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BIOMODIFICATION OF RAW MEAT IN ORDER TO OBTAIN FUNCTIONAL PRODUCTS ENRICHED WITH BENEFICIAL MICROFLORA

[1]Anton Nesterenko, [2]Andrey Koshchaev, [3]Nadezhda Kenijz, [4]Albina Luneva, [5]Albina Varivoda

[1]Kuban State Agrarian University named after I.T. Trubilin, Faculty of Processing Technologies, Kalinina str., 13, Krasnodar, 350044, Russia.

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Abstract:
Products that have a consortium of lactic acid and bifidobacteria in their composition play an important role in the nutrition of people, especially children, the elderly and the sick. Microorganisms are active producers of useful substances capable of transforming natural compounds or chemically synthesized compounds into substances valuable to humans. The aim of the work is to study the consortia of microorganisms capable of softening low-grade and tough raw materials in order to enrich the food with microflora, which improves digestion. The objects of study were selected cultures of Lactobacillus plantarum, Bifidobacterium siccum, Staphylococcus carnosu, raw meat beef flank, beef meat and horse meat. Studies of functional, technological, and physicochemical properties were carried out in accordance with standard research methods. In the course of work, consortiums of microorganisms for functional and technological properties of model forcemeats were studied. The introduction of starter cultures with a given composition contributes to increasing the quality of raw meat, accelerating the salting, affects the physico-chemical, structural, mechanical and biological value of raw meat.

Keywords:*functional and technological properties, starter cultures, meat raw materials, microflora.*

Corresponding author:
Anton Nesterenko,
Kuban State Agrarian University named after I.T. Trubilin,
Faculty of Processing Technologies, Kalinina str., 13,
Krasnodar, 350044, Russia

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INTRODUCTION:

Normal microflora that populates the human intestine is important for regulating the optimal level of metabolic processes in the body, as well as for creating a high colonization resistance of the intestinal tract to conditionally pathogenic microorganisms. The variety of functions performed by saprophytic microorganisms determine their crucial role in maintaining normal human life. However, in recent years there has been a tendency to the growth of pathological conditions, accompanied by a violation of the microecological equilibrium of the intestine, which in almost all cases requires a pharmacological correction [1].

Over the years, we have been searching for optimal means aimed at preventing the occurrence of dysbiosis and increasing the body's resistance to adverse environmental factors. To this end, try to apply fermented with the help of bacteria dairy products, which are currently an important component of human nutrition. However, the microorganisms contained in these products, as a rule, are transient and do not colonize in the intestine. Constant improvement of technologies and formulations of manufactured products led to the creation of biologically active food supplements based on eubiotics, which in modern conditions occupy a leading place in the prevention and complex therapy of a number of diseases [2, 3].

In the chain of measures to fight for the normalization of the microflora of the gastrointestinal tract, the formation of biocenoses in its contents, which would include specially selected lactic acid bacteria, is very important. At the same time, the enrichment of the flora is promising not only by a single monoculture, but by a complex of selected strains possessing high adaptability to a given habitat. For reproduction of beneficial microorganisms other than dairy, other food substrates must also be sought. There is no doubt that the creation of a “controlled association of microorganisms” in the gastrointestinal tract, which by its functions would have a versatile beneficial effect on the organism, has a great future [4, 5].

All this suggests that food products (meat, dairy, etc.) containing lactic acid bacteria and bifidobacteria should be considered not only as food of increased biological value, providing the body with plastic and energy substances, but also as the most valuable preventive and therapeutic agents .

With the development of biotechnology, it became possible to manufacture new types of meat products of general, special and therapeutic and prophylactic purposes affecting the natural intestinal microflora, improve the methods of enzymatic processing of raw meat in order to improve its functional and technological properties [6, 7, 8].

In this regard, the aim of the work is the creation and study of consortia of microorganisms capable of softening low-grade and hard raw materials in the processing industry and the development on the basis of the obtained results of high-value food of a wide range.

MATERIAL AND METHODS:

For biomodification raw meat were chosen culture Lactobacillus plantarum, Bifidobacterium siccum, Staphylococcus carnosus.Dlya sample preparation of starter cultures, lactic acid and bifidobacteria activated in sterile meat broth with lactose under sterile conditions in an incubator for 12 hours and then introduced into a screen model stuffings 1ml / 100g.

The raw material of meat was selected as an object of study: beef groin, beef and horse meat. Raw meat was minced in a meat grinder with a grating hole diameter of 3 mm.

Moisture-binding ability (MBA) was determined by the Grau-Hamm method. Stickiness was determined by the Sokolov-Bolshakov method [9].

Water-holding capacity (WHC) of minced meat was determined as the difference between the mass fraction of moisture in the stuffing and the amount of moisture separated during the heat treatment [9].

To determine the fat-holding capacity (FHC), the mass of the sample was found after determining the WHC and quantitatively transferred it to the cups, after which it was dried to constant weight at 150 ° C. Then a weighed mass of 2.0 g was placed in a porcelain mortar, 2.5 g of calcined quartz sand and 6.0 g of α-monobromonaphthalene were added and carefully ground for 5 minutes. After the time the mixture was filtered through a filter paper and the refractive index was determined in a transparent filtrate. Further, FHC was calculated [9].

The pH was determined on a pH-340 potentiometer according to GOST R 51478-99 [10]. The pH value of the hydrolysates solutions was determined by a potentiometric method using a universal pH-150M ionometer.

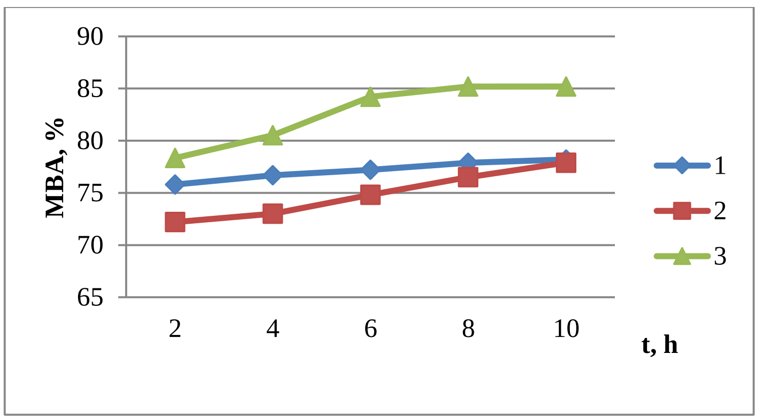
Mass changes were determined by weighing on the scales and in the ratio in% by weight of the feedstock.

To determine digestibility, an in vitro enzymatic method was used to determine the biological value of meat. The method consists in consecutive action on the protein substances of the product under study by a system of proteases consisting of pepsin and trypsin with continuous stirring and removal from the reaction sphere of the products of hydrolysis by dialysis. This avoids inhibition of digestive enzymes by low molecular weight peptides and free amino acids [9].

RESULTS AND DISCUSSION:

The basis of the effectiveness of any biotechnology is the knowledge of all the patterns of change in the properties of the raw materials used during the process. In the technology of meat products, the most significant parameters are the so-called functional and technological indicators: moisture-binding, water-holding, the ability of raw meat, its stickiness (especially in the technology of sausage products). When choosing the optimal modes of enzymatic processing, one should take into account the change in each of these parameters, and, in addition, structural-mechanical indicators, the main of which is the shear force.

In the process of traditional salting, a smooth increase in the MBA occurs, the level of which, over time, stabilizes. The study of the effect of the created consortium of microorganisms showed (Fig. 1 a, b) that its use in the process of salting leads to a slight (3–8%) and stable growth of MBA during the whole salting for all three types of model minced meat.



a)

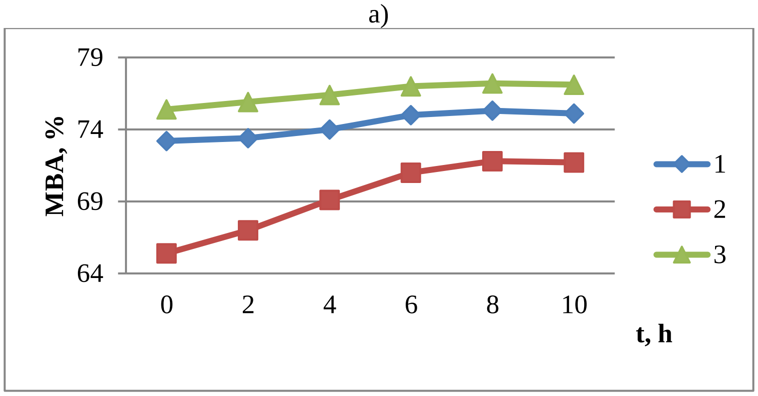


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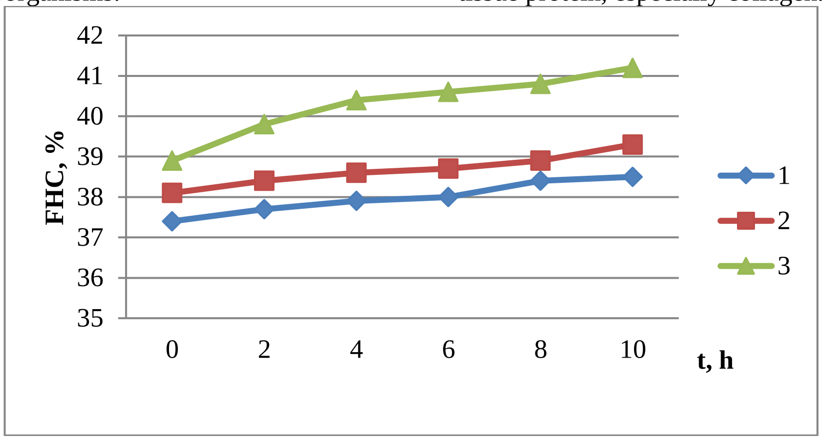
Figure 1: change in water-binding ability (MBA) of model minced meat with the Ambassador
(a) using starter cultures; (b) without the use of starter cultures:1 – ground beef flank; 2 – Minced horse meat; 3 – Minced beef muscle tissue.

Thus, for beef flank minced meat, the maximum value of MBA with the addition of the created consortium was 78.2% against 75.1% with traditional salting, for horsemeat and minced meat from muscle tissue 77.9% against 71.7% and 78.2% against 77.1%, respectively.

WHC studies have shown that with traditional salting, there is a sharp increase in the first hours. Maximum WHC values are achieved after two hours of processing for minced horse meat and beef muscle tissue, four hours for minced beef flank, after which WHC values are reduced.

With combined salting with microbial treatment, there is a smoother increase in WHC during the first 4-6 hours, and in the future there is a slight decrease in WHC, and the final values for combined salting for all types of model minced meat is much higher than with traditional salting without the addition of a consortium of microorganisms.

Presented in (Fig. 2 a, b) FHC parameters showed that FHC model minced meat with the addition of a consortium of microorganisms is slightly higher compared to the control samples, obviously, this is due to the high fat-retaining properties of connective tissue protein, especially collagen.



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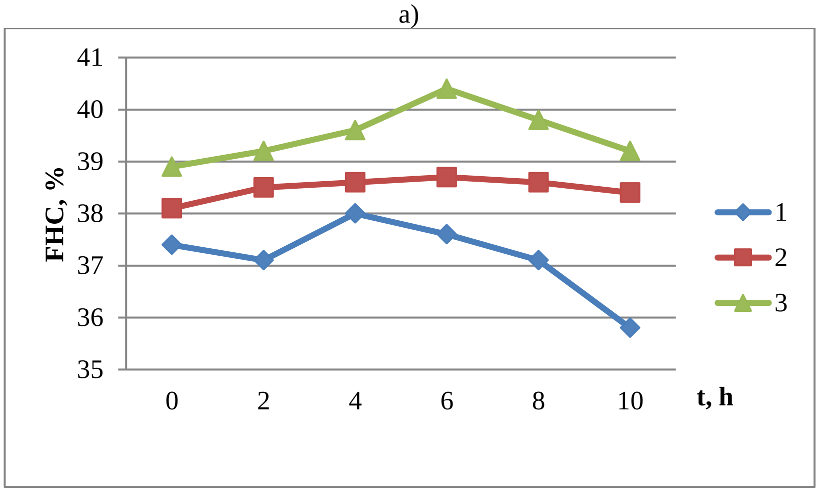
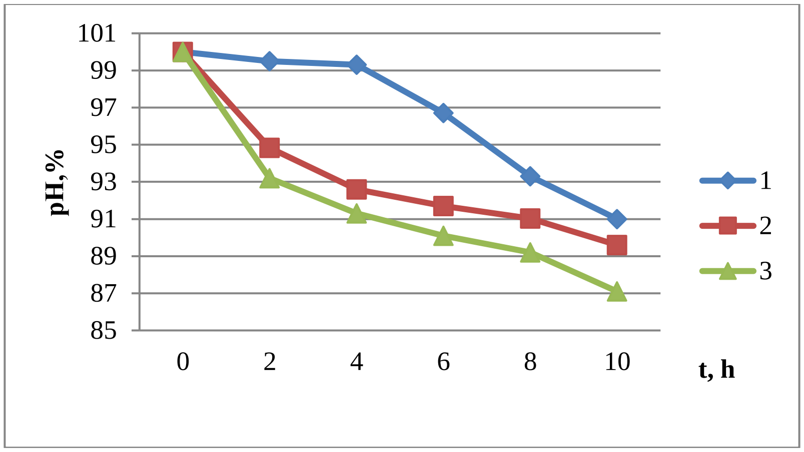


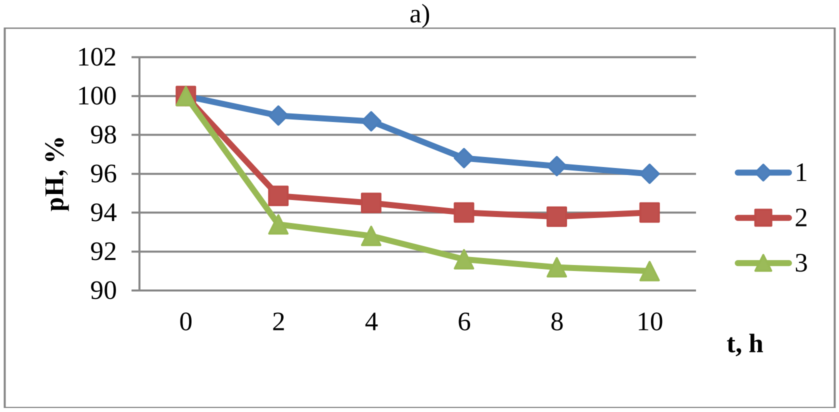
b)

Figure 2: Dynamics of changes in fat-holding capacity (FHC) of model minced meat during salting (a) using starter cultures; (b) without the use of starter cultures: 1 – Ground beef flank; 2 – Minced horse meat; 3 – Minced beef muscle tissue.

Interpreting the results of pH shown in figure 3 a, b we can say that the pH of model minced meat during the experiment decreased significantly compared to controls.



a)



b)

Figure 3: Dynamics of change (pH) of model minced meat environment during salting
(a) using starter cultures; (b) without the use of starter cultures: 1 – ground beef flank; 2 – Minced horse meat; 3 – Minced beef muscle tissue.

The results of experimental studies have shown that the action of microorganisms significantly increases the stickiness of all three types of minced systems (Fig. 4). In the presence of a consortium of microorganisms, the growth of adhesion capacity is somewhat faster, with higher maximum stickiness values (2.8–3.1 N/cm^2, depending on the type of minced meat).

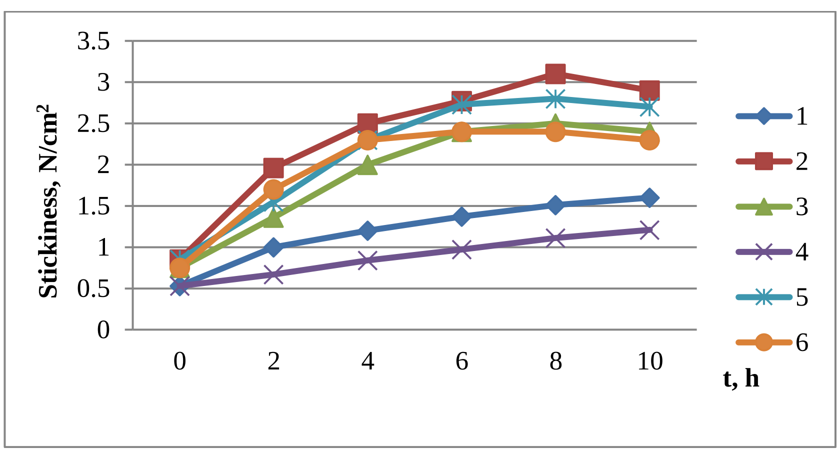


Figure 4: dynamics of changes in the stickiness of model minced meat during salting

1-minced beef flank with the addition of starting cultures; 2 – Minced horse meat with the addition of starting cultures; 3 – Minced beef muscle tissue with the addition of starting cultures; 4 – minced beef flank without the addition of starting cultures; 5 – minced horse meat without the addition of starting cultures; 6 – minced beef muscle tissue without the addition of starting cultures.

The output of the product during heat treatment is one of the main indicators characterizing the efficiency and manufacturability of the decision. In this regard, studies have been conducted on the effect of heat treatment on the yield of the product. The results are presented in table 1

Table 1: Yield of finished products

Sample	Yield, %
Ground beef flank + starter cultures	112
Minced horse meat + starter cultures	109
Minced beef muscle tissue + starter cultures	125
Control (beef flank without starting crops)	92
Control (no horse meat starter culture)	74
Control (muscle tissue without starting culture)	98

To determine digestibility, an enzymatic method for determining the biological value of meat in vitro was used. The basis of the method is enzymatic hydrolysis under conditions in which the availability of the attacked peptide bonds is determined not only by the properties of the protein, but also by additional factors related to the structure and chemical composition of the food product.

Hydrolysis is carried out in a special device that provides continuous mixing and dialysis of low molecular weight hydrolysis proteins.

During the experiments on digestibility, the results given in table 2 were obtained.

Table 2: Results of in vitro digestibility studies

Product Brief	The accumulation of products of enzymatic hydrolysis (mmol / dm^3) with the duration of hydrolysis, h					
	Pepsin			Trypsin		
	1	2	3	4	5	6
Flank+LAB	0,31	0,54	0,71	1,15	1,53	1,79
Horse+ LAB	0,29	0,43	0,57	0,91	1,25	1,46
Beef 2nd grade+ LAB	0,29	0,48	0,63	1,03	1,4	1,61
Flank	0,25	0,39	0,5	0,79	1,12	1,31
Horsemeat	0,16	0,26	0,32	0,56	0,8	0,98
Beef 2 grades	0,19	0,34	0,41	0,69	0,94	1,13

With the addition of our complex lactic acid bacteria, there is an increase in the digestibility of the starting products.

In traditional salting, the nature of the MBA dependence can be explained by the fact that during the initial stages of hydrolysis, fragments of protein molecules (proteinase activity) are formed, which have a large number of easily accessible charged groups that can retain water. With further hydrolysis occurs accumulation of oligopeptides and free amino acids, which are known to be unable to effectively bind water. The results of increasing the MBA obtained by salting with the addition of microorganisms are obviously associated with an increased intensity of the action of microorganisms on the connective proteins of crushed meat raw materials, obviously, due to this, there is an accumulation of a large number of easily accessible charged groups, also lactic acid bacteria in the process of life assimilate the amino acids formed.

The water-holding capacity (WHC) of raw materials is the most important indicator for meat products undergoing heat treatment. This indicator demonstrates the ability of raw materials to retain moisture in the heating process, which primarily affects the yield of the finished product. Obtaining the results testify to the synergy (mutual reinforcement) of the action of the consortium of microorganisms and salt in the process of salting [11].

pH in the production of meat products is also one of the important indicators. Since the isoelectric points of meat proteins are in the “acidic” pH range (5.3), increasing the concentration of hydrogen ions leads to a decrease in MBA.

As a result of the breakdown of proteins and their transition to the dissolved state in the process of maturation and salting of raw meat, fragile thixotropic structures can occur, forming highly plastic, gelatinous masses of high viscosity, which have strong adhesive properties. This effect affects the stickiness index. Stickiness plays a large role in the process of molding products and indirectly characterizes the ability to form a monolithic structure during heat treatment, which is especially important for chopped (minced) meat products: sausages, hams, etc. [3, 7].

The results obtained on the dynamics of changes in the stickiness of model minced meat are obviously associated with a decrease in pH to 5.3, during which collagen swelling, hydrolysis of low molecular weight bonds and activation of cellular enzymes occur. An increase in the duration of exposure (over 8 hours resulted in a slight decrease in stickiness), which, apparently, is associated with the formation of low molecular weight proteolysis products that do not have high adhesiveness.

Analyzing the results of the digestibility of model ground meat, it can be said that the degree of hydrolysis of proteins in samples with the addition of a complex of lactic acid bacteria was higher than in samples of pure ground meat without the use of lactic acid bacteria.

CONCLUSION:

Adding the lactic acid bacteria complex to both fallow and horse meat, and to beef muscle tissue leads to an increase in the functional and technological properties of indicators such as MBA, WHC, FHC, yield, stickiness, as well as lower pH, which is not unimportant in the production of meat and sausages. The nature of the action of the consortium of microorganisms allows us to recommend it for use in the purpose of bating, improving the quality of raw materials in the technology of a wide range of meat products with different ratios of muscle and connective tissue.

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