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A Biotechnological Processing of Collagen Containing By-products of Bovine Animals.

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ABSTRACT

In the article the way of a biotechnological processing of collagen containing by-products of bovine animals is examined. The processing conducts with such concentrates and starters of bifidus and propionic bacteria as Propionic Culture PS-4, Probio-Tec BB-12, concentrate Bifilact-Pro, concentrate «Iodpropioniks», concentrate of bifidus bacteria's liquid. The results of the research of the biotechnological processing influence on such functional-technological indices of the raw-material as damp-binding, water-holding and fat-holding capacities are given. It is established that in the result of the suggested biotechnological processing the above-listed indices improve as compared with the control, and also the outlet rises after the thermal treatment. Besides, the processing with the complex of bifidus and propionic bacteria favours an intensive accumulation of amine nitrogen, that is pointed out on their high proteolytic activity. The suggested way of the processing can be used for the preliminary preparation of collagen containing by-products to the bringing in to the minced meat of sausage goods and minced half-finished goods.

Keywords: bifidus bacteria, propionic bacteria, by-products, collagen structure, functional-technological indices.

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INTRODUCTION

Recent years it is urgent to make high nourishing food on the base of collagen in combination with muscle proteins. One of the most positive characteristic of meat goods with a high content of connective tissue is a beneficial effect on the work of a digestive system associated with the specificity of the property of decomposition products of collagen inherent in dietary fibers (Asgar, 1982; Neklyudov, 2003) [1, 2].

High functional–technological indices of collagen (Gomez-Guillen, 2011) open wide prospects for developing new technologies (Hashim, 2015), making it possible to substitute a basic raw material and get high-quality foods at the same time [3, 4].

As collagen containing raw material by-products of the second category, rich of collagen proteins, are of a particular interest.

With a high food value the use of collagen containing by-products in producing meat foods is limited for the reason that there are some specific property: stiffness, a peculiar scent, a low capacity for conservation (Mustapha, 2012) [5]. Not one decade many researchers are occupied with the problem of the modification of the collagen containing by-products qualities for the possibility its further use in the composition of meat systems without any deterioration of organoleptic and other indices. Recent years a ferment raw material processing is especially popular when biotechnologies are developing intensively (Cheng, 2009; Liu, 2012; Rawdkuen, 2012) [6-8].

A practical application experience of ferment preparations for the processing of collagen containing by-products accumulated in foreign countries (the USA, Canada, France, Germany, etc.) proves that this way of the processing is quite effective for improving raw materials properties and increasing the value of making meat half-finished products, sausage goods on the base of pastes, emulsions, hydrolyzates used as protein fortifiers (Neklyudov, 2003; Rawdkuen, 2012) [2, 8].

Many researchers point out a wide use of bacterial preparations and starters of microorganisms for the improvement of meat raw material properties (Campbell-Platt, 1995; Hammes, 1998; Ruiz-Moyano, 2008) [9-11]. Bifidus and propionic bacteria are included in many of them (Ruiz-Moyano, 2008; Danylenko, 2014) [11, 12].

One of the indices of biochemical activities of the mentioned bacteria is their proteolytic activity (Hettinga, 1972; Lyannaya, 1986; Dupuis, 1998) [13-15]. In the process of a vital function of bifidus bacteria necessary nutrients accumulate in a large quantity. These nutrients are vitamins and amino acids lysine, arginine, glutamic acid, valine, methionine, leucine, tyrosine (Lyannaya, 1986; Biavati 2000) [14, 16].

The analysis of literary sources shows that starting cultures are used mainly for the quality improving of minced meat in the process of salting, for the acceleration of the aging process of dry sausages (Erkkila, 2000; Klingberg, 2005; Ruiz-Moyano, 2008) [11, 17, 18]. In accessible sources it is not found out any information about using bifidus and propionic bacteria for the improving of collagen containing by-products properties.

In view of the stated above, the research of the properties of collagen containing by-products exposed to the biotechnological processing of bifidus and propionic bacteria is urgent.

MATERIAL AND METHODS

The subjects of the inquiry were substrates, got on the base of by-products of bovine animals with bringing in vegetable addition and lactulose.

For getting the substrates collagen containing by-products of bovine animals – ears, labia, a farding bag, a lung were used. The by-products were preliminarily processed by bacterial concentrates and starters of bacteria.

It is known an active growth of bifidus bacteria is observed at the temperature of $38\pm 1^{\circ}\text{C}$. Though in conditions of meat-processing enterprises it is not economically reasonable to set up specialized premises with this temperature for conducting the preliminary biotechnological processing of by-products.

It is also known that bifidus bacteria grow more active in the presence of some species of lactic-acid, propionic bacteria, and also growth promoted substances (Garcia, 2002) [19].

For this reason we composed combined starters including bifidus and propionic bacteria: a combined starter BB-12 and PS-4 in ratio 2:1; a combined starter of the preparation "Iodpropioniks" and concentrate of bifidus bacteria in ratio 2:1.

As except bifidus bacteria lactic acid and propionic bacteria enter into the composition of the concentrate Bifilact-Pro, it was used for biotechnological processing of by-products in its pure form.

The biotechnological processing was conducted at the temperature of $2\pm 2^{\circ}\text{C}$. This temperature meets the conditions of aging meat raw material at meat-processing enterprises.

An intensity of the proteolysis was rated at the accumulation in a substrate of amine nitrogen using a biuretic method.

Functional-technological indices of the raw material (damp-binding, water-holding and fat-holding capacities) were researched after the biotechnological processing had been conducted.

The testing of a damp-binding capacity were conducted using a pressing method, which is based on an exudation of water by a testing sample when it was pressed slightly, sorption of exuded water with a filtering paper and it is also based on a detection of the quantity of the separated moisture on the spot area on the filtered paper. An authenticity of the results is secured of a triple repetition of the identifications.

A damp-binding capacity of the raw material was determined as a difference between a moisture mass fraction in food and the quantity of moisture, separated in the process of the heat treatment. A fat-holding capacity was determined as a difference between fat mass fraction in food and the quantity of fat, separated in the process of the heat treatment.

A process of proteins coagulation leads to an induration of their structure, a reduction of damp-binding capacity and accompanies with an exudate of meat fluid, and therefore, a juiciness reduction of food. An extra factor of technological properties of minced meat can serve an index of a mass loss during the heat treatment. The method is based on the mass change of the sample before and after the heat treatment.

RESULTS AND DISCUSSION

For conducting the biotechnological processing the preparation of by-products were conducted with the following way. Refrigerated labia, ears, a lung and a farding bag of bovine animals were washed, defatted and minced on a meat chopper with the hole diameter of the grid of the 2-3 mm.

Before the introduction to minced collagen containing by-products the bacterial concentrate and combined starters were activated in skim milk at the temperature of $38\pm 1^{\circ}\text{C}$ during 3 hours before the formation of a dense bunch and were introduced 5% in number of the processed by-products mass.

With the aim of an intensification and a depth increasing of a transformation of connective tissue proteins of collagen containing by-products bifidogenic substances (vegetable raw material with a high content of dietary fibers and lactulose) were added to the substrate. As a vegetable raw material oatmeal or buckwheat flour was used 10% in number from the mass of processed by-products. For the intensification of bifidus bacteria growth lactulose was introduced 1% in number from the mass of processed by-products.

The obtained protein-carbohydrate compositions were sustained at the temperature of $2\pm 2^{\circ}\text{C}$ during 16-24 hours.

During the sustenance an intensity of amine nitrogen accumulation was estimated in the substrate in every 4 hours of the sustenance (pic. 1).

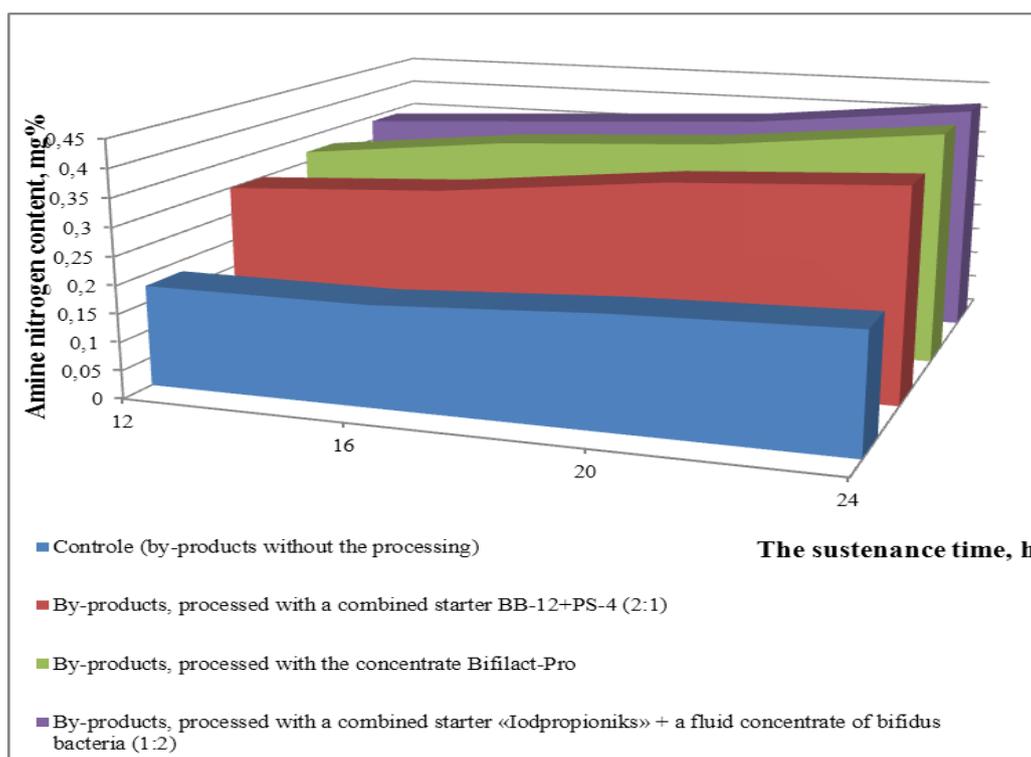
According to the picture 1 it is possible to draw a conclusion that proteolysis progresses more intensively in the substrates with the concentrate Bifilact-Pro and «Iodpropioniks» with a fluid concentrate of bifidus bacteria during the processing of by-products with a combined starter.

After having conducted a biotechnological processing, functional and technological indices of the minced meat made from by-products were identified (pic.2).

For the identification of the output after the heat treatment meatballs were formed with the mass 15-20 gr each one from the by-product minced meat and they were boiled in boiling water till it was ready. The results of the meatballs output are shown in the table 1.

According to the picture 2 we can make a conclusion that functional-technological indices of by-products turned out to be better than a control sample in any way of their biotechnological processing. A biotechnological processing with the concentrate Bifilact-Pro turned out to be more effective.

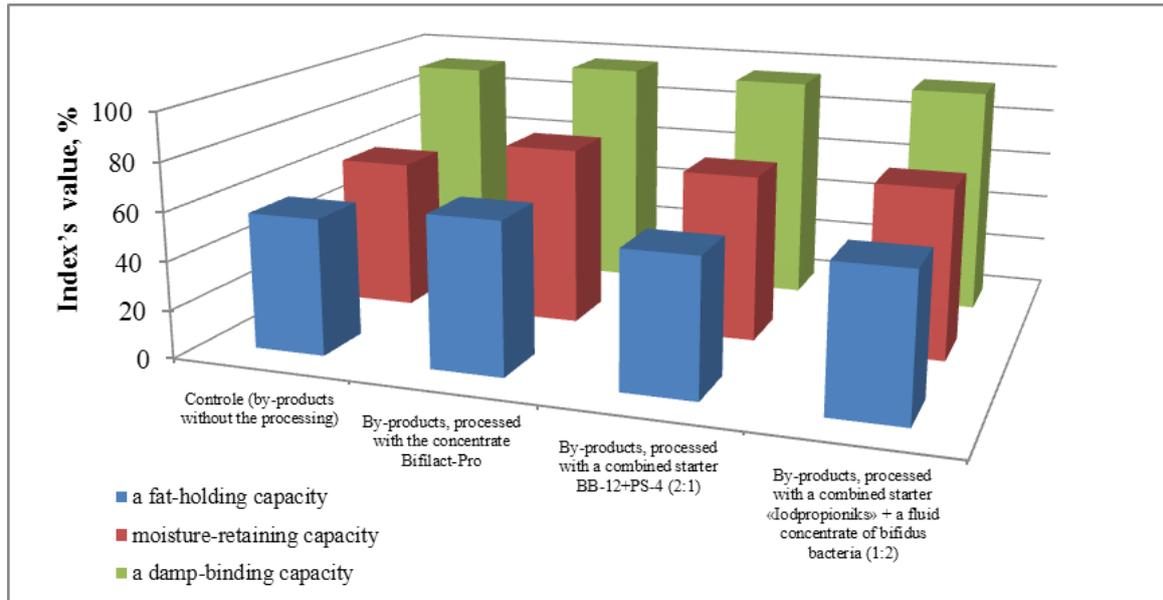
The results of the table 1 prove the improvement of the functional-technological properties of the raw material after the biotechnological processing, because there is the output increase of the minced meat after the heat treatment.



Picture 1: An accumulation of amine nitrogen in substrates in the process of the sustenance

Table 1: An output of the meat balls made from by-products minced meat after the heat treatment

Minced meat sample Index	Control (by-products without any processing)	By-products processed with a combined starter BB-12+ PS-4 (2:1)	By-products processed with the concentrate Bifilact-Pro	By-products processed with the combined starter «Iodpropioniks» + a fluid concentrate of bifidus bacteria (1:2)
An output after the heat treatment, %	64,2±0,3	72,5±0,4	75,4±0,4	76,1±0,3



Picture 2: Functional-technological properties of the minced meat from the collagen containing by-products undergone biotechnological processing

As the results of the carrying out work we can make a conclusion that a biotechnological processing of collagen containing by-products with the complex bifidus and propionic bacteria assists the improvement of by-products' functional-technological properties. This processing can be used for the preliminary preparation of collagen containing by-products to the introduction to the minced meat of sausages goods and minced half-finished goods.

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