MODIFIED EDIBLE COATINGS FOR MEAT PRODUCTS

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Introduction

Many kinds of meat products without protective coatings which are manufactured according to traditional technology are intended for long-term storage. In this case, the changes in moisture content affect the quality and lead to weight losses, as well as fat oxidation and changes in the colour of muscle tissue. Under the influence of air oxygen, the surface becomes contaminated, and the development of moulds and bacteria are inevitable. Therefore, creating protective coatings would be a great advantage. Protective coatings are the most effective methods of packaging, because they can be formed directly on food products without any contact with oxygen from the air, and they are formed with simplified packaging technology.

In the last few years, several kinds of coatings and films were investigated in an attempt to maintain the quality of fresh and frozen meat, poultry and seafood products. There are good prospects for edible coatings and water-soluble coatings (US Patent 5824751, 1998). There is a film-forming composition, containing starch, monoglycerides of edible animal fats, sorbic acid, water or meat broth, for coating meat and meat products (European patent 829503, 1998), which has a drawback that there are relatively high meat losses. A composition of a protective coating containing distilled acetylated monoglycerides and distilled monoglycerides for smoked sausages and pork products has been patented, (Japanese patent №27446525, 1998), but the limitation of this composition is formation of rigid coating on the product, that can result in loss of the mass of a meat product during chilling and freezing. Nevertheless, edible protective coatings on pre-cooked meat products have not been used widely up to the present time.

The purpose of the study was the creation of the compositions on the basis of polysaccharides of different surface activity, and of water-soluble high molecular protein components, possessing biological activity, to protect prepared meat products from oxidative and microbial spoilage, and impart them specific properties, that allows us to extend the range of the manufactured products.

Materials and Methods

Collagen and chitosan were chosen as the main raw materials for the coating. The presence of active end groups in the molecule of collagen, a complicated spatial conformation with the trend to form fibrillar structures provides the possibility of its binding with various low- and high molecular compounds. Chitosan, a polysaccharide, obtained from shells of crustacea is such a compound. A polycation fibrillar structure of chitosan provides the effective adhesion affinity to structural proteins, to collagen also. This allows the creation of various film-forming complexes on the basis of collagen and chitosan and introduce into them active materials, absorbing or excreting specific substances.

Comparative investigations of the developed compositions and experimental film structures have been carried out to choose the optimum composition. In the investigations the following parameters were determined: structural viscosity of the composition on the rotary Viscosimeter Reotest-2; strength and elongation during stretching of the model films, vapor permeability of the model films, microbiological and organoleptical characteristics of meat products in edible coatings; acid and peroxide number of meat products in edible coatings during storage.

The protective edible coating with optimum parameters was formed on the surface of smoked-cooked pork and beef products by their immersion in a 2% composition mixture with its subsequent coagulation in a setting bath, containing a 25% solution of common salt, and drying during 36 hours at the air relative humidity 65-75% and temperature 20-25^{0}C.

Results and Discussion

Several versions of film-forming composition mixtures have been developed. They contained protein and polysaccharide fractions in different relationships and additives with functional effects, such as acetic and lactic acid, and essential oil of ginger.

At the first stage, the influence of lactic acid on the viscosity of composition mixtures was investigated. It was shown that the composition mixture, obtained with the use of the mix of 0.5 M lactic and acetic acid in the ratio 1 : 3 as a solvent, had a viscosity 48.26 Pa*s which is 1.2 times lower than the viscosity of the composition mixture, obtained by the solution in 0.5 M acetic acid. This is connected with the plastifying effect of lactic acid through the reduction of inter-molecular interaction and the complex formation of the latter with polar groups of collagen structure.

Further increase in the amount of incorporated lactic acid reduced the viscosity of the composition mixture, but led to stickiness of the films. It is connected with a significantly larger amount of the introduced lactic acid, than the forces of the inter-molecular interaction could join, and it is in unbound condition in inter-molecular space.

At the second stage, essential oil of ginger was incorporated into the composition mixture at 0.3; 1.0 and 2.0% in relation to the mass of its dry matter. The composition mixture contained the solution of collagen (SC) and chitosan obtained by solving in the mix of 0.5 M of lactic and acetic acids in the ratio 1: 3. It was found that the essential oil of ginger actually had no influence on viscosity, strength characteristics and vapor permeability of films obtained from these composition mixtures. However, an increase in the concentration of the essential oil to 2% led to a very sharp smell of model films, that could affect the flavour characteristics of the final product. Therefore, in subsequent experiments the composition was used, containing SC-chitosan, solved in the mixture of 0.5 M of lactic and acetic acids in the ratio 1: 3 added with 1% essential oil of ginger with the parameters, as follows: viscosity of the composition – 50 Pa* with the deformation velocity 1 c^{-1} ; pH value – 3.2 –4.0; thickness of the coating on the product – 0.06 ± 0.005 mm; vapor permeability – not more than 400 g/m^2 for 24 hours; strength – not less than 9 MPa.
The composition with such parameters was applied to meat products from pork and beef. Analysis of the obtained results has shown that during storage the indices of total plate count of the samples having protective edible coating did not exceed the norm, while in the control sample these indices were by one order higher - 1* 10^3 CFU/g.
Sensory investigations have shown that taste and flavour typical for smoked-cooked products were preserved longer in the samples in edible coating, than in the controls.
Along with microbiological investigations, the acid and peroxide numbers of the samples of meat products in edible coatings during storage were determined. It was found that these indices for all the meat products with coatings were lower than in the control samples. When the weight losses of the samples in edible protective coatings and in the control ones were investigated during storage, it was found that in the coated samples they were lower by 6%, than in the samples without coatings.

Conclusions

The investigations carried out have shown that a film-forming composition mixture developed on the basis of the solutions of collagen and chitosan, provided the formation of protective edible coating on the surface of smoked and cooked meat products. This edible coating has a number of optimum characteristics with regard to thermal stability, vapour-, gas permeability, and providing preservation of quality, reduction of weight losses and increase in storage life of ready meat products.

References

US Patent 5824751, 1998
European Patent 829503, 1998
Japan Patent 2746525, 1998