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**IMPACT OF LACTIC ACID PRODUCT ON QUALITY INDICES OF RAW MEAT FOR THE
SMOKED SAUSAGES PRODUCTION**

Abstract: Background: Conducted research pertains to technologies of animal products processing and the development of biotechnological methods for stabilizing microbial and enzymatic biological leaven for meat. **Materials and Methods.** The studies were conducted in the conditions of the Research Institute of Food and Animal Processing Technologies and Laboratory of Microbiological Research Methods, Department of Microbiology of Bila Tserkva National Agrarian University. Moisture retaining capacity and bacterial contamination of beef and pork were determined. **Results.** The effect of processing raw meat with lactic acid product – yogurt on the moisture retaining capacity was experimentally established. With the highest titratable acidity of yoghurt of 100–110 °T, the moisture retaining capacity of pork and beef was inferior to control on 2.13 and 1.29 % and amounted to 51.88 and 62.73 %. Under a titratable acidity of lactic acid beverage of 100–110 °T with total number of lactic acid bacteria on the surface of raw meat, it was 8.1×10^8 and 8.5×10^8 , which prevailed samples with acidity level of 60–70 °T on 24.5 and 24.3 %. **Conclusions.** The results of studies have revealed the effect of processing raw meat by yogurt with different titratable acidity on moisture retaining capacity and bacterial contamination.

Keywords: raw meat, pork, beef, smoked sausages, dairy products, bacterial leaven, yogurt, moisture retaining capacity, bacterial contamination.

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**ВЛИЯНИЕ МОЛОЧНОКИСЛЫХ ПРОДУКТОВ НА КАЧЕСТВЕННЫЕ ПОКАЗАТЕЛИ МЯСНОГО СЫРЬЯ
ДЛЯ ПРОИЗВОДСТВА СЫРОКОПЧЕНЫХ КОЛБАС**

Аннотация: Проведенные исследования относятся к технологиям переработки продуктов животноводства и отработки биотехнологических способов стабилизации микробных и ферментативных биологических заквасок для мяса. Исследования проводили в условиях Научно-исследовательского института пищевых технологий и технологий переработки продуктов животноводства и лаборатории микробиологических методов исследований кафедры микробиологии Белоцерковского национального аграрного университета. Определяли влагоудерживающую способность и бактериальное обсеменение мясной сырья крупного рогатого скота и свиней. Экспериментально установлено влияние обработки мясного сырья молочнокислые продукты йогуртом на влагоудерживающую способность. При высочайшем титруемой кислотности йогурта 100–110 °T влагоудерживающую способность свинины и говядины уступала контролю на 2,13 и 1,29 % и составляла 51,88 и 62,73 %. По титруемой кислотности молочнокислого напитка 100–110 °T, где общее количество молочнокислых бактерий на поверхности мясного сырья была $8,1 \times 10^8$

и $8,5 \times 10^8$, преобладали опытные образцы с уровнем кислотности 60–70 °Т на 24,5 и 24,3 %. Результаты исследования выявлено влияние обработки мясного сырья йогуртом с разной титруемая кислотность на влагоудерживающую способность и бактериальное обсеменение.

Ключевые слова: мясное сырье, свинина, говядина, сырокопченые колбасы, молочнокислые продукты, бактериальная закваска, йогурт, влагоудерживающая способность, бактериальное обсеменение

Для цитирования: Влияние молочнокислых продуктов на качественные показатели мясного сырья для производства сырокопченых колбас / С. В. Мерзлов, Н. Н. Федорук, А. В. Андрийчук, Ю. В. Федорук, В. Н. Надточий, О. П. Гребельник, Г. П. Калинина, С. А. Полищук // Вест. Нац. акад. наук Беларусі. Сер. аграр. навук. – 2021. – Т. 59, № 3. – С. 378–384. <https://doi.org/10.29235/1817-7204-2021-59-3-378-384>

Introduction. Smoked sausages are different from other sausage products in terms of their complexity, durability of technological process of production, high functional and consumer characteristics and ability for long-term storage. The excellent quality of smoked sausages determines its competitiveness in the market and makes it the most attractive to the consumer [1-3]. The production consists of a number of technological operations including: preparation, salting or pickling, grinding of raw materials, preparation of the mixture, syringing; sedimentation of minced meat; smoking; drying; packaging and storage of the ready product [4, 5].

Marinades that contain bacterial cells improve the functional and technological properties and increase the biological value of meat product [6-8].

Bacteria performs play an important function in processing of raw meat for sausages, forming the desired microflora, which greatly contributes to the formation of the necessary technological and sensory qualities and prolong the storage of the finished product [9-11].

The Purpose of the research was to study the effect of bacterial leaven for yoghurt on the quality indicators of raw meat for production of smoked sausages.

Material and research methods. Laboratory studies were conducted in the conditions of the Institute of Food and Animal Processing Technologies and Laboratory of Microbiological Research Methods, Department of Microbiology of Bila Tserkva National Agrarian University, which is certified according to the State standard of Ukraine ISO 10012: 2005 in 2020.

Two types of raw meat were used for scientific research. The first was meat of cattle, namely the body hind quarter. The chemical composition of the beef samples was: 68.2 % moisture, 19.5 % protein and 10.3 % fat. The second was pig meat, which consisted of 51.5 % moisture, 16.3 % protein and 28.9 % fat.

The experiments were performed according to the scheme of the experiment which is shown in table 1.

Table 1. Scheme of the experiment

Groups of samples	Investigated factor
Control	Sample processing with 18 % saline solution
I experimental	Sample processing by yoghurt with titrated acidity of 60-70 °T
II experimental	Sample processing by yoghurt with titrated acidity of 80-90 °T
III experimental	Sample processing by yoghurt with titrated acidity of 100-110 °T

Yoghurt prepared from bacterial leaven of purified microorganism cultures was used to process the samples of raw meat. The leaven contained microorganisms: *Streptococcus salivarius subsp. thermophilus*, *Lactobacillus delbrueckii subsp. bulgaricus*, *Lactobacillus acidophilus*, *Lactococcus lactis subsp. Lactis*.

We used 18.0 % solution of salt in the control variant.

The first experimental group of meat samples was treated with yogurt with a titrated acidity 60-70 °T. Meat samples from II and III experimental groups were marinated with yoghurt that had titrated acidity 80-90 and 100-110 °T.

To determine the qualitative and quantitative microbial composition, inoculation from yoghurt with different acidity levels was carried out, followed by microscopy.

After treatment with the leaven for 48 hours, the microbiological parameters of the samples' surface were determined.

Microbiological studies were performed by the methods defined by the State sanitary rules and regulations 4.4.5-078-2001 “Microbiological standards and methods of catering control”.

Microscopy of bacterial cells was performed on fixed stained smears using the method of Vinogradsky-Shulgin-Brid. The number of microorganisms of the test sample is calculated by the formula:

$$M = \frac{AxS}{VxX}xn,$$

where M - is the number of cells in 1 cm³; A - is the average number of cells in square of the field of view; S - is the area of the square of the field of view and prototype, μm²; V - is the volume of suspension deposited in glass in cm³; n - is a dilution of the prototype.

Two nutrient media such as *Lees agar* and *Streptococcus thermophilus agar* were used to determine bacterial contamination.

Method of serial dilutions was used for inoculation of the suspension. The inoculation was performed by applying a 1.0 cm³ suspension (from 1 to 10⁻⁶ dilutions) in the molten and cooled agar in Petri dishes, followed by thermostatization for 48 hours at 37 °C [12, 13].

Evaluation of the raw materials quality was carried out according to the methods of A. M. Polivoda, R. V. Strobkyina, M. D. Lyubetskyi [14].

To determine the moisture retaining capacity of raw meat, we used the press method of R. Grau and R. Gamm, modified by V. Volovynska and B. Kelman [15] in three times repetitions to prove the results.

Results and discussion. When yogurt is used as a leaven, the level of lactic microflora content is of particular importance, which affects the quality of the product and its expiration date. Therefore, we studied the quantitative and qualitative composition of lactic acid bacteria in raw materials.

After the microscopy of smears from yoghurts with different titrated acidity, groups of lactic acid bacteria and their number were identified (Table 2).

T a b l e 2. The total number of lactic acid bacteria in yogurt, CFU/g

Index	Control	I experimental	II experimental	III experimental
Total number	-	2.8 × 10 ⁷	3.6 × 10 ⁷	7.8 × 10 ⁸
from them: <i>Streptococcus thermophiles</i>	-	1.6 × 10 ⁷	2.8 × 10 ⁷	5.0 × 10 ⁸
<i>Lactobacillus bulgaricus</i>	-	1.2 × 10 ³	1.8 × 10 ³	2.8 × 10 ⁴

High concentration of lactic bacteria was found in yoghurt which was used in the first experimental group where the titrated acidity level was 60-70 °T. The total amount of colony-forming units (CFU) was 2.8 × 10⁷. In the yogurt used for the experimental group II, the number of microorganisms was 3.6 × 10⁷, which is 28.5% higher compared to the I experimental group.

The largest number of microorganisms was observed in samples where yogurt had an acidity of 100-110 °T and was 7.8 × 10⁸ CFU, which is 21.7 times higher than in an acid dairy product with an acidity of 80-90 °T.

After inoculation and thermostatting the test specimens, changes in the intensity of colony placement were detected on the nutrient medium (Fig. 1).

The highest intensity of placement colonies of lactic acid bacteria was noted in the III experimental group. The smallest one was in the first sample. The absence of lactic acid bacteria is observed in the control, due to the fact that the sample was not pickled with lactic acid product.

It was observed during microbiological studies that the effect of fermentation of raw meat and microflora composition in the samples varied (Table 3).

The number of colonies of lactic acid bacteria *Streptococcus thermophilu* in raw meat (pork) treated with 60-70 °T acid yogurt was 1.5 × 10⁷ CFU/g. The highest number of lactic acid bacteria was observed in meat samples of the III experimental group – 3,8 × 10⁸ CFU/g.

In the variant where a 100-110 °T titrated acidic beverage was used, the number of *Lactobacillus bulgaricus* in pork increased to 4.3 × 10⁴ CFU/g.

There was no significant increase in *Streptococcus thermophiles* and *Lactobacillus bulgaricus* in beef after 48 hours of yogurt picking relative to quantitative microflora in pork.

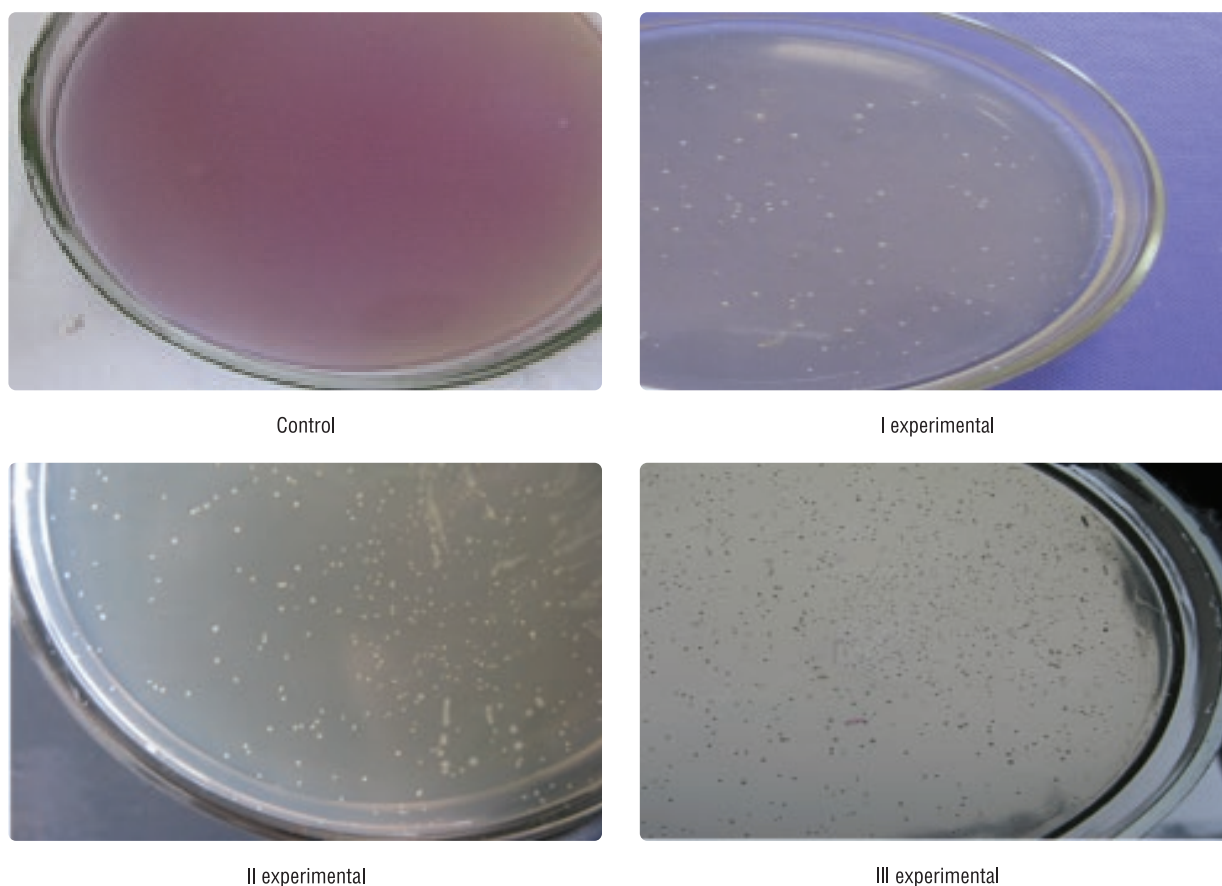


Fig. 1. The intensity of placement colonies of lactic acid bacteria

T a b l e 3. Quantity of lactic acid bacteria in raw meat, CFU/g

Index	Control	I experimental	II experimental	III experimental
Total amount:				
in pork	-	3.3×10^7	4.6×10^7	8.1×10^8
in beef	-	3.5×10^7	4.9×10^7	8.5×10^8
Including:				
<i>Streptococcus thermophiles</i>				
in pork	-	1.5×10^7	2.4×10^7	3.8×10^8
in beef	-	1.6×10^7	2.5×10^7	4.0×10^8
<i>Lactobacillus bulgaricus</i>				
in pork	-	1.8×10^3	2.2×10^3	4.3×10^4
in beef	-	1.9×10^3	2.4×10^3	4.5×10^4

A regularity has been found that the higher the titratable acidity of yogurt as a marinade, the greater the number of lactic acid bacteria in the meat after pickling.

A characteristic feature of smoked sausages is the thick consistency and low moisture content, no more than 30.0 % in the ready product. Therefore, the moisture retaining capacity of the raw material, which directly affects the quality of the ready product, is of great importance. The level of moisture retaining capacity of the test specimens is shown in Fig. 2.

Research shows that the physical and chemical parameters of raw meat have changed due to the use of a bacterial leaven that contains bacteria for pickling.

In the control where saline was used to process the raw material, the moisture retaining capacity was 54.01 % for pork and 64.02 % for beef. In the first experimental group, this index was 1.88 % lower than in the control. An increase in the titratable acidity of yoghurt (80-90 °T) affected the meat's moisture retaining capacity, so index was less than in the control on 1.21 %. At the highest titrated acidity the moisture retaining capacity was inferior to control by 2.13 %. Indices of water retaining capacity of beef

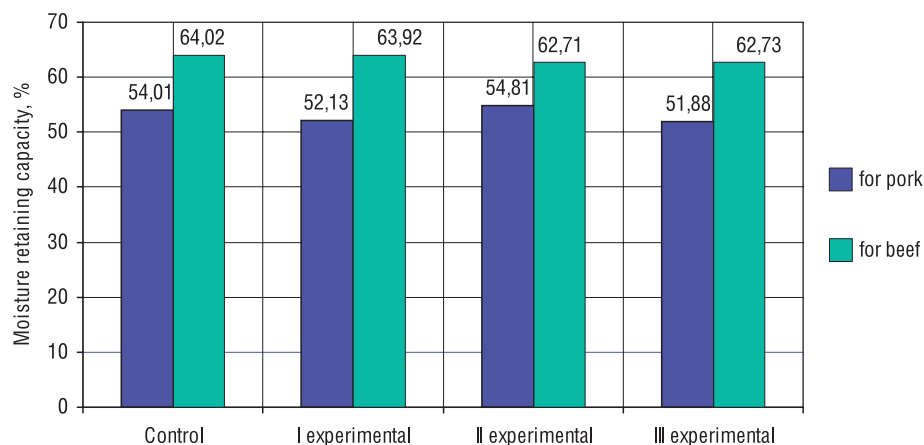


Fig. 2. Moisture retaining capacity of pork and beef

had the same tendency as pork and accounted 64.02 % in the control, I-III experimental groups 62.73-63.92 %, which was inferior to the control indicators by 1.29 and 0.1 %.

In our opinion, this tendency can be explained by the high content of organic acids and enzymes in yogurt, which impacts the physicochemical processes that occur during meat fermentation and accelerate the hydrolysis of connective tissues.

The sensory indices of the finished product are influenced by the quality of the raw material and the methods of its processing. In the production of sausages, an important indicator is the consistency of the product, which depends on the quality of the meat quality [7, 16, 17].

Meat consistency is mainly impacted by its tenderness, juiciness and softness. Scientists have found that the above mentioned technological indicators and commodity properties depend on the moisture retaining characteristics of meat [18, 19]. Therefore, the study of these properties of meat during storage is of great practical importance.

A technological feature of making smoked sausages is pickling the raw meat in salt solution. The disadvantages of using a large amount of salt for the sausages production include its unsatisfactory effect on the human body. Frequent consumption of such products can lead to increased blood pressure, swelling, and kidney disease [20-22]. Too salty foods increase the risk of stroke and heart attack. American scientists have found that the regular use of excessive amounts of salt in foodstuffs provokes changes immune system in the intestine, which lead to degradation of human cognitive functions [8, 23, 24].

Stabilized bacterial yeast cells contained in dairy products improve and restore the gut microbiota, which, in turn, has a positive effect on the level of immunity, general condition of the body, skin [25, 26]. Dairy products are a necessary component of the diet for diseases of the gastrointestinal tract, as well as after taking antibiotics [5, 27]. The constant intake of lactic acid bacteria in the gastrointestinal tract significantly increases the absorption of vitamins and microelements.

Conclusions

After treatment of pork and beef with yogurt with titratable acidity of 100-110 °T, the highest concentration of bacterial microorganisms was determined, where the total amount was 8.1×10^8 and 8.5×10^8 . They were predominant in the experimental samples, where yogurt with titrated acidity of 60-70 °T was used, by 24.5 and 24.3 % respectively

The impact of the treatment of raw meat with bacterial leaven on the moisture retaining capacity was noted. At the highest titrated acidity 100-110 °T the moisture retaining capacity of pork and beef was inferior to meat treated with saline by 3.9 and 2.7 % and made 51.5 and 62.7 %.

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