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INVESTIGATION OF THE PROPERTIES OF BOILED SAUSAGES FROM THE BIOMODIFIED STUFFING DURING STORAGE

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Abstract. The results of the investigation of influence of the bacterial ferment entry, namely *Lactobacillus sakei*, on changes of functional and technological and microbiological characteristics during storage, have been given in the article. The investigation of the dynamics of changes of protein, fatty component and accumulation of residual microflora, has been conducted in this paper. Confirmed that the introduction of this culture inhibits the development of undesirable microflora, which guarantees high quality and safe products. Also economically justified the use of innovative development for the production of sausages; compiled by the technological scheme of production of boiled sausage making starting microflora. As objects of research were used poultry. It is also proved that the use of *Lactobacillus sakei* positive effect on sensory characteristics of cooked sausages, improving the consistency, taste, odor, color of cooked sausages.

Key words: poultry meat, bacterial ferments, starting cultures, meat products, sausage.

ДОСЛІДЖЕННЯ ВЛАСТИВОСТЕЙ ВАРЕНИХ КОВБАС ІЗ БІОМОДИФІКОВАНОГО ФАРШУ ПРОТЯГОМ ЗБЕРІГАННЯ

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Анотація. У статті представлено результати дослідження впливу бактеріальної закваски, а саме *Lactobacillus sakei*, на зміни функціонально-технологічних і мікробіологічних характеристик варених ковбас протягом зберігання. Проведено дослідження динаміки змін білкової, жирової складової варених ковбас і накопичення залишкової мікрофлори. Підтверджено, що внесення даної культури пригнічує розвиток небажаної мікрофлори, що гарантує високоякісну та безпечну продукцію. Також економічно обґрунтовано використання інноваційної розробки для виробництва ковбасних виробів; складено технологічну схему виробництва вареної ковбаси із внесенням стартової мікрофлори. Уякості об'єктів досліджень було використано м'ясо птиці. Доведено, що використання *Lactobacillus sakei* позитивно впливає на органолептичні показники варених ковбас, покращуючи консистенцію, смак, запах, колір варених ковбас

Ключові слова: м'ясо птиці, бактеріальні закваски, стартові культури, м'ясні продукти, ковбаса.

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Introduction

Different methods of increasing of the terms of meat and meat products storage have been investigated up to now. In ordinary conditions sausages are kept comparatively for a short period of time, that's why they are attributed to the perishable products.

During storage different undesirable changes, connected with the activity of biochemical, microbiological and physical and chemical processes can occur in the meat products. In fresh meat these processes are stipulated by the natural way of autolysis, in thermally treated – by residual microflora and secondary contamination. Every product, under fixed storage conditions, has its time-limit of storage, determined on the basis of physical and technological investigations [1,13].

Time-limit of meat products storage corresponds to the phase, under which the activity of microflora doesn't reveal. The most frequent reason of meat spoiling is microflora, especially putrefactive, as well as influence of its own tissue enzymes. With a purpose of preventing from spoiling and increasing of storage terms, meat and meat products are immediately canned, using one of the methods.

Raising the problem

Extended storage of sausages is relevant due to the fact that more than 10 – 15 % of meat products subjected to a return of trading networks in the enterprise. The use of preservatives, antibiotics, various gases for lengthening the storage time although to solve the issue, but is dangerous to human health. In this work it is assumed

prolong the period of storage of cooked sausages from poultry through the use of biotechnological technique. It is proposed to introduce a hand-picked starting microflora in cooked sausages, this is a fundamentally new approach to address this issue.

Literary review

Microbiological stability and safety of the majority of food products is based on combination of some canning factors ("barriers"), which can't overcome microorganisms, present in them. On this basis the conception of "barrier effect" was proposed for the first time. Application of the "barriers" is quickly developed all over the world, because it provides microbiological stability, safety as well as stable organoleptic properties of the products. The most important "barriers" for food products are: low value of pH and values of water activity, application of the means which counteract to the growth of bacteria (preserving substances) and gas means. Packing, in its turn, allows to protect the product from the secondary contamination of microflora [11-12].

The most efficient way of food protection from spoiling can be achieved with the help of "barrier conception". The additional barrier is bioprotection. In particular the biological protection includes: using of milk-sour bacteria for limiting of the development of undesirable flora in meat products; improvement of the quality at the expense of decreasing of microflora amount leads to spoiling; providing of stability and invariability of organoleptic indices [2].

Technological activity of microorganisms is connected with formation of the specific biologically active components: organic acids, bacteriocines, enzymes, vitamins, that contributes to improvement of sanitary and microbiological, organoleptic indices of the finished product and also allows to intensify the production process.

On the whole, lactic acid bacteria which possess the ability to split easily assimilated proteins of muscular tissue intensively and simultaneously to split proteins, assimilated with difficulty, of connective tissue, are mainly used in production; moreover, the products of growth of bacteria vital functions in condition of exoenzymes are isolated, also stable dynamics of pH reduction testifies to accumulation of lactic acid [2,14].

Boiled sausages are unstable products, which are usually widely used by population without the additional thermal treatment. So, strict sanitary-bacteriological demands are produced to sausage, and the primary raw material at the stages of the technological process as well as the finished raw material are subjected to the bacteriological investigation.

During the production of boiled sausages according to the traditional recipe, the terms of storage according to Government standards 4436:2006 don't exceed 48 hours under storage in the refrigerator (+5...+8°C). Boiled sausages are in great demand and, in the condition of possible storage of 48 hours, the largest share of them is returned to the production – it's actual to increase the expi-

ration date of the boiled sausages by the method which was offered, namely by using "starting" cultures. With this purpose the complex investigations, which characterize the dynamics of fatty, protein fraction changes and the amount of residual microflora as well as the peculiarities of structural-mechanical and organoleptic indices changes in the product in the process of storage, have been carried out.

Materials and methods

Table 1 – During conducting of the experimental investigations, the following methods of determining have been used [4,9]

The indices of the investigations	Government standard
- sample selection	9792,26929-94
- content of moisture mass share	9793-74
- pH level	ISO 2917:2001
- volatile fatty acids	28859-90
- content of amino-ammoniac nitrogen	7158:2010
- water-retaining ability	ISO 11274-2001
- fat-retaining ability	ISO 11274-2001
- content of mass share of sodium nitrate	8558, ENV 12014-3
- content of mass share of sodium chloride	9957
- peroxide number	23042-86
- general bacterial number	9958
- sanitary-demonstrative microorganisms	9958
- determining of antibiotics presence	P 53912-2010
- determining of antagonistic effect	P 53912-2010

The experimental part of the scientific-research work has been carried out in the laboratories of the chair of meat, fish and seafood and biochemistry, microbiology and nutrition physiology of ONAFT. The poultry meat of different producers, namely "Nasha Ryaba", "Gavrylivski kurchata" and the meat of the foreign producer "K'Okule" (France), has been used as an object of investigation; with the purpose of obtaining objective results of the investigation "starting" cultures of Hr. Hansen (Denmark) [3]. The investigations have been carried out at the stage of obtaining the raw material, at the stage of salting and storage by the following indices: organoleptic, physical-chemical and microbiological.

Results and discussion

The first checking point-determining of the sanitary condition of the product immediately after conducting the thermal treatment cycle. According to the results of the conducted investigations, one can point out that applying of bacterial ferment has definite bactericidal action. It's known that the microorganism, which was applied with *Lactobacillus sakei* additive, produces a num-

ber of heat-stable bacteriocines, which reveal their anti-septic properties. Further, influence of the additive on the residual microflora, has been given.

The investigation of microflora amount changing (fig. 1) has shown that during applying of the addi-

tive, the level of colony-generating items, even in 7-8 days, is lower than the indices admitted by Government standards (table 1). The more lasting storage isn't expedient through negative influence on organoleptic indices (drying).

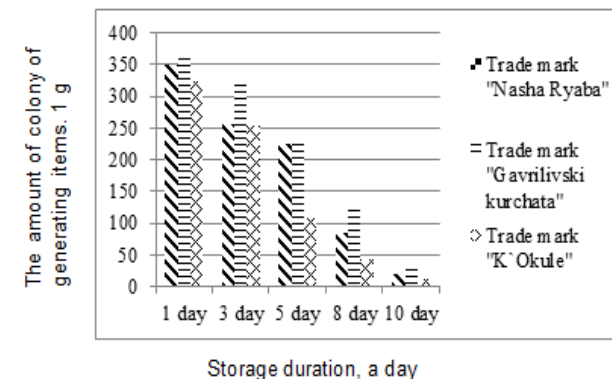


Fig. 1. The amount of colony-generating items / 1 g of the product after conducting of thermal treatment of boiled sausages depending on storage duration

According to fig. 1 the amount of colony-generating items decreases depending on storage duration. From the scientific point of view it can be explained by the fact that *Lactobacillus sakei*, namely bacteriocines and lactic acid have a pernicious effect on putrefactive residual microflora and it's also known that the number of micro-

organisms decreases in condition of nutritive substances decrease.

Together with determining of the quantitative composition of microflora, the determination of the qualitative composition has been carried out. The results of the investigations are given in table 2 [15].

Table 2 – Requirements of the microbiological indices according to Government standards

The name of the index	Standard	The results of the investigations	Checking methods
The amount of mesophile and optional-anaerobic microorganisms, colony-generating items in 1 g. of the product, no more than	1*10 ³	>1*10 ³	According to Government standards 10444.15
Bacteria of intestinal bacillus group (koliforms) in 1 g. of a product	not allowed	—	According to Government standards 9958 or 30518
Sulfite-reducing klostridii in 0,01 g. of a product	not allowed	—	According to Government standards 9958 or 29185
Bacteria of Proteus type in 0,1 g. of a product	not allowed	—	According to Government standards 9958
Staphylococcus aureus in 1,0 g. of a product	not allowed	—	According to Government standards 10444.2 or ISO 6888-1, ISO 6888-2
Pathogenic microorganisms, in particular bacteria of Salmonella in 25 g. of a product	not allowed	—	According to Government standards 9958, EN 12824

Quality of sausages is determined by physical and chemical indices – content of moisture, sodium chloride, sodium nitrite, which are given in table 3 according to Government standards [5].

Table 3 – Requirements of physical-chemical indices according to Government standards

The name of the index	Standard	Results	Checking methods
Mass share of moisture, % no less than	70,0	70,0	According to Government standards 9793
Mass share of sodium chloride, % no more than	2,5	2,5	According to Government standards 9957 or ISO 1841-1, ISO 1841-2
Mass share of sodium nitrite, % no more than	0,005	0,005	According to Government standards 8558.1 or ENV 12014-3, ENV 12014-4

Storage of the sausages is accompanied by active acidity change as a result of lactic acid influence. The pH reaction of meat which depends on glycogen content in the muscular tissue has a great influence on the degree of microbe producing seeds. In the process of maturing and storage of meat, glycogen decomposition occurs with lactic acid formation, as a result pH of meat reduces. An-

alysing figure 2 one can observe pH lowering and this is connected with a high acid-forming ability of lactic acid bacteria which go into the composition of the starting culture – *Lactobacillus sakei* and is an important property when using in meat industry. We should note that active acidity stabilizes under optimum meaning 5,5 of pH.

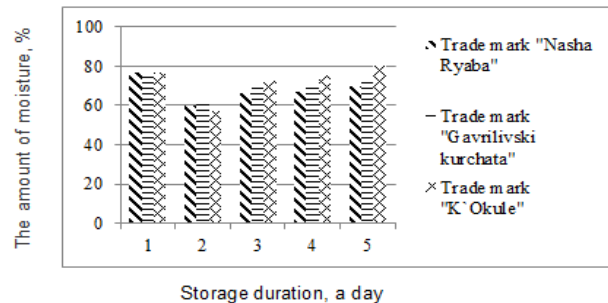


Fig. 3. Influence of bacterial ferment on meaning of moisture mass share in the process of boiled sausages storage

It should be noted that lactic acid bacteria can regulate and stabilize pH by changing of correlation of metabolism products, maintaining pH at a definite level, what is important in production of boiled sausages. Moisture content is an important index, because moisture is a factor of microflora development and it's also limited by Government standards. In fig. 3 the dependence of the amount of stuffing moisture on storage duration has been presented. From fig. 3 we can make a conclusion that stuffing moisture is changed depending on residual microflora. At first microorganisms consume moisture and that's why its amount decreases and further during making sausages it increases, because bonds between the cells themselves were destroyed and additional moisture can be brought from the refrigerator. Further the process of loss of weight through drying occurs and the amount of moisture decreases again.

According to figure 4 sodium nitrite is fully destroyed under the influence of nitritoreductase enzyme and is all with myoglobin and the amount of residual nitrite decreases.

Lactic acid bacteria contain constitutive nitritoreductase and restore nitrites and sodiums as final acceptors during utilization of lactate. Applying of lactic

acid bacteria increases formation of nitrosopigments and favourably influences durability of painting. That's why weak-sour medium and restoring conditions, which are created under development of lactic acid bacteria, contribute to forming of nitrosomyoglobin and improves colour characteristic of the product under lower doses of nitrite. In the process of storage, the condition of fatty fraction plays an important role. In connection with this, the investigation of the acid number changing of boiled sausages in the process of storage, has been conducted (fig. 5).

From fig. 5 one can see that all the indices are within the norm and positive influence *Lactobacillus sakei* on fat freshness in the process of boiled sausages storage.

It's known that the processes of development of microorganisms, connected with increase of proteolytic enzymes amount, which are able to influence the biochemical changes of protein molecules with accumulation of amino-ammoniac nitrogen and increase of volatile fatty acids amount (VFA).

With increase of VFA (fig. 6a), desamination of proteins under influence of fissive enzymes, produced by residual microflora, occurs.

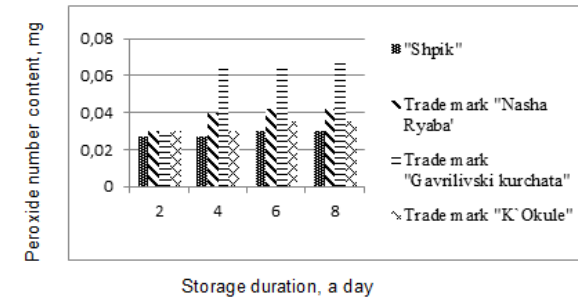


Fig. 5. Dynamics of changing of fat freshness in the process of boiled sausages storage

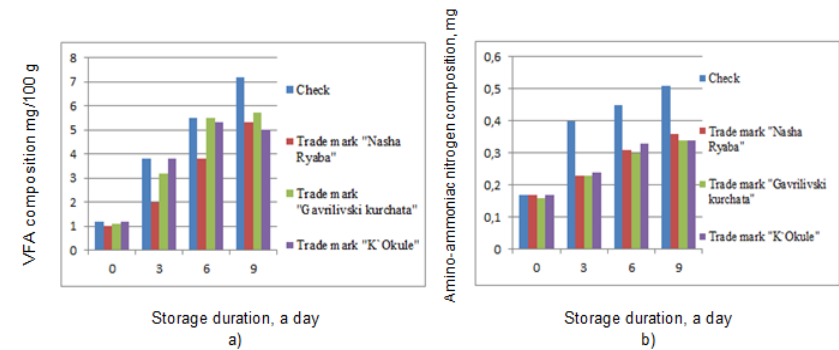


Fig. 6. Dynamics of meaning changing: a) – VFA composition; b) – amino-ammoniac nitrogen composition in the process of storage

As a result of the conducted investigations it can be noted that VFA increase in the control sample occurs more intensively than in the sample with the additive. The comparative analysis allows us to state that the main role in their accumulation is connected with proteolytic enzymes, which *Lactobacillus sakei* produces.

Accumulation of amino-ammoniac nitrogen characterizes degradation of protein substances and it leads to lowering of food value of meat products. From drawing

6b one can see that the rate of accumulation of proteins decomposition products in the control sample is much higher than in the sample with the additive.

Accumulation amino-ammoniac nitrogen and VFA is a predecessor of taste- and aroma substances, which are developed during thermal treatment and stipulating organoleptic characteristics of the finished product [6,9].

The results of the organoleptic estimation are given in table 4.

Table 4 – Organoleptic characteristics of boiled sausages

Samples of sausages	Mark by 5 – ball scale					
	sight on the section	colour	odour	taste	consistence	general
Control (without ferments)	4,3	4,0	3,9	4,0	3,8	4,0
The investigated sample "Nasha Ryaba" with <i>Lactobacillus sakei</i>	4,9	4,7	4,55	4,65	4,7	4,9
The investigated sample "Gavrilivski kurchata" with <i>Lactobacillus sakei</i>	4,85	4,7	4,6	4,7	4,65	5,0
The investigated sample "K Okule" with <i>Lactobacillus sakei</i>	4,9	4,85	4,6	4,75	4,85	5,0

From the table we can see that, by organoleptic indices, the samples of the sausages, produced with the starting culture, are estimated higher than the control one. The surface of all investigated sausages is dry, clean, the cover fits the stuffing closely. The indices of the cut product quality have been determined immediately after cutting. The sight on the section of the tested samples advantageously differs from the control one. Sausages with the starting culture have dense consistence, pleasant odour. The taste is fairly salty, without outside smacks. Consequently, the results, obtained during organoleptic estimation of boiled sausages, tell about the fact, that using of the starting cultures of *Lactobacillus sakei* improve consistence, taste, odour, color of the boiled sausages.

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ИССЛЕДОВАНИЕ СВОЙСТВ ВАРЕННЫХ КОЛБАС ИЗ БИОМОДИФИЦИРОВАННОГО ФАРША В ТЕЧЕНИЕ ХРАНЕНИЯ

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Анотация. В статье представлены результаты исследования влияния внесения бактериальной закваски, а именно *Lactobacillus sakei* на изменение функционально-технологических и микробиологических характеристик в течение хранения. В работе провели исследование динамики изменений белковой, жировой составляющей вареных колбас и накопления остаточной микрофлоры. Подтверждено, что внесение данной культуры подавляет развитие нежелательной микрофлоры, что гарантирует высококачественную и безопасную продукцию. Также экономически обосновано использование инновационной разработки для производства колбасных изделий; составлена технологическая схема производства вареной колбасы с внесением стартовой микрофлоры. В качестве объектов исследований были использованы мясо птицы. Ведь мясо птицы - качественный, богатый белками продукт с низкой калорийностью в сравнении со свиной и говяжьей. В нем

Conclusions

- The appropriateness of the bacterial ferments of *Lactobacillus* type on microbiological (MAFANM, bacteria of intestine bacillus group, sulfite-reducing klostridii, bacteria of Proteus type, Staphylococcus Aureus, bacteria of Salmonella type), physical and chemical (the amount of moisture, active acidity, nitrite content), biochemical indices (content of peroxide number, amino-ammoniac nitrogen, volatile fatty acids);
- The technology of the boiled sausage from poultry meat with application of the starting culture *Lactobacillus sakei* has been offered and it allows to prolong the term of a product storage from 2 to 7 days;
- The complex of the scientific research has been carried out and the technology of production of the boiled sausages from poultry meat with biomodification of the stuffing has been offered.

коллагена і еластина содержится меньше, чем в мясе скота, и за счет этого увеличено содержание полноценных белков, поэтому мясо птицы усваивается организмом человека легче (96 – 98 %) и более полно, чем мясо других сельскохозяйственных животных. Мясо птицы отличается оптимальным количественным соотношением незаменимых аминокислот. Также доказано, что использование *Lactobacillus sakei* положительно влияет на органолептические показатели вареных колбас, улучшая консистенцию, вкус, запах, цвет вареных колбас.

Ключевые слова: мясо птицы, бактериальные закваски, стартовые культуры, мясные продукты, колбаса.

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ВИБІР ОПТИМАЛЬНОГО СПОСОБУ «ВІДКЛАДЕНОГО ВИПІКАННЯ» ХЛІБОБУЛОЧНИХ ВИРОБІВ ЛІКУВАЛЬНО-ПРОФІЛАКТИЧНОГО ПРИЗНАЧЕННЯ

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Анотация. У роботі здійснено вибір оптимального способу «відкладеного випікання» при виробництві хлібобулочних виробів лікувально-профілактичного призначення. Досліджено вплив добавок: порошку лецитину та екстракту плодів шпигини в кількості 5 % до маси борошна, а також різних способів тістопріготування на органолептичні, фізико-хімічні та структурно-механічні властивості готових виробів. Тісто готували безопарним і опарним (рідка і густа опари) способами. Одні зразки тесту поміщали в холодильну камеру при температурі –8 °С і після дефростації расстаивается і випікалися. Інші зразки готувалися за технологією часткового випікання. Контрольні зразки готували за традиційною технологією. Аналізуючи отримані результати досліджень можна зробити висновок, що хліб, приготовлений за технологією «відкладеного випікання» на рідкій опарі, не має виражених відмінностей органолептичних та фізико-хімічних показників у порівнянні з безопарним методом. Так само варто відзначити поліпшення органолептичних показників готових виробів із заморожених напівфабрикатів з добавкою екстракту плодів шпигини в кількості 5 % до маси борошна.

Ключові слова: відкладене випікання, часткове випікання, лабораторний зразок, заморозка, заморожені напівфабрикати, добавки.

ВИБОР ОПТИМАЛЬНОГО СПОСОБУ "ОТЛОЖЕННОГО ВЫПЕКАНИЯ" ХЛЕБОБУЛОЧНЫХ ИЗДЕЛИЙ ЛЕЧЕБНО-ПРОФИЛАКТИЧЕСКОГО НАЗНАЧЕНИЯ

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