454429, 2010.
15. Babkin V.A., Nefedova N.A., Medvedeva E.N., et al. Study of physicochemical properties of arabinogalactan of different larch species. *Khimija rastitel'nogo syr'ja* [Chemistry of plant raw material], 2015, no. 2, pp. 29–35. DOI: http://dx.doi.org/10.14258/jcprm.201502557. (In Russian).
16. Gombozhapova N.I., Bryanskaya I.V., Danilov M.B., and Medvedeva E.N. Vliyanie arabinogalaktana na svoystva rassolov dlya delikatesnykh myasoproduktov [Effect of arabinogalactan on the properties of brines for delicacy meat products]. *Izvestia vuzov. Pishevaya tekhnologia* [News institutes of higher Education. Food technology], 2011, vol. 1, no. 1, pp. 152–154. (In Russian).
17. Zharinov A.I., Kuznetsova O.V., and Cherkashina N.A. *Tsel'nomyshechnye i restrukturirovannye myasoprodukty* [Whole muscle and restructured meat products]. Moscow: ITAR-TASS Publ., 1994. 179 p.
18. Efremova A.S. and Zabashta A.G. Osobennosti sostavleniya i ispol'zovaniya rassolov [Features of the preparation and use of brines]. *Myasnye tekhnologii* [Meat technologies], 2009, no. 10, pp. 52–57. (In Russian).

Please cite this article in press as: Gombozhapova N.I., Bazhenova B.A., Leskova S.Yu., Badmaeva T.M., and Danilov A.M. Influence of the new multicomponent brine on the quality characteristics of the boiled horse meat product. *Foods and Raw Materials*, 2017, vol. 5, no. 1, pp. 11–19. DOI: 10.21179/2308-4057-2017-1-11-19.