

The effect of brine components on the quality and yield of smoked-boiled delicatessen products

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Abstract. Domestic producers use multicomponent brines for the production of delicatessen products. The composition of which includes a wide range of ingredients and food additives. The use of multicomponent brines is associated with the need to regulate biochemical processes in raw materials to improve marketability of finished products. The purpose of our research was to select the optimal percentage of brine introduction, to identify the effect of brine components on the quality of manufactured products and on the shelf life of finished products in vacuum packaging. The injection parameters, pressure, speed are set, optimal massage modes and the total operating time of the meat massager for the production of smoked-boiled products: carbonade and "meat nut" are selected. The output of finished products and the shelf life of smoked and boiled products in vacuum packaging in the refrigerator are also determined.

1 Introduction

The meat industry in our country is one of the most actively developing in the food industry [1]. To provide enterprises with high-quality raw materials, a number of scientists are working to find methods for improving and obtaining meat with high indicators [2-3].

The success of each enterprise is competitiveness and a wide range of products. The products manufactured are designed for the material capabilities of various population groups; in this regard, enterprises successfully compete in the market [1]. Domestic producers of meat products, including meat delicacies, are looking for methods of rational use of raw materials due to its shortage and instability of its quality. Improvement and stabilization of functional and technological properties of meat raw materials is also a priority in the food industry [4-5]. Delicatessen products have always been in high demand among most consumers. A lot of time is spent for the manufacture of smoked-boiled products and various methods are used to accelerate the production processes [6]. According to the data obtained from literary sources, it was revealed that processing

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enterprises use various variants of brine systems for the production of meat products. They are based on the quality of raw materials and a number of other indicators, which ultimately determine the quality of finished products. The cost of the raw materials used is constantly increasing and this affects the cost of delicatessen meat products. At processing enterprises, work is underway to find methods to accelerate production processes and obtain high-quality delicatessen products from pork and beef. Reducing the cost and improving the organoleptic properties of products are one of the priorities in the food industry. According to a number of authors, one of their promising ways of processing raw materials is injecting, massaging with various brine systems. Many manufacturers of meat delicacies add special additives in the form of brines to the recipes. When choosing a brine additive, attention is paid to solubility, stability, low losses during heat treatment and the taste qualities of the finished product. Also, in the production of various delicatessen products, there is a need to reduce the loss of meat extract. To achieve the desired results in finished products of such characteristics as tenderness, juiciness, taste, it is necessary to monitor the activity of intramuscular enzyme systems, the state of muscle tissue, and the degree of their change. Also, the rate of redistribution of salt, water and soluble substances between the product and the brine [7-11]. The penetration of salting ingredients into meat tissues and their interaction with proteins causes a change in the physicochemical properties of muscle tissue [12]. Injecting of meat raw materials is carried out with the help of needles. During injection, the ingredients in the brine are redistributed and thus they are evenly distributed in the raw materials, the duration of salting is reduced, the absorption and retention of the brine are better, the loss of protein and soluble substances is reduced, the yield of products is increased [13]. An increase in the permeability of raw materials for brine can also be achieved through the use of massaging and tumbling. A number of scientists are conducting research to study the effect of salting ingredients and vacuum packaging on the physicochemical qualities and storage quality of the finished product [14].

The purpose of the research is to study the effect of brine components on the quality and yield of finished smoked-boiled delicatessen products.

To achieve it, the following tasks were set:

1. To determine the optimal amount of brine introduced by injection.
2. To determine the quality and yield of the finished products manufactured.
3. To study the effect of brine components on the shelf life of finished products in vacuum packaging.

2 Materials and Methods

The research was carried out in the conditions of Zvenigovsky Meat Processing Plant LLC. The object of the study was chilled pork, which was subjected to injection with multifunctional brine systems, as well as finished products of smoked-boiled carbonade, smoked-boiled "meat nut".

During the study, the following indicators were studied:

- The brine pH, the pH of meat at the beginning and after injection – were determined in accordance with the requirements of GOST R 51478-99 Meat and meat products (pH);
- meat yield after injection – by weighing on electronic scales.
- yield of the finished product was determined by weighing the finished products after completion of all technological processes.

3 Results and Discussion

When choosing functional additives for brine preparation, we focused on the composition and components included in this mixture, as well as how they will have an effect on the quality of finished product. Two functional additives were selected for injection. The composition of the first functional additive included the following components: stabilizers (E450i, E339i, E1442), thickeners (E407, E414, E415), animal protein (pork), wheat fiber, flavors (bacon), flavor intensifiers E621, antioxidant E301, the second functional additive: acidity regulator E451i, soy protein, potato starch, animal protein (pork), flavorings (meat), flavor intensifier E621, antioxidant E301. Distinctive features of functional additives are that carrageenan and gum predominate in the first one, and soy protein in the second one. Carrageenan, gum, and wheat fiber are natural components, they have a high moisture-binding, fat-binding effect, as well as emulsifying ability. In addition, wheat fiber reduces moisture evaporation during heat treatment. Soy protein also has many positive features, and one of them is to improve the quality of the product by increasing complete proteins.

Brine for injection was prepared by adding components to water with intensive stirring, flake ice was used to reduce the temperature. Proper preparation of brine is extremely important for color formation, obtaining the desired yield, and storage duration. Low temperature of the brine reduces the likelihood of an increase in temperature during massaging and stirring, which, in turn, reduces the risk of bacterial growth in the injected meat. This method of protection is especially important because injected meat contains a lot of free water and other components that promote the growth of bacteria. The prepared brine was kept before injection for 15-20 minutes for the complete formation of the brine system. From the first functional additive, brine was prepared – Brine No. 1, from the second – Brine No. 2. Table 1 shows the recipe of brines for meat injection.

Table 1. Brine recipe for injection, kg

Ingredients	Brine No. 1	Brine No. 2
Functional additive	6	6
Nitrite salt	4,4	4,4
Table salt	0,35	0,35
Water	89,25	89,25
Total	100	100

A Gunther D - 64807 injector was used for injecting. The brine was injected into the meat using a multi-needle syringe. In the production of delicatessen products, experts recommend to pay more attention to the pH of raw materials, which ultimately affects the yield and quality of the finished product. Prior to the start of the study, the brine and meat pH was measured and the mass of meat was determined before injection. After injection, measurements of these indicators were also carried out. The weight of meat and the pH measurements of meat raw materials before and after injection are given in Tables 2 and 3.

Table 2. Meat weight before and after injection

Indicators	Smoked-boiled carbonade		Smoked-boiled "meat nut"	
	Brine No. 1	Brine No. 2	Brine No. 1	Brine No. 2
Meat weight before injection, kg	300±0,02	300±0,02	300±0,02	300±0,02
Meat weight after injection, kg	434,4±0,51	435,2±0,37	447,8±0,66	446,2±0,58

Raw materials intended for the production of smoked-boiled carbonade after injection with Brine No. 1 increased by 44.8%, Brine No. 2 - by 45.06%, smoked-boiled "meat nuts" injected with Brine No. 1 - by 49.3%, Brine No. 2 - by 48.7%.

The meat injecting process is shown in Figures 1 and 2.



Fig. 1. The process of injecting raw materials



Fig. 2. Injected raw materials

According to the data obtained, it can be judged that the injection process was successful, so the meat pieces turned out to be soft, tender, juicy, without damage to muscle tissue.

Table 3. Change in the pH of meat raw materials before and after injection

Parameters	Smoked-boiled carbonade		Smoked-boiled "meat nut"	
	Brine No. 1	Brine No. 2	Brine No. 1	Brine No. 2
meat pH before injection	5,78±0,08		5,88±0,04	
meat pH after injection	6,08±0,01	5,98±0,01	6,18±0,01	6,11±0,01

Studies have shown that there was an increase in meat pH.

During the injection, the pressure, brine feed rate, brine temperature, and raw material temperature were regulated, the data are given in Table 4. To determine the optimal amount of brine injection into meat, the percentage of injection was adjusted.

Table 4. Parameters of the injection process

Parameters	Smoked-boiled carbonade		Smoked-boiled "meat nut"	
	Brine No. 1	Brine No. 2	Brine No. 1	Brine No. 2
Raw material temperature	5,5-6	5,5-6	4,5-5	4,5-5
Brine temperature	3,4-4,4	3,4-4,4	3,4-4,4	3,4-4,4
% of injection	44,7	45,1	49,3	48,9
Injector parameters:				
Needle beam speed, %	70	70	50	50
Conveyor belt speed,%	50	50	50	50
Type of injection	2-fold	2-fold	2-fold	2-fold
Brine pressure, bar	2,7	2,7	3,5	3,5

For injection, raw materials with different temperature conditions were used for smoked-boiled carbonade in the range of 5.5-6⁰C, and for smoked-boiled "nuts" 4.5-5⁰C, the brine temperature was the same in the range of 3.4-4.4⁰C. The injection of raw materials was carried out 2-fold, while the speed of the needle beam and the conveyor belt was monitored.

When meat is exposed to mechanical action, it becomes tender, juicy, the consistency is improved, and most importantly, the permeability of salting substances increases. The operating parameters of the meat massager equipment are given in Table 5.

Table 5. Parameters of the meat massager operation

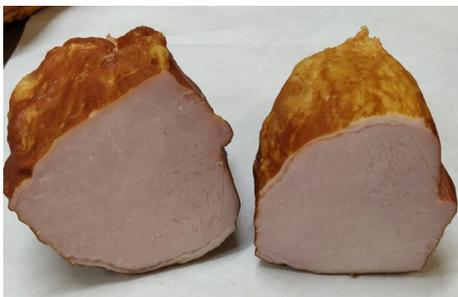
Parameters	Smoked-boiled carbonade		Smoked-boiled "meat nut"	
	Brine No. 1	Brine No. 2	Brine No. 1	Brine No. 2
Total working time, h	4	4	8	8
Working period, min	20	20	20	20
Rest period, min	10	10	10	10
Vacuum level, %	85	85	85	85
Number of revolutions per min	6	6	8	6

Massaging of raw materials was carried out for 20 minutes with a rest period of 20 minutes for the production of smoked-boiled carbonade and for smoked-boiled "nuts", and the massager total working time was 4 hours for raw materials used for the production of smoked-boiled carbonade and 8 hours for raw materials for smoked-boiled "nut".

After massaging, the raw materials were sent for molding and heat treatment. The technology of production of boiled-smoked products of carbonade and "meat nuts" was carried out in accordance with the Technical specifications of TU 9213-033-89525043 "Meat delicacies". Technical conditions.

The yield of finished products after heat treatment was 115.2% for smoked-boiled carbonade and 118.4% for smoked-boiled "meat nut" injected with Brine No. 1, with injected Brine No. 2 - 116.1% and 119.8%, respectively.

Finished products of smoked-boiled carbonade and smoked-boiled "meat nut" are shown in Figures 3 and 4.

**Fig. 3.** The finished product of smoked-boiled carbonade**Fig. 4.** The finished product of smoked-boiled "meat nut"

To give the product a delicate taste, preserving all the properties of animal protein, while ensuring the safety of the product in the package without releasing excess moisture - the main technological problems at enterprises.

To increase the shelf life and storage, smoked-boiled products were packed in vacuum packaging.

Vacuum packaging ensures the safety of finished products from rapid deterioration, as the growth of pathogenic bacteria slows down. Also, the preservation of taste, original appearance, smell, and humidity level is the advantage of using this package [15-17].

Smoked-boiled carbonade and smoked-boiled "meat nuts" in vacuum packaging (Fig. 5 and 6).

To assess the effect of brine components on the quality of finished products, as well as to determine the appropriate norms for its injection, the shelf life of products packed in vacuum packaging was studied.

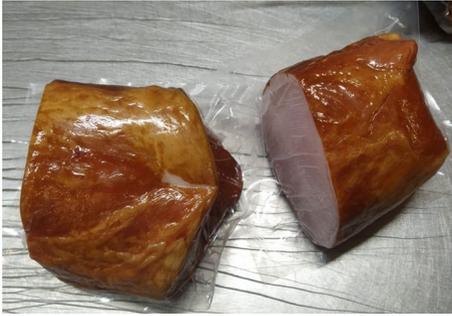


Fig. 5. Smoked-boiled carbonade in vacuum packaging



Fig. 6. Smoked-boiled "meat nut" in vacuum packaging

Meat products in vacuum packaging were in the refrigerator at a temperature of 2...4⁰C. The condition of the products was assessed on 5th and 20th day of storage.

According to the data obtained, it was revealed that on the 5th day of storage, finished products injected with Brine No. 1, No. 2 were characterized by a satisfactory product density, moderate brine cut-off was observed, on the 20th day in products injected with Brine No. 1, No. 2 - the density of the product was satisfactory, but syneresis was more pronounced.

4 Conclusions

Thus, the injection of raw materials using mechanical processing made it possible to improve the technological properties of pork and to obtain a product with a high yield of finished products. Injected with brines: Brine No. 1 - 115.2% for smoked-boiled carbonade and 118.4% for smoked-boiled "meat nut", Brine No. 2 - 116% and 119%, respectively.

The data obtained indicate that of the two brines with different functional composition, Brine No. 2 turned out to be better. The expediency of using vacuum packaging in the manufacture of smoked boiled products has also been revealed and the terms of cold storage - 20 days have been established.

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