The influence of complex spices on the change in the quality indicators of chopped semi-finished products during storage

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Abstract. The trend of active development of consumption of chilled meat products and instant food products has persisted over the past years, despite the fact that the retail price of chilled meat is higher than frozen. This trend is observed not only in Russia but throughout the world. The main factors affecting the preservation of the quality and duration of storage of meat products in the chain from procurement to use by the end user is the composition and concentration of microflora. The active development of microflora during storage is a key indicator of shelf life and a reference point for the manufacturer. Stabilization of microbiological indicators of finished products is an important factor for the manufacturer and can be achieved through the use of active packaging, the introduction of preservatives and antioxidants, including in the composition of complex spices. The article studies the effect of complex spices on the change in microbiological indicators of chopped semi-finished products during storage, assesses the sanitary assessment of the content of BGKP, Listeria monocytogenes, Salmonella, KMAFanM according to the following regulatory documents: GOST 31747-2012, GOST 32031-2012, GOST 31659-2012, GOST 10444.15-94

1. Introduction
On the meat market of the Russian Federation there is a stable demand from buyers and an increase in sales of both frozen and chilled semi-finished products among other products of the meat industry [1-4], by about 5% per year. This is due to the wide range of these products and their taste.

Meat semi-finished products are distinguished by their compactness, versatility, and also the speed of preparation (minced meat semi-finished products, frozen), these are important criteria due to which they occupy a separate niche in the food market [5-7].

The problem of ensuring a consistently high quality of food is a priority for all branches of the food industry [8-10]. It acquires particular relevance at the present time, when the competitiveness of products becomes the main goal of the manufacturer, especially if the product complies with modern trends in nutrition and the principles of the food safety system [11-16]. In the conditions of the meat industry, the main contribution to the quality of products is made by the raw material factor [17-20]. The use of frozen
meat, as well as meat with an abnormal course of development of autolytic processes, is the reason for the deterioration in the quality of finished products.

Changes in the qualitative characteristics of raw materials lead to the need to improve technological processes and introduce new progressive technologies, which will allow meat producers to function in the current economic conditions [21-26].

Therefore, at this time, the need to develop a technology that makes it possible to produce chopped semi-finished products that provides stability of properties during cold storage, which will be achieved by adding food additives to the product, comes to the fore [27].

Changes in the properties of products during refrigerated storage are conditioned by the processes occurring in them (physical, chemical, biochemical, microbiological, histological, etc.), which in some cases improve the consumer properties of products, and in others cause their spoilage.

Therefore, the purpose of refrigeration processing and storage of products is to ensure a favorable course of the former (autolytic - in meat, etc.) and to minimize the latter (shrinkage, microbiological, oxidative, etc.).

The aim of the research is to study the effect of complex spices on the quality indicators of chopped semi-finished products.

2. Materials and methods

As the object of the study, 4 samples of chopped semi-finished products were selected, the ingredient composition is presented in tables 1-4.

| Table 1. Formulation of sample 1. |
|----------------------------------|
| **Ingredient** | **Weight, kg** |
| Pork semi-fat 70% frozen | 39.14 |
| Pork semi-fat 70% chilled | 29.35 |
| Beef 1 grade frozen | 29.35 |
| NaCl | 0.78 |
| Tarispice mix | 0.49 |
| Flavoring | 0.29 |
| Preservative "simbust" | 0.39 |
| Beet dye concentrate | 0.20 |

| Table 2. Formulation of sample 2. |
|----------------------------------|
| **Ingredient** | **Weight, kg** |
| Pork semi-fat 70% frozen | 39.18 |
| Pork semi-fat 70% chilled | 29.38 |
| Beef 1 grade frozen | 29.38 |
| NaCl | 0.78 |
| Tarispice mix | 0.49 |
| Flavoring | 0.29 |
| Grillfresh natural preservative | 0.29 |
| Beet dye concentrate | 0.20 |

| Table 3. Sample recipe 3. |
|---------------------------|
| **Ingredient** | **Weight, kg** |
| Pork semi-fat 70% frozen | 39.22 |
| Pork semi-fat 70% chilled | 29.41 |
| Beef 1 grade frozen | 29.41 |
| NaCl | 0.78 |
| Tarispice mix | 0.49 |
| Flavoring | 0.29 |
| Preservative "XtraBlend RA" | 0.20 |
| Beet dye concentrate | 0.20 |
Table 3. Sample recipe 3.

| Ingredient                        | Weight, kg |
|----------------------------------|------------|
| Pork semi-fat 70% frozen         | 39.10      |
| Pork semi-fat 70% chilled        | 29.33      |
| Beef 1 grade frozen              | 29.33      |
| NaCl                             | 0.78       |
| Tarispice mix                    | 0.49       |
| Flavoring                        | 0.29       |
| Preservative smoke flavor Cloud S-5 | 0.49 |
| Beet dye concentrate             | 0.20       |

For the manufacture of chopped semi-finished products, we take pork bold 70% frozen, pork bold 70% chilled, beef 1 grade chilled. They are crushed on a top with a grate diameter of 18-20 mm. Further, the crushed raw material is fed through the conveyor to the mixer. Edible salt, tarispice mixture, flavoring agent, simbust preservative, beetroot concentrate is added to the raw materials in the mixer. The minced meat is mixed and fed to the syringe-drawer. On the syringe-top, consisting of a filler-syringe, an additional top-nozzle with a lattice diameter of 5 mm is installed. Coming out of the nozzle, the minced meat falls on the molding machine. After that, the semi-finished products are placed in trays, sealed with foil and sent for marking. The finished trays are placed in corrugated boxes and sold to retail chains.

3. Results and discussions
The main task of the research was to establish the effect of complex spices on the microbiological indicators of the samples under study. In the course of the research, tests were carried out to determine standardized indicators, such as BGKP, Listeria monocytogenes, Salmonella in 4 samples of ready-made "homemade" minced meat. The test results are presented in table 5.

Table 5. Research results of standardized microbiological indicators.

| Indicator name       | Standard name            | Normative value       | Actual result, day |
|----------------------|--------------------------|-----------------------|--------------------|
|                      |                          |                       | 0                  | 6                  | 10                 | 12                 | 16                 |
| Sample 1             |                           |                       |                    |                    |                    |                    |                    |
| coli cluster bacteria| GOST 31747-2012          | Not allowed in 0.0001 g| n/f*               | n/f                | n/f                | n/f                | n/f                |
| Listeria monocytogenes| GOST 32031-2012        | Not allowed in 25.0 g  | n/f                | n/f                | n/f                | n/f                | n/f                |
| Salmonella           | GOST 31659-2012          | Not allowed in 25.0 g  | n/f                | n/f                | n/f                | n/f                | n/f                |
| Sample 2             |                           |                       |                    |                    |                    |                    |                    |
| coli cluster bacteria| GOST 31747-2012          | Not allowed in 0.0001 g| n/f                | n/f                | n/f                | n/f                | n/f                |
| Listeria monocytogenes| GOST 32031-2012        | Not allowed in 25.0 g  | n/f                | n/f                | n/f                | n/f                | n/f                |
| Salmonella           | GOST 31659-2012          | Not allowed in 25.0 g  | n/f                | n/f                | n/f                | n/f                | n/f                |
| Sample 3             |                           |                       |                    |                    |                    |                    |                    |
| coli cluster bacteria| GOST 31747-2012          | Not allowed in 0.0001 g| n/f                | n/f                | n/f                | n/f                | n/f                |
| Listeria monocytogenes| GOST 32031-2012        | Not allowed in 25.0 g  | n/f                | n/f                | n/f                | n/f                | n/f                |
| Salmonella           | GOST 31659-2012          | Not allowed in 25.0 g  | n/f                | n/f                | n/f                | n/f                | n/f                |
| Sample 4             |                           |                       |                    |                    |                    |                    |                    |
| coli cluster bacteria| GOST 31747-2012          | Not allowed in 0.0001 g| n/f                | n/f                | n/f                | n/f                | n/f                |
| Listeria monocytogenes| GOST 32031-2012        | Not allowed in 25.0 g  | n/f                | n/f                | n/f                | n/f                | n/f                |
| Salmonella           | GOST 31659-2012          | Not allowed in 25.0 g  | n/f                | n/f                | n/f                | n/f                | n/f                |

n/f – not found.

Based on the data obtained, we can conclude that all samples meet the safety requirements for microbiological indicators.
At the next stage, we analyzed the content of the number of mesophilic aerobic and facultative anaerobic microorganisms at different stages of storage. The index of the number of mesophilic aerobic and facultative anaerobic microorganisms (KMAFAnM) characterizes the total microbial contamination of the product (CFU/g).

The composition of QMAFAnM includes such groups of microorganisms as bacteria, yeast, mold fungi. The presence of these microorganisms must be monitored throughout the entire technological process of manufacturing minced meat semi-finished products. The results are shown in table 6.

Table 6. Results of studying the content of QMAFAnM in experimental samples at various stages of storage.

| Sample name | Standard indicator (according to GOST 10444.15-94) | Actual indicator (CFU/g) per day |
|-------------|---------------------------------------------------|---------------------------------|
| Sample 1    | No more 5.0×10^6 CFU/g                            | 6.0×10^6 2.2×10^5 5.1×10^5 9.1×10^4 1.0×10^6 |
| Sample 2    | No more 5.0×10^6 CFU/g                            | 4.2×10^5 6.0×10^5 8.0×10^5 3.2×10^6 5.8×10^6 |
| Sample 3    | No more 5.0×10^6 CFU/g                            | 1.8×10^7 4.0×10^6 4.7×10^6 7.3×10^6 2.0×10^7 |
| Sample 4    | No more 5.0×10^6 CFU/g                            | 2.8×10^4 6.1×10^4 8.7×10^4 2.2×10^5 4.0×10^5 |

The results of table 6 are reflected in figure 1.

Figure 1. Dynamics of growth of QMAFAnM in the studied samples.

The data presented in table 6 and figure 1 indicate that not all samples can withstand a shelf life of 12 days. The first sample with the addition of "symbust" declared a shelf life of 12 days, which was confirmed during the experiment. The sample of minced meat with the addition of Grillfresh natures was close to the first sample, but on the 16th day the maximum permissible value was exceeded. The sample of minced meat with XtraBlend RA additive exceeded this indicator on the 12th day, which means that this sample performed worse than the control one. The sample of minced meat with the addition of "Cloud S-5" for 16 days did not exceed the standard value, which means that it has a longer shelf life than other samples.
4. Conclusion

In the course of the studies, it was found that in all studied samples, quality indicators such as BGKP, Listeria monocytogenes, Salmonella were not found in the standardized mass of the product. The study of QMAFAnM showed different dynamics of the growth of microorganisms in different samples, the smallest growth is observed in sample 4, which indicates a higher resistance of the sample to microbiological spoilage and a longer shelf life. It is advisable to continue researching this sample in order to establish physicochemical and organoleptic characteristics.

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