Improvement of the Technology of Meat Products Manufacturing with the use of Phytopreparations

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Abstract—**The article is devoted to the improvement of the technology of meat products manufacturing with the usage of phytopreparations. The phytopreparation "Health", on the basis of herbal additives of Chamomile, Hypericum, Oregano, Thyme and Calendula (marigolds) as preservatives in the production of cooked sausages, is developed. The ingredient composition is substantiated and the recipe of sausages is optimized with the usage of the developed phytopreparation. It is found that its use can increase the shelf life of sausages by 35%, increase the pH level and the proportion of bound moisture. Finished sausage products have acceptable organoleptic properties, higher nutritional value and meet safety requirements. The economic efficiency of production is determined, which increases the net profit by 14.3% and the level of profitability by 30.9%. The social effect of the use of such sausage products, which is to protect human health by the biological risk reduction associated with exposure to toxic microorganisms, is also found.**

Index Terms—**phytopreparations, extract, safety, nutritional value, quality, meat products**

I. Introduction

The problem of compliance of the quality of nutrition with human health and age is one of the most relevant. It is becoming more and more important every year, because the growth of the world's population does not meet the capabilities of the country's industries to produce quality food products [1]-[3]. Human health is important in the establishment of all countries of the world, and quality food is a factor of its implementation [4]-[6].

The variety of food products on the world market, on the one hand, improves the functionality due to the large number [7]. However, on the other hand, it complicates their choice, as the large nomenclature of food products requires sufficient knowledge of many of their characteristics, especially those, that are related to quality [8]-[10]. In this context, functional food products represent a direction of development of the modern food industry, which contributes to improvement of their quality [11], [12].

In many countries of the world, there is a set of tendencies to increasing of the interest of specialists and scientists to functional products of natural origin [13]. This is primarily due to their quality, usefulness, affordability, environmental friendliness, relative cheapness [14]. It is also worth noting, that over a long

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period of time, humanity has accumulated enough information about the medical and pharmaceutical effects of phytopreparations on the human body. It also contributes to their spread and widespread usage [15]-[17].

Functional food products, that increase the body's resistance to extreme situations, normalize mental and physical working capacity, are used for therapeutic and prophylactic purposes [18], [19].

Natural plant raw materials – herbs – recognized and widely used in the food and medical industries [20]-[22]. The positive properties of many plants, especially medicinal, due to their ability to activate enzyme systems and enhance the body's energy supply [23]. Therefore, nowadays it is necessary to develop technologies of food products with the given composition and properties, and also to increase their positive influence on human body [24], [25].

Nowadays, the current problems are such as: an improvement of the quality of meat products, their enrichment with biologically active substances and extension of the shelf life [26]-[29].

Also, in terms of medicinal properties, the ability to improve some functional and technological properties of products (shelf life extension (SLE) of final products, regulation of colour formation reaction, enrichment with biologically active substances, etc.) and the availability of these plants in Ukraine, it is advisable to use the following herbs: Chamomile, Hypericum, Oregano, Thyme and Calendula (marigolds).

II. Materials and Methods

The study was conducted in the research laboratory of veterinary medicine and in the production conditions. The following methods – organoleptic, physicochemical, microbiological, biological, analytical methods of product research – used in the organization of the experiments.

The scheme of experimental research is presented in Fig. 1.

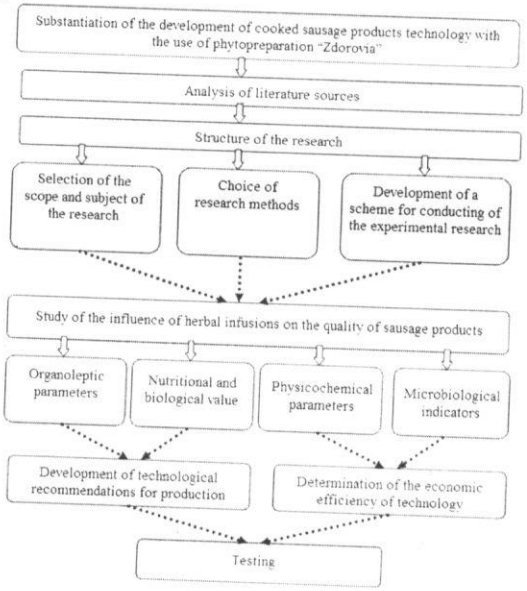


Figure 1. Scheme of experimental research

The research was conducted in 6 stages.

At the 1st stage of the research:

- The information, related to modern aspects of meat products manufacturing, is analyzed and systematized;
- Analysis of the problem of the shelf life extension of cooked meat products is carried out;
- The concept of purposeful use of human-safe additives of plant origin in order to increase the shelf life of perishable cooked meat products (cooked sausages, liver sausages, p â t é s) is developed.

At the 2nd stage of the research, the choice of perspective substances of plant origin which can be used both, as preservative additives independently, and as a part of compositions, was theoretically substantiated and experimentally confirmed.

At the 3rd stage, the studies were conducted to determine the effect of promising plant additives on the change of organoleptic and microbiological parameters of meat products. As a result, the optimal quantitative parameters for the introduction of plant origin additives, as well as the main factors, that have influence on the shelf life, were determined. Mathematical dependences of the preservative effect on the amount of additives, as well as the estimated shelf life (when using optimal doses in aerobic storage conditions) on the residual microbiological contamination and storage temperature, were determined.

At the 4th stage, recipes and technologies of sausage products with the use of preservatives were substantiated and developed.

At the 5th stage, the consumer properties were studied and the safety indicators of the developed types of meat products were determined. On the basis of the obtained results, a comprehensive quality indicator is calculated.

At the 6th stage, on the basis of research of changes of microbiological and organoleptic indicators, there were defined:

- Guaranteed shelf life of various types of cooked meat products;
- The effect of additives on the change of their physico-chemical and structural-mechanical parameters;
- Basic patterns of lipid changes during storage of cooked sausage products.

The following research methods are used in the article: organoleptic, physicochemical, microbiological, biological, analytical methods of product research [30], [31].

Organoleptic quality assessment was performed according to the generally accepted methodology with the use of a nine-point differential rating scale [32].

The content of protein, fat, salt and moisture was determined in accordance with the standards [33]-[38]. The ash content was determined by gravimetric method. The carbohydrate content was determined by spectrophotometry by colour reaction of complexes formed by carbohydrates with organic reagents. The energy value was obtained by calculation method [39]. The complex quality indicator was calculated by quasimetric method for meat products.

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Water-binding capacity (WBC) was determined by the method of pressing by Grau and Hamm in the modification of V. Volovinskaya and B. Kelman.

Determination of sodium chloride content was performed in an aqueous extract of the product by Mohr's method in a neutral medium. The method is based on the deposition of a chlorine ion by a silver ion in a neutral medium in the presence of potassium chromate as an indicator. Determination of pH was performed according to generally accepted methods.

Determination of water binding capacity: to determine this parameter, a sample weighing 0.3 g was taken from the test object and weighed on accurate electronic scales. The sample was placed on an ashless paper filter between two horizontally placed glass plates and was subjected to the application of a kilogram of cargo for 10 minutes. The stain, left by the test object and the stain from the pressed (after the filter dries) water is traced with a pencil; the area limited by the outer and inner contours is determined with the help of a planimeter.

Organoleptic assessment of sausage samples was performed on a five-point scale, determining the appearance, colour and appearance of the cut, aroma, taste, texture, juiciness.

In case of suspicion of falsification of sausages (addition of starch to the minced meat, even in cases where it is not provided by the recipe), the presence of starch in the minced meat is determined. An average sample is taken for laboratory tests. The samples are freed from the twine, shell and separated by species, passed twice through a meat grinder with a diameter of the lattice hole of 3-4.5 mm, mixing thoroughly.

The content of moisture, sodium chloride, nitrite, nitrate, starch was determined during the physicochemical research of the final product.

Taking into account the exact properties of nitrite and the possibility of its participation in the synthesis of carcinogenic nitrosamines, the amount of nitrite in products is strictly limited. Considering the potential danger of nitrate and the difficulty of reactions regulation of nitroso pigment formation, the use of nitric acid salts in salting meat is prohibited in Ukraine. At the same time, the possibility of conversion of nitrite to nitrate is not excluded, which requires control of the content of nitric acid salts in meat products.

Determination of microbiological parameters of sausage products. Saburo's medium is used to determine the content of yeast and mold (the size of colony-forming units (CFU) in 1 g of product). The samples were kept at a temperature of 22°C for three days. Kessler's nutrient medium is used (exposure 24-48 hours at a temperature of 37°C), followed by inoculation on Endo's medium at 37°C for 24 hours, to determine the bacteria of the Escherichia coli group (BECG) in 0.001 g of product.

Determination of pathogenic microorganisms, including the genus Salmonella, in 25 g of product was performed with the use of an enrichment of the medium – selenite broth (Leifson's medium). The samples were kept at a temperature of 37°C for 16 – 18 hours, followed by inoculation on Endo's medium (exposure 24 hours at a temperature of 37°C), as well as magnesium medium (exposure 24 hours at a temperature of 37°C), followed by inoculation of samples on bismuth-sulfite agar at a temperature of 37°C for 48 hours.

Determination of CFU MAFAM (mesophilic aerobic and facultative anaerobic microorganisms) in 1 g of fatty acid synthesis (FAS) was performed by inoculation on enriched meat-peptone agar at a temperature of 30 ℃ and culturing the microorganisms for 72 hours.

Bacteria were determined according to standards: bacteria of the Salmonella genus [40]; bacteria of the Staphylococcus genus [41]; bacteria of the Escherichia coli group [42], [43].

The selected meat product material was labeled and fixed in 10% neutral formalin for microscopic examination. After fixation, pieces (0.5x1 cm) were cut out, dehydrated, compacted, embedded in paraffin, and histocuts were made, which were stained with hematoxylin and eosin and Van Gizon. Light microscopy and microphotography of histopreparations were performed with the use of an OLYMPUS CX 41 microscope and an OLYMPUS C 5050 camera.

The economic efficiency of meat production was assessed in accordance with regulatory documentation. The main indicators that were taken into account in determination of the economic efficiency – the cost of basic and auxiliary raw materials, production costs, cost of 100 kg. of products, profit from sales and the level of production profitability.

Cooked meat products were used as control samples in the study of the effect of herbal supplements on the change of organoleptic, microbiological, physicochemical and structural-mechanical parameters during storage.

Methods of regression analysis, statistical and graph-analytical data processing using standard software were used for objective and reliable evaluation of research results.

It is proposed to include an aqueous extract of medicinal plants instead of water in the recipe of meat products, namely: Chamomile, Hypericum, Oregano, Thyme and Calendula (marigolds). Such collections of herbs have the following advantages: good medicinal properties; ability to improve the functional and technological properties of products (increasing the shelf life of final products, regulation of the reaction of colour formation, enrichment with biologically active substances); availability of these plants in Ukraine.

The choice of maximum amounts of plant extracts was guided by the recommendations of the Institute of Nutrition of Ukraine "Determination of safety and efficacy of dietary supplements", according to which the daily dose of dietary supplements should not exceed a single therapeutic dose determined when using these substances as drugs (if you take dietary supplements at least twice a day), and the maximum dose of dietary supplements in 100 g (single serving) of the product should not exceed 1/20 of the daily dose of dietary supplements. The daily dose of dietary supplement of Chamomile extract is 1 g, Oregano – 0.75 g, Hypericum – 0.4 g, Thyme – 1 g, Calendula – 0.5. Therefore, 100 g of

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product should contain no more than 50 mg. of Chamomile extract, 40 ml. of Oregano extract, 20 ml. of Hypericum, 50 ml. of Thyme extract and 50 ml. of Calendula extract. The introduction of these extracts in such quantities in the model samples of minced meat did not affect its organoleptic characteristics (smell, taste, colour), the data are shown in Table I.

TABLE I. THE AMOUNT OF MOISTURE IN RAW MEAT

Samples	The ratio of water and phytopreparation in raw materials, %	
	water	phytopreparation
Sample № 1	15	10
Sample № 2	7,5	17,5
Sample № 3	0	25
Sample №4 (control)	25	0

Thus, the extract of medicinal plants will increase the functional performance of the final product, namely: the formation of meat products colour; formation of products taste; antioxidant properties; antibacterial property; the ability to activate enzyme systems and enhance the body's energy supply; normalization of mental and physical performance; cheap cost and availability in Ukraine.

III. RESULTS OF INVESTIGATIONS

Meat product tasting was carried out at the first stage of the research. It was performed directly by consumers, as well as by professionals, who know the requirements for meat products. Organoleptic assessment was performed on a nine-point scale according to the generally accepted differentiated scale. The results of the tasting are presented in Table II and Fig. 2.

TABLE II. ORGANOLEPTIC ASSESSMENT OF MEAT PRODUCTS

Indicators	Average assessment, scores			
	Sample № 1	Sample № 2	Sample № 3	Sample №4 (control)
Appearance	7,6±0,5	7,5±0,5	7,56±0,5	7,6±0,5
Cut's view	7,8±0,4	7,7±0,4	7,8±0,4	7,8±0,4
Smell	7,8±0,4	7,6±0,4	7,7±0,4	7,4±0,5

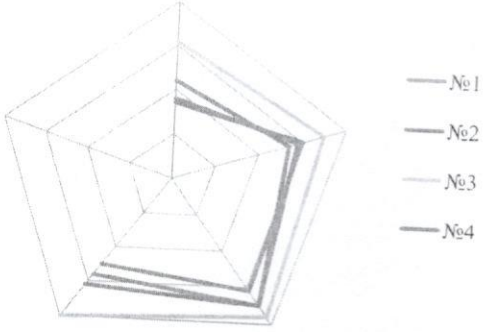


Figure 2. Results of organoleptic assessment of meat products

Tasting assessment showed that the use of phytopreparation (in optimal doses) as preservatives in the production of sausages did not affect their organoleptic characteristics (Fig. 2).

The average scoring for each indicator of the control sample of meat products did not differ from the corresponding assessment of samples of these products with the addition of plant extracts. The use of plant-based compositions as preservatives did not affect such indicators as: appearance, sectional view and colour, consistence. However, a number of experts found that due to the use of compositions it was possible to modify the taste and aroma of the final product by creating an original flavor range. As a result – samples with the addition of these compositions on such indicators as taste and smell received a higher score than control samples, which used traditional classic spices.

Tasting assessment showed that the developed products meet the requirements of the consumer in terms of organoleptic parameters, as well as intersectoral standards. The use of herbal additives in optimal quantities does not cause deterioration of the organoleptic characteristics of the final products.

Analysis of the chemical components of products is necessary in determination of the food potential in meeting the physiological needs of the body in plastic material and energy. It is studied and determined that the consumption of meat products in the amount of 100 g satisfies 14.2-16.6% of a person's daily need for protein and 12.4-14.9% – for fat. The ratio of protein and fat in all samples meets the physiological requirements and it is 1:0.9-1.2 (Fig. 3).

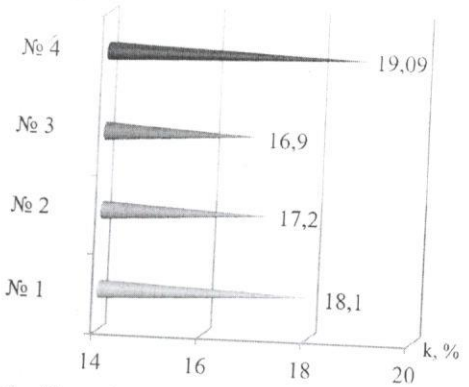


Figure 3. The results of studies of the mass fraction of protein *k* in meat products

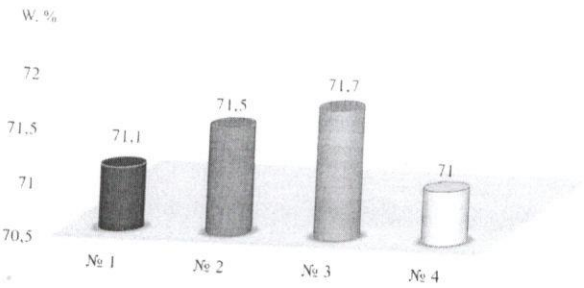


Figure 4. The results of studies of the mass fraction of protein *k* in meat products

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Calculation data show that all samples are high-calorie products with an energy value of 749-835 kJ/100 g. The moisture content of meat products was also studied (Fig. 4).

Analysis of the obtained data (Fig. 4) shows that the moisture content in the test samples does not differ much from the control samples, and is optimal for these products.

Water-binding capacity (WBC), plasticity n and water activity a_w in control and experimental samples of meat products were studied (Fig. 5 – Fig. 7).

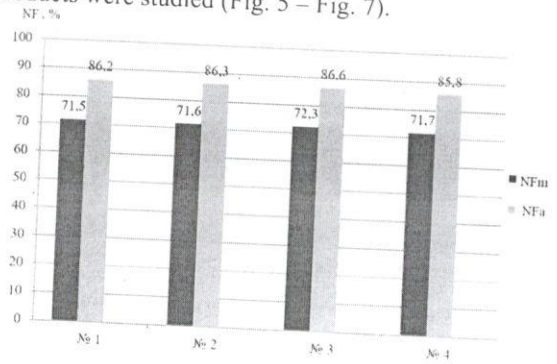


Figure 5. The results of the study of meat products, where NFa – control samples; NFm – prototypes

The analysis of the obtained results shows that the indicators of NF (negative feedback) in the experimental samples are slightly higher than in the control ones, which is explained by the introduction of a phytopreparation, the components of which bind moisture in meat products better.

The plasticity indicators of the experimental samples showed a higher result, which is a positive characteristic in the quality criteria of meat products (Fig. 6).

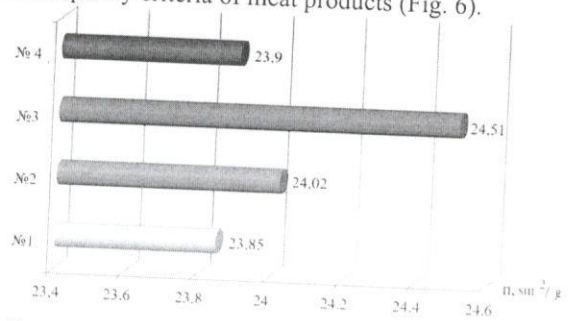


Figure 6. The results of the study of the meat products plasticity n

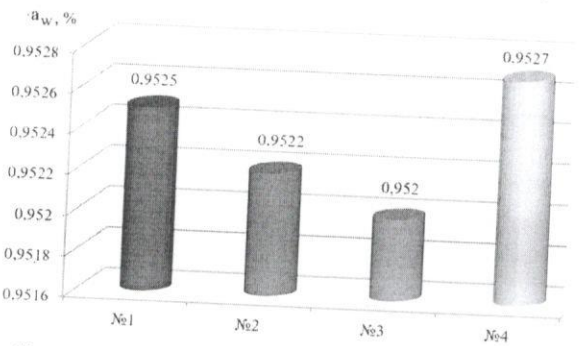


Figure 7. Results of determination of water activity a_w in meat products

The improvement of plasticity was due to the phytopreparation introduction. Water activity also affects meat products (Fig. 7).

The water activity index a_w in the experimental samples of meat products is lower than in the control sample, which characterizes the resistance of the system to the development of microflora.

The results of pH level studies of the meat products are shown in Fig. 8.

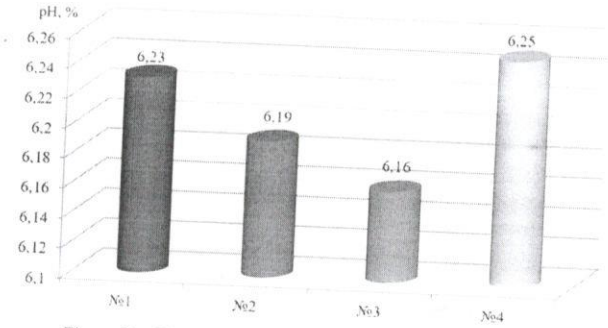


Figure 8. The results of studies of meat products *pH* level

Analysis of the research results (Fig. 7, Fig. 8) shows that the active acidity of the experimental and control samples characterizes meat products as benign. The lower pH indicator of the experimental samples is explained by the addition of a phytopreparation, which contains a high content of flavonoids and their glucosides, phenolic acids and tannins. Also, the indicators of emulsifying ability (EA) and emulsion stability (ES) of meat products were studied (Fig. 9).

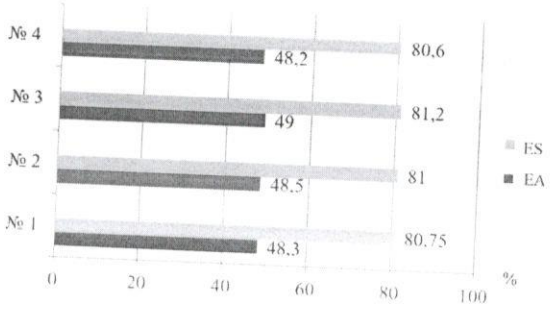


Figure 9. Results of EA and CE ES studies of meat products

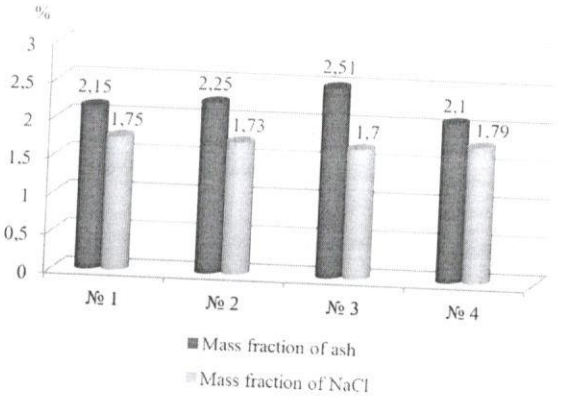


Figure 10. Research results of mass fraction of ash and NaCl of meat products

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The indicators of EC and ES in the experimental samples are high, which indicates a positive effect of phytopreparation. The increase in these indicators is insignificant and is in the range from 0.3 to 1%.

The indicators of the mass fraction of moisture in the experimental samples are higher, which indicates the positive effect of the introduced phytopreparation, the components of which improve the distribution and water binding in the product (Fig. 10).

The ash content increases and the NaCl content decreases in the experimental samples, this shows the positive effect of the components of the applied phytopreparation. Higher values of sample №3, due to the presence of sugars, ascorbic acid, essential oils, carotenoids, colour pigments and tannins, which contain nitrogen-free aromatic compounds and a characteristic viscous taste.

The biological value of meat products was determined by protein digestion in vitro, the results of the studies are shown in Table III.

TABLE III. DIGESTIBILITY OF PROTEINS IN VITRO

Enzyme	Table 3. Digestibility of proteins, mg of tyrosine / g of protein			
	Sample №1	Sample №2	Sample №3	Sample №4 (control)
By Pepsin	12,97	12,99	13,01	12,96
By Trypsin	13,99	14,05	14,09	13,95
General digestibility	26,96	27,04	27,1	26,91

Analysis of Table III shows that the total digestibility of proteins in the experimental samples is higher than the control, which indicates a positive effect of the introduced phytopreparation on digestion.

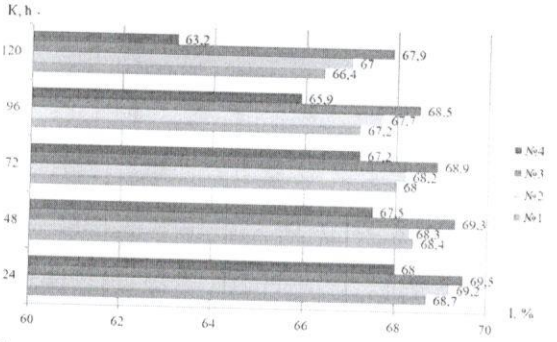


Figure 11. The dynamics of changes in the total moisture content / of meat products during storage *K*

It is known, that many properties of meat products, in particular, the ability to bind moisture, structural and mechanical properties largely depend on the pH level. There is often observed, that the pH of meat products deviates to the alkalis, as a result of the activity of the final microflora during storage of these products. It causes the breakdown of proteins with the accumulation of nitrogenous bases, ammonia, amines, which helps to reduce the concentration of hydrogen ions. Therefore, to determine the storage characteristics of meat products, their total moisture content / and pH level were studied (Fig. 11, Fig. 12).

The ash content increases and the NaCl content decreases in the

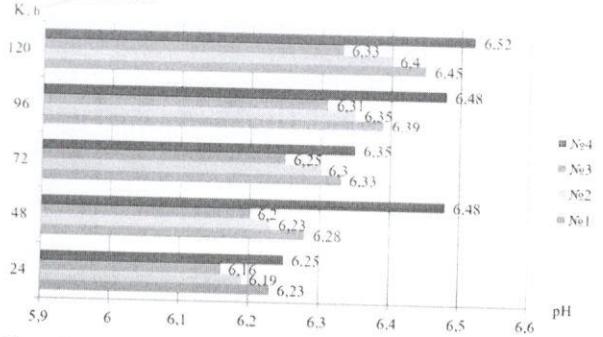


Figure 12. Dynamics of pH change of meat products during storage *K*

The content of total moisture in the experimental sample №3 is more stable during a certain shelf life (Fig. 11). The pH values in the experimental sample № 3 are much better because in the control sample the pH rises rapidly in the alkaline side, which reduces the quality of the product and causes the breakdown of proteins (Fig. 12).

Thus, the addition of phytopreparations to meat products improves their characteristics. As a result, not only the time of adaptation of microbial cells to new conditions increased, but also the rate of generation of microbial cells reduced. In the control sample after 7 days of storage, the quantity of mesophilic aerobic and optionally anaerobic microorganisms (QMAFAnM) increased by 10.7 times, in the experimental samples – in the range of 8.8-9.1 times. It was found that QMAFAnM did not exceed the permissible value (1000 CFU/g of raw material) in the control sample (without extracts) for 2 days, in the experimental samples №1 and №2 – 5 days, in the experimental sample №3 – 4 days.

When studying the chemical composition of plant extracts, we noted that the dry extracts of Oregano, Chamomile, Hypericum, Thyme and Calendula contain large amounts of phenolic compounds that have antimicrobial action. Taking into account the fact that phytopreparations are introduced into meat products in small quantities (10-25%), they can have bactericidal action.

IV. DISCUSSION

Thus, the introduction into the experimental samples of preservatives of vegetable origin allowed to increase the shelf life of cooked sausages, pâtés, liver sausages (in terms of their aerobic storage at a temperature of 8 ℃) for 1-3 days (depending on the type of additive and product).

During storage of samples of cooked sausages in a natural casing for 5 days QMAFAnM in the control sample increased by 10.8 times, in the experimental samples – by 3.2-4.4 times.

Based on the obtained data, it was found that the use of compositions and plant extracts as preservatives allowed to increase the shelf life of cooked sausages up to 2 days

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(sausages – from 2 to 4 days), the use of phytopreparations allowed to increase the shelf life of these sausages by 1 day.

When analyzing the dynamics of QMAFAnM development in cooked meat products under aerobic storage at a temperature of 6 ℃, it was found, that preservatives, as in the previous case (at 8 ℃) are an additional factor to the low delay temperature. There is an increase in mesophilic microflora, resulting in a decrease in the rate of mesophilic microorganisms' generation and increase the duration of the period of physiological adaptation of these microorganisms to new conditions (Lag-phase).

During storage of both control and experimental samples, there was a tendency to shift the pH to the alkaline side (although the change in pH values was within the error of the experiment). The pH value of control samples increased by 0.09-0.12, experimental samples – by 0.02-0.05 during the study period (sausage products – 6 days).

In the process of the storage of meat products samples, there is a tendency to increase the proportion of moisture. When stored for 6 days at a temperature of 8 ℃, the mass fraction of moisture in the control sample increased by 3.0%, and in the experimental samples – by 1.4-1.6%. This is due to the shift of pH to the alkaline side. Developed phytopreparations, which are part of the experimental samples, slow down the pH shift to the alkaline side. As a result, the process of NF increasing in the experimental samples is less intense, than in the control one.

For the further extension of the shelf life of finished meat products, bacterial yeast for use in the meat industry and science-based bacterial yeast, based on Lactobacillus sakei and Staphylococcus xylosus, were screened. In addition, the feasibility of making sourdough starter at the stage of minced meat preparation was experimentally proven. This step is due to the high peptide activity of the introduced cultures, which are able to produce not only bacteriocins, but also a large number of enzymes.

The next stage of the work was the selection of the optimal mass fraction of the drug in order to improve the sanitary condition of the minced meat. The control was performed to determine the total bacterial count of the finished products immediately after heat treatment.

It was determined, that with the increase of the mass fraction of the drug the total bacterial number decreases in direct proportion. However, further research has shown that more microorganisms can degrade rheological characteristics at the beginning and during storage due to the production of proteolytic enzymes. This is confirmed by experimental studies by the determination of the cooked sausages structure during storage.

During storage, the intensity of the decrease in the amount of moisture is maximum in the control sample and in the sample with a mass fraction of the drug is 0.15%. This is due to the consumption of moisture by the residual microflora. The obtained data correlate with microstructural studies, which indicate that with increasing drug the structure of cooked sausages becomes loose, and does not comply with State standards of Ukraine (SSU).

According to regulatory documentation, there are microbiological standards for a product that goes out of production, but is not controlled during storage. That is why we controlled the quality of cooked and smoked sausages during storage by a set of physicochemical and biochemical parameters in the product.

It is determined that the increase in the mass fraction of the drug leads to deeper destructive changes in the protein and fat fraction. In contrast to the control sample, where these changes occur under the action of residual microflora, in the sample with a high content of proteolytic enzymes, such destruction occurred at the beginning of storage.

We determined a certain effect of the developed yeast in relation to Enterococcus faecalis, Escherichia coli, in the course of the investigation (Fig. 13).

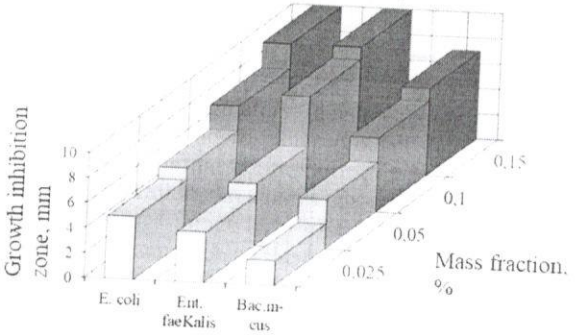


Figure 13. Comparative characteristics of antimicrobial properties of the drug

A comparison of samples of the final product was carried out according to the main quality indicators, in order to test the effectiveness of the proposed technology for the production of sausages with the use of phytopreparations. Determination of the chemical composition made it possible to obtain data on the quality of the product and its nutritional value. They depend on the quantitative ratio of moisture, protein, fat and minerals and indicate the stability of the properties of the product during storage.

According to microbiological indicators, all samples of meat products complied with current standards regulatory documentation. Bacteria of the Escherichia coli group, Salmonella genus and sulfite-reducing clostridia were not detected in the final product. The content of lactic acid microflora and micrococci is increased in samples, made with phytopreparation.

It is determined that the use of a composite additive of the phytopreparation slows down the oxidation of fats and allows to prolong the shelf life of final meat products. The guaranteed shelf life of sausages made with a composite additive, as well as the developed phytopreparation "Health" is not more than 14 days at a temperature of 6°C to 8°C.

The analysis of technical and economic indicators of meat products with the addition of phytopreparation

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"Health" allowed to calculate the economic efficiency of their production, which increases the net profit of meat enterprises by 14.3%, and their level of profitability – by 30.9%.

Tests were carried out to determine the effectiveness of the proposed solutions in production and determine their economic effect, taking into account the conducted research. To do this, the existing meat enterprises produced meat products with the addition of phytopreparations. As a result, the following recommendations are proposed:

– The use of the developed phytopreparation "Health" during the production of cooked sausage products extends the shelf life of finished products by 35% (up to 14 days);

– There is achieved a social effect, which is to protect the health of people living in environmentally unfavorable conditions, by enriching sausage products with useful microelements and obtaining antibacterial properties, as well as reducing the biological risk associated with exposure to toxic microorganisms.

V. Conclusion

Experimental studies have confirmed the prospects for the use of herbal supplements – Chamomile, Hypericum, Oregano, Thyme and Calendula (marigolds) as preservatives in the production of cooked sausage products. It is determined that the proposed additives have high antimicrobial activity against microorganisms of the genus Bacillus, Micrococcus.

The phytopreparation "Health" on the basis of plant additives is developed. The ingredient composition is substantiated and the recipe of sausage products is optimized with the use of the developed phytopreparation. The optimal amount of its introduction into sausages is 25%.

A comprehensive study of the quality indicators of the developed meat products has shown that they have acceptable organoleptic properties, high nutritional value and meet safety requirements.

It is determined that the use of the developed phytopreparation allowed to increase the shelf life of sausage products by 35%. It was investigated that during the storage of such products there was a tendency to increase the pH level and the proportion of bound moisture.

Based on the analysis of technical and economic indicators of meat products with the addition of the phytopreparation "Health", the economic efficiency of their production was calculated, which increases the net profit by 14.3% and the level of profitability – by 30.9%.

The social effect, which is to protect human health by enriching sausage products with useful microelements and obtaining antibacterial properties, as well as reducing the biological risk associated with exposure to toxic microorganisms, was determined.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Valentyna Burak wrote basic concept of the work, described the research methodology, supervised research and the progress of writing the work; Dmytro Yakymchuk managed all the processes of the work, exercised methodological control over the progress of research, organized the process of coordination of all parts of the work and its writing process, wrote the article; Mykola Valko prepared equipment for research, described the methodology of research; Olga Mamai, Kateryna Zubkova and Olha Stoianova conducted the research, analyzed and processed the obtained data, described the studies; Oleksandr Spryn analyzed experimental data, participated in writing the article; Svitlana Reshnova participated in research, performed chemical analysis of experimental samples; Serhiy Holiaka described the experimental section, participated in writing the article; Mariya Shinkaruk processed experimental data, provided methodological support. All authors had approved the final version.

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