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EFFICIENCY OF *BACILLUS* SPP. PROBIOTIC MSCROORGANISMS USE FOR SANITARY TREATMENT OF SURFACES

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The use of probiotics allows to reduce contamination and to extend the shelf life of products. This is relevant in the sphere of food safety for the consumer. Under laboratory conditions, the optimal composition of probiotics from 5 strains of Bacillus (Bacillus subtilis UNCSM 020, Bacillus amyloliquefaciens ALB65, Bacillus licheniformis UNCSM 033, Bacillus pumilus UNCSM 026, Bacillus subtilis var. mesentericus UNCSM 031) was experimentally selected by in vitro method.

The study of microbal contamination of moisture-retaining wipes, treated with probiotics, when storing samples of meat products on them, was carried out.

QMA&OAMO (mesophyll aerobic and optional-anaerobic microorganisms) of untreated meat and by-products and those treated once with probiotic by aerosol method have been compared.

Artificial contamination of meat samples with pathogenic microorganisms was carried out, followed by probiotic contamination. The research was conducted to study the possible replacement of pathogenic microflora on the surface of products with useful microflora. The efficiency of treatment of work surfaces in a butcher shop with probiotic and disinfectant has been compared.

Bacillus spp. reproduction and inhibiting the growth of pathogens was observed in the study of a moisture-retaining wipe treated with probiotics starting from the second day of meat storage. Probiotic treatment of the moisture-retaining wipe improved the organoleptic properties of meat products. From the second day of storage, the contamination of probiotic-treated poultry meat was 11 times less than that of unprocessed products.

The rate of QMA&OAMO of probiotic-treated meat decreased on the 5th day in contrast to untreated meat, where bacterial contamination increased more than 1,500 times compared to the first day. It was found that probiotic bacteria Bacillus spp. are an effective tool for combating pathogenic microorganisms Listeria spp, Salmonella spp, E. coli, Pseudomonas spp, St. aureus. They also inhibited the growth of molds and yeast in meat processing plants.

Eight hours after probiotic treatment, microbial contamination of trays, equipment, boards, refrigerators was 5.2, 10.3, 18.9, 5.2 times less, respectively, compared to treatment with chlorine-containing disinfectant.

Key words: *probiotic, Bacillus spp., insemination, meat, by-products, offal organoleptic changes.*

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Introduction

Demand for poultry meat has increased significantly over the last few decades due to its low cost, high nutritional value, dietary value and suitability for further processing. Moreover, forecast studies suggest an expansion of the poultry market (Petracci et al., 2015). Meat is an important source of high-quality dietary protein for a large part of the world's population (Salter, 2018).

Libyan scientists have proven that meat and meat products contain various nutrients that provide favorable conditions for the reproduction of microorganisms. Most of the isolated bacteria are zoonotic and pose a great danger to public health (Eshamah et al., 2020; Lonczynski et al., 2021).

Greek scientists claim that the isolation of bacterial diversity from chicken meat may give a new understanding of the microbiota. They have studied the storage of products (chicken breast, fillet and thighs) at different temperatures from 0–+5°C up to +10°C. The main microbiota of fresh samples were *Acinetobacter, Brochothrix, Flavobacterium, Pseudomonas, Psychrobacter* and *Vibrionaceae.*

These microorganisms were isolated by the end of storage in > 80% of samples, with the exception of *Psychrobacter* and *Flavobacterium*, whereas *Photobacterium* was also identified (Dourou et al., 2021).

American scientists (Tran, 2020) claim that *Listeria monocytogenes* is a food pathogen that contributes to high levels of hospitalization and mortality among infected people. A characteristic feature of the pathogen spread is the ability to reproduce at refrigerator temperature and rapid contamination of products.

Over a period of 11 years in the Dnipropetrovsk region of all analyzed samples of poultry meat (according to planned studies) 36.7% of cases of contamination by microorganisms of the genus Listeria were found (Borovik & Zazharska 2019; Zazharska & Borovuk, 2019).

Biofilms that form *L. monocytogenes* due to contamination of different surfaces are a threat to production and a danger to consumers (Harada et al., 2021).

Uncontrolled use of disinfectants and detergents in various concentrations has led to the formation of resistant pathogenic and opportunistic microorganisms in the meat processing industry. The introduction of modern probiotics will reduce contamination and extend the shelf life of products. After all, product safety is a critical issue for the consumer.

In the presence of sodium hypochlorite the formation of the biofilm of *L. monocytogenes* is reduced. This indicates that NaOCl may reduce the ability of *Listeria* spp. to form biofilms on the surfaces (Bansal et al., 2021). The use

of saline solutions reduces the spread of the pathogen *L. monocytogenes* (Shmychkova et al., 2021). The growth of pathogenic microorganisms is influenced by the antibacterial and fungicidal action of ethanol plant extracts and herbal infusions (Zazharskyi et al., 2019; Zazharskyi et al., 2020).

Chinese scientists, who studied the growth of bacteria of the genus *Listeria* spp. in various treatments, claimed that only heat treatment damages the bacterial cell, the time and temperature of treatment significantly reduces the growth and development of microorganisms (Fang et al., 2021).

Scientists from Washington claim that the pathogen can be destroyed in industrial plants with the help of saturated steam 100ºC, although it neutralizes both pathogenic microorganisms and biofilms created by probiotics (Hua et al., 2021).

Chinese scientists in veterinary practice use some probiotics *Bacillus* spp. for the treatment and prevention of diseases of various etiologies (Lv, et al. 2020).

The fight against antibiotic resistance in poultry farming encourages scientists to intensively search for alternatives, such as probiotics *Bacillus* spp. (Park et al., 2016; Neveling et al., 2021).

Bacteria *Bacillus* spp. rapidly absorb organic material by necrotrophy without leaving pathogenic and opportunistic bacteria. Enzymes which produce microorganisms *Bacillus* spp. break down the biofilm of pathogenic bacteria colonies (Ham, 2017).

Probiotics *Bacillus* spp. are safe for life and health, as evidenced by the Safety Data Sheet in accordance with Regulation (EC) № 1907/2006.

The work aimed to investigate the efficiency of aerosol sanitation of surfaces and products using the experimentally developed composition of probiotic bacteria *Bacillus* spp.

Materials and methods

The research was conducted in the Dnipropetrovsk Regional State Laboratory of the Civil Service of Ukraine for Food Safety and Consumer Protection, which is accredited by the National Accreditation Agency of Ukraine for competence in accordance with the requirements of DSTU ISO/EC 17025, № 2H192 until June 19, 2023, and has a permit to work with pathogens of II-IV pathogenicity groups.

During the year, the work was carried out on the possible replacement of pathogenic microflora on the surface of products with useful microflora with 9 strains of *Bacillus* spp. (*Bacillus subtilis subsp Spizizenii Nakamura et al*. *ATCC 6633*, *Bacillus megaterium*, *Bacillus licheniformis UNCSM 067*, *Geobacillus stearothermophilus ATCC 7953*, *Bacillus stearothermophilus BKM B718*, *Bacillus stearothermophilus ATCC 12980*, *Bacillus coagulans SS/19*, *Bacillus cereus var.mycoides 537*, *Bacillus cereus var.mycoides HB)* and 3 species of lactobacilli (*Lactobacillus, Lactococcus, Bifidobacterium*).

According to the results of research, the unsuitability to counteract the pathogenic microflora of all studied lactobacilli and some cultures of *Bacillus* spp. has been established. In laboratory conditions, the optimal composition of *Bacillus* microorganisms (*Bacillus subtilis UNCSM 020, Bacillus amyloliquefaciensALB65, Bacillus licheniformis UNCSM 033, Bacillus pumilusUNCSM 026, Bacillus subtilis var. mesentericus UNCSM 031)* has been experimentally selected by in vitro method.

Day old cultures that were grown at 37°C on MPA medium at the same concentration of 0.5 Mac Farland (200 ml) were used for the study. A total of 3 liters of *Bacillus* spp. (probiotics) was obtained. The solution had a concentration of 2.0×10^6 vegetative forms to ensure rapid contamination of surfaces. This solution was used for aerosol treatment of test surfaces: an underlying pad (polymer packaging) size 18×14 cm^2, moisture-retaining wipes 8×6 cm^2, trays, equipment, boards, refrigerators and for immersion of samples of meat products.

Sample preparation for microbiological tests was performed in accordance with DSTU 8720:2017 and DSTU ISO 6887-1: 2003.

For microscopy, smears were stained by Gram in the Hooker modification (DSTU 5093: 2008). The microorganisms were counted using an automatic colony counter Scan-500 (Interscience, France).

Examining of the underlying pad was performed by the method of washing in accordance with DSTU ISO 18593:2006. The moisture-retaining wipe was examined according to the State sanitary rules and norms "Paper and cardboard bsed on waste paper intended for packing of dry foodstuff. Hygienic requirements, criteria of quality and safety, methods of definition". Approved: Order of the Ministry of Health of Ukraine 13.11.2006 N 746 Registered in the Ministry of Justice of Ukraine on December 5, 2006, N 1266/13140.

Studies on the detection of the pathogen were carried out following current regulations: *Escherichia coli* in accordance with DSTU ISO 4832:2015, *Pseudomonas* spp. ISO 13720:2010, *Staphylococcus aureus* DSTU ISO 6888-1:2003, *Listeria monocytogenes, Listeria ivanovii, Listeria innocua*, ISO 11290-1:2017, *Salmonella* spp ISO 6579-1:2017. According to each normative document, appropriate differential diagnostic media were used.

Experiment 1

In order to study whether the packaging can pose a threat and danger due to the accumulation of pathogens in it, the microbial contamination of the underlaying pad and the moisture-retaining wipes was investigated during storage of meat product samples.

Two moisture-retaining wipes treated with probiotics were placed on the underlaying pad, and the same number of untreated wipes was placed on the other underlaying pad. Meat products were placed on wipes and pads and examined for 5 days. Samples with products were kept at a temperature of +4ºC during the experiment without covering them with food film in order to restore production conditions.

A study of microbial contamination of wipes during the storage of meat product samples has been carried out.

Experiment 2

Samples of meat products (legs, heart and liver) were aerosolized once with a probiotic suspension. Untreated meat served as a control. Samples during the study were stored at a temperature of +4ºC for 5 days. QMA&OAMO were calculated daily according to DSTU 4833:2006.

Experiment 3

The next step was to artificially contaminate meat samples with pathogenic microorganisms, followed by probiotic contamination. The experiment was conducted to study the possible replacement of pathogenic microflora on the surface of products with useful microflora.

Meat products were artificially contaminated (pieces of meat of broiler chickens, heart and liver) with test cultures of pathogenic microorganisms, namely: *Escherichia coli UNCSM – 007*, *Pseudomonas aeruginosa UNCSM – 012*, *Staphylococcus aureus UNCSM – 017*, *Listeria monocytogenes UNCSM – 041*, *Listeria ivanovii UNCSM – 042*, *Listeria innocua UNCSM – 043*, *Salmonella enteritidis UNCSM – 081*.

Experimental day old cultures of pathogenic microorganisms were brought to a concentration of 0.5 Mac Farland. 100 ml of sterile water and 10 ml of day old culture of pathogenic microorganisms were placed to 500 ml sterile glass jars. Samples of meat products weighing 100 g were immersed in a solution of pathogens for 1 min.

After immersion, the samples were placed on a sterile pad for 10 minutes. The samples were then re-immersed for 1 min in 100 ml of probiotic culture suspension and placed on a pad with a moisture-retaining wipe. For further observation and study, the samples were stored in a refrigerator at a temperature of +4ºC without covering them with food film.

Experiment 4

The purpose of the last study is to conduct sanitary and microbiological control in a butcher shop. The day before, all equipment in the meat shop (place for cutting and packing of products) was washed and disinfected.

Three units of each – trays, inventory (knives, scapulas for forcemeat), boards, refrigerators were selected. The first unit served as a control, not treated. The second was treated with a chlorine-containing disinfectant (1 hour exposure). The third was treated with an aerosolized suspension of *Bacillus* spp. (1 hour of exposure).

Swabs were taken from the surfaces of trays, equipment, boards, refrigerators before starting work, after 1, 2, 4, 6, 8 hours of the enterprise operation. The total microbial count in the swab was determined in accordance with DSTU ISO 18593:2006.

Research results

Experiment 1

The moisture-retaining wipe without treatment on the 5th day of storage of meat products on it is more impregnated with bloody exudate in comparison with the wipe treated with probiotics (Figs. 1, 2).

Fig. 1. Untreated wipe on the fifth day of product storage

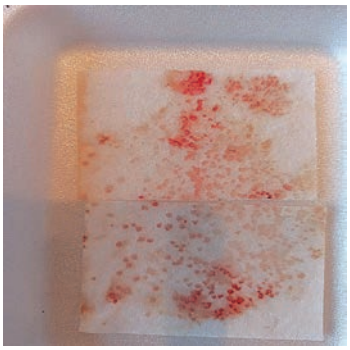

Fig. 2. Wipe treated with probiotics on the fifth day of product storage

During the first two days of storage of poultry meat and by-products on a wipe and a pad, no pathogens of microorganisms were detected. On days 3 and 4 of the study, on the untreated with probiotic wipe we revealed *E. coli*, but no pathogens were found on the treated wipe (Table 1).

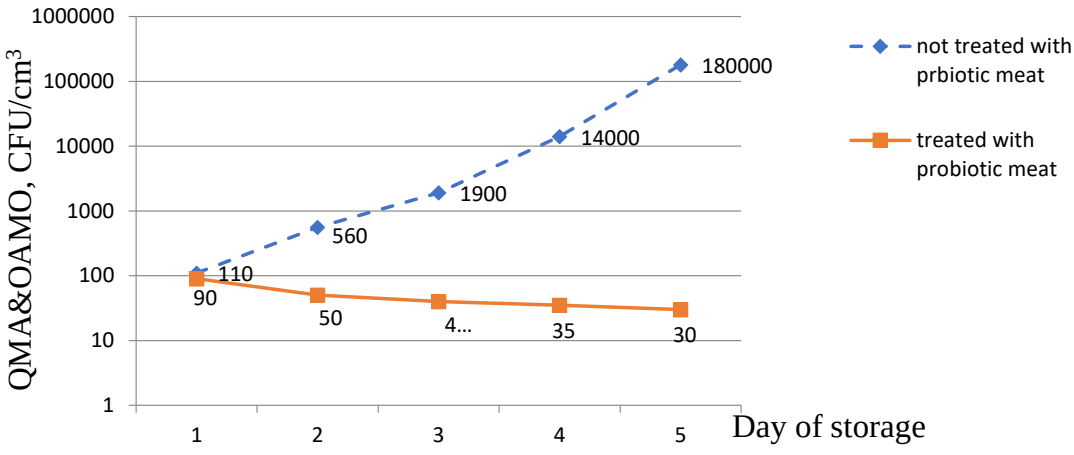

Fig.3. The level of microbial contamination of broiler chicken meat by after experimental contamination with probiotics (*Bacillus* spp.)

Table 1

Detection of pathogens in the moisture-retaining wipe and underlaying pad during the storage of meat products

Meat storage period, day	Moisture-retaining wipe and underlaying pad	
	Not treated	Treated with probiotic
	Detected pathogenic microorganisms	
1	Not detected	Not detected
2	Not detected	Not detected
3	*Escherichia coli*	Not detected
4	*Escherichia coli*	Not detected
5	*Staphylococcus aureus*, *Escherichia coli*	Not detected

On the 5th day on an untreated wipe we found *St. aureus* and *E. coli*, but no pathogens were detected on the treated wipe.

Experiment 2

From the second day of storage of products, the contamination of poultry meat treated with probiotics is 11 times less compared to untreated products (Fig. 3).

The rate of QMA&OAMO of probiotic-treated meat decreased to the 5th day in contrast to untreated meat, where bacterial contamination increased more than 1,500 times compared to the first day.

Meat that has not been treated with probiotics had significant contamination (Fig. 4) compared to treated meat (Fig. 5), where *Bacillus* spp. inhibited the growth of most microorganisms.

Fig. 4. Colonies of microorganisms from meat products not treated with probiotics, 3rd day of storage

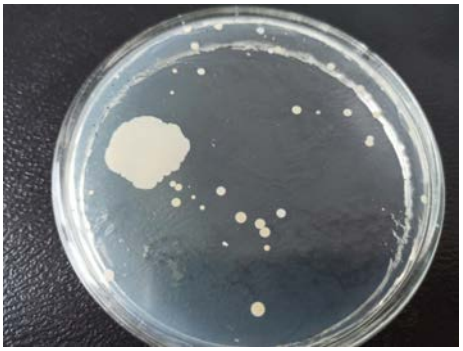

Fig. 5. Colonies of microorganisms from meat products treated with probiotics, 3rd day of storage

Visual examination of the untreated with probiotic heart and chicken liver (Fig. 7) showed organoleptic changes: slight weathering and excess blood exudate in the wipe, which caused a specific odor. The surface of the liver was non-shiny with areas of grayish color. The heart was flabby with yellowed adipose tissue.

Fig. 8 shows the by-products after aerosol treatmenttreated with probiotic suspension on the second day of storage. Chicken liver, which was aerosolized with a probiotic suspension (Fig. 8) had a bright dark brown color with a shiny surface. Partially impregnated wipe with small remnants of blood exudate, suitable for further storage of products.

Fig. 7. By-products not treated with probiotics, 2nd day of storage

Fig. 8. By-products treated with probiotics, 2nd day of storage

Period of storage of by-products was 2 days. To determine the possibilities of probiotics, the liver and heart were stored for 5 days.

Significant changes on the 5th day of storage occurred in the liver not treated with probiotics (Fig. 9). The color changed to brown-green, the surface slipped, the smell was putrid. According to organoleptic parameters, the by-products were stale. However, the heart and liver treated with probiotics on the 5th day of storage almost did not change their organoleptic properties (Fig. 10).

We observed a slightly blood-soaked wipe that absorbed excess fluid from the meat product. The heart is slightly weathered and lackluster, the liver was shiny, dark brown.

On the 2nd day of storage of meat products, namely chicken legs, the color of the meat of both samples was pale pink, the surface was shiny. But when storing meat that had not been treated with probiotics, the wipe was slightly impregnated with excess exudate (Fig. 11) compared to treated products (Fig. 12).

Fig. 9. By-products not treated with probiotics, 5th day of storage

Fig. 10. By-products treated with probiotics, 5th day of storage

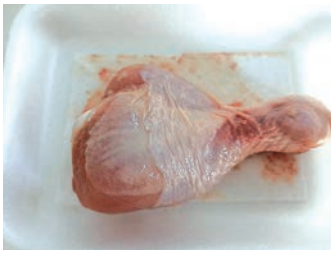

Fig. 11. Chicken leg not treated with probiotics, 2nd day of storage

Products not treated with probiotics (Fig. 13) on the 5th day of storage had a very unpleasant odor (musty blood). The skin surface was yellow, mucus was observed, red muscle tissue. Externally, the food product was unusable. The wipe was blood-filled and had a specific, unpleasant odor.

However, on the fifth day of storage of probiotic-treated meat (Fig. 14), we observed an odor characteristic for fresh meat products with no signs of spoilage.

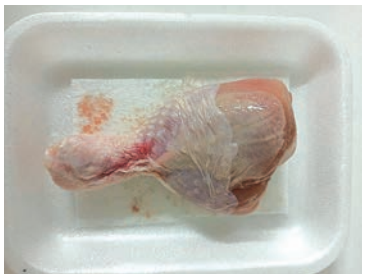

Fig. 12. Chicken leg treated with probiotics, 2nd day of storage

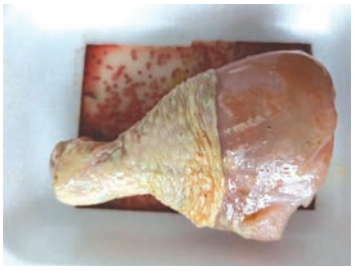

Fig. 13. Chicken leg not treated with probiotics, 5th day of storage

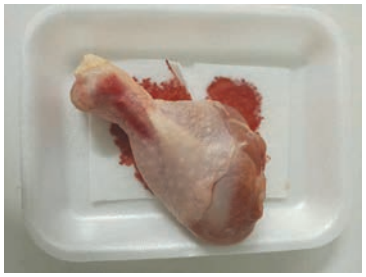

Fig. 14. Chicken leg treated with probiotics, 5th day of storage

Experiment 3

The most common strains of microorganisms monitored by the state and found in the retail and meat processing network were used for the experiment, namely: *Salmonella* spp, *Listeria* spp, *Escherichia coli*, *Pseudomonas* spp, *Staphylococcus aureus*.

In order to restore production conditions the forced contamination of meat products (first by pathogen and then by probiotics) was conducted. The degree of microbial contamination was studied (Table 2).

Table 2

Microbial contamination of chicken meat products by experimental contamination with pathogens followed by contamination of *Bacillus spp.*

Perion of storage, day	Meat products (meat, liver, heart) artificially contaminated with pathogenic microorganisms				
	Listeria spp.	***Salmonella spp.***	***Escherichia coli***	***Pseudomonas spp.***	***Staphylococcus aureus***
	The result of microbiological culture				
1	Bacillus spp.	Bacillus spp.	Bacillus spp.	Bacillus spp.	Bacillus spp.
2	Bacillus spp.	Bacillus spp.	E. coli	Bacillus spp.	St. aureus
3	Listeria spp.	Salmonella spp.	E. coli	Bacillus spp.	St. aureus
4	Listeria spp.	Salmonella spp.	E. coli	Pseudomonas spp.	St. aureus
5	Listeria spp.	Salmonella spp.	E. coli	Pseudomonas spp.	St. aureus

On the first day of storage of contaminated products in the bacteriological study we observed continuous growth of *Bacillus* spp. which inhibited the growth of the pathogen. However, on day 2, *Escherichia coli* and *Staphylococcus aureus* were detected.

On the 3rd day microorganisms *Bacillus* spp. replaced only *Pseudomonas* spp., and other pathogenic cultures were isolated. On days 4 and 5, no probiotic properties were observed in all experimental samples - experimental pathogens were detected.

Thus, contaminated poultry meat products that were immersed in a mixture of pathogenic bacteria and subsequently treated with *Bacillus* spp suspension reduced the spread of pathogens by the formation of biofilms.

Experiment 4

Sanitary and microbiological control was carried out in a butcher's shop using the developed *Bacillus* spp suspension and a conventional chlorine-containing agent. The number of isolated microorganisms is given in (Table 4). It should be noted that surfaces with different porosity (wooden boards and metal inventory) were used.

2 hours after a single probiotic treatment of boards and refrigerators in the bacteriological study the growth of only *Bacillus* spp. was present, which means the formation of a biofilm on the surfaces.

Therefore, aerosol treatment with probiotics after 4 hours allowed to completely eliminate the microflora on all experimental surfaces.

At the end of the work shift, the microbial contamination of trays, equipment, boards, refrigerators after treatment with probiotics was 5.2, 10.3, 18.9, 5.2 times less, respectively, compared with treatment with disinfectant.

Discussion

There are no literature data on research in Ukraine regarding the replacement of pathogenic microflora in meat products with probiotics *Bacillus* spp. in poultry farming.

The use of the developed solution based on the suspension of probiotics *Bacillus* spp. when treating moisture-retaining wipes, pads, products, work surfaces in the butcher's shop has been tested experimentally.

Korean scientists have shown that *B. subtilis* probiotics are safe for human health and can be an effective biological agent to reduce the growth of *Listeria* spp. Microorganisms *Bacillus* spp. have the ability to spread widely due to high biological activity and significant accumulation, regardless of the matrix of food products, or environmental objects, water, soil (Choi et al., 2020).

Probiotics slow down the reproduction of microorganisms*: Listeria spp.*, *Salmonella spp.*, *E. coli*, *Pseudomonas spp.*, *Staphylococcus aureus*, *Brochothrix thermosphacta*, *Carnobacterium spp*., *Luctobacillus spp*., *Leuconostoc spp*. and *Weissella spp*. The presence of these pathogens accelerates the spoilage of products starting from production to consumption (Stupar et al., 2021). According to the results of our own research, we also obtained data on probiotic inhibition of reproduction of microorganisms: *Listeria* spp., *Salmonella* spp., *E. coli, Pseudomonas* spp., *St. aureus*.

Italian scientists studied the microbial spoilage of meat products during storage at a temperature of +5˚C using different packaging and concluded that spoilage occurs between the 7th and 14th days of storage. Pathogens have been found in spoiled meat, but probiotics have significantly slowed down the spoilage of meat (Ercolini et al., 2006). This coincides with the obtained data: by-products treated with probiotics almost did not change their organoleptic properties on the 5th day of storage.

Polish scientists claim that *Bacillus* spp. form a probiotic biofilm that has antimicrobial and enzymatic activity (Jeżewska-Frąckowiak, 2018).

According to the data obtained regarding microbial contamination of meat products, there was no growth of pathogens in samples where probiotics had been used.

The main advantage of using probiotics *Bacillus* spp. is that with their help a stable solution to the problems of control of pathogenic microorganisms can be found. The only requirement for the use of probiotics *Bacillus* spp. – is a regular aerosol treatment, which is obvious in a continuous production process. Repeated treatment with probiotics, its layering, will create a safe surface due to the biofilm *Bacillus* spp.

Table 4

Microbial contamination of the swabs from the test surfaces, n=3, CFU/cm^3

Place of swab selection		Time of swab selection					
		Before work	After 1 hour	After 2 hours	After 4 hours	After 6 hours	After 8 hours
trays	without treatment	60	230	990	1200	34000	450000
	disinfectant	0	30	70	140	260	430
	probiotics	0	10	30	42*	60*	82*
inventory	without treatment	10	560	4800	59000	71000	400000
	disinfectant	0	90	170	330	590	960
	probiotics	0	30	50	47*	86*	93*
boards	without treatment	230	580	3100	42000	35000	560000
	disinfectant	40	190	380	760	1200	1800
	probiotics	0	50	62*	76*	83*	95*
refrigerators	without treatment	80	110	180	360	840	1400
	disinfectant	0	40	60	110	180	330
	probiotics	10	30	38*	47*	56*	63*

*Note: * – the presence of the growth of Bacillus spp. only*

The aerosol application of the probiotic on the surface is of great importance in the study of sanitary-microbiological control, because it allows to minimize the volume of liquid used (*Bacillus* spp. suspension).

Chicken by-products does not have a long shelf life, unlike meat products. During long-term storage of by-products in the refrigerator, they are still characterized by weathering and deterioration of organoleptic properties. When treated with probiotics, it is possible to eliminate the main defects of meat that occur when spoiled - such as an unpleasant odor, discoloration, mucus.

The use of a probiotic mixture of bacteria *Bacillus* spp. to reduce product contamination can be implemented at the facilities of the meat processing industry, in the retail network.

Conclusions

The use of a mixture of experimental cultures of probiotics *Bacillus* spp. allows to replace pathogenic flora and to colonize a surface to prevent the spread of agents of food toxicoinfections.

In order to reduce contamination of products starting from the 2nd day, it is recommended to change the moisture-retaining wipe to a new one treated with probiotics. Changing the wipe will reduce contamination, help to form a biofilm and as a result a safe surface due to the moisture-absorbing property.

Eight hours after treatment of work surfaces with probiotics, their bacterial contamination is several times less compared to treatment with chlorine-containing disinfectant, which proves the possibility of use probiotics *Bacillus* spp for disinfection of equipment in the meat processing industry.

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Ефективність використання про біотичних мікроорганізмів Bacillus* spp*. для санітарних обробок поверхонь

Застосування пробіотиків дозволяє зменшити контамінацію і продовжити термін придатності продукції, що є актуальним у сфері безпеки харчових продуктів для споживача. У лабораторних умовах методом in vitro експериментально підібрано оптимальний склад пробіотиків із 5 штамів Bacillus (Bacillus subtilis UNCSM 020, Bacillus amyloliquefaciens ALB65, Bacillus licheniformis UNCSM 033, Bacillus pumilusUNCSM 026, Bacillus subtilis var. mesentericus UNCSM 031).

Вивчено мікробне забруднення серветок, що утримують вологу, оброблених пробіотиком під час зберігання на них зразків м'ясної продукції. Здійснено порівняння КМАФАнМ м'яса і субпродуктів, необробленого та одноразово аерозольно обробленого пробіотиком. Проведено штучне забруднення патогенними мікроорганізмами зразків м'ясної продукції із подальшою контамінацією пробіотиками. Дослідження проведено з метою вивчення можливого заміщення патогенної мікрофлори поверхні продукції на корисну. Ми порівнювали ефективність оброблення робочих поверхонь у м'ясному магазині пробіотиком і дезінфектантом.

Під час дослідження серветки, що утримує вологу, обробленої пробіотиками на другій добі зберігання м'яса, спостерігалося розмноження Bacillus spp. і пригнічення росту патогенів. Оброблення пробіотиком серветки, що утримує вологу, покращило органолептичні властивості м'ясної продукції. Із другої доби зберігання продукції забрудненість м'яса птиці, обробленого пробіотиком, в 11 разів є меншою порівняно із необробленою продукцією. Показник КМАФАнМ обробленого пробіотиком м'яса зменшувався до 5 доби на відміну від необробленого, де бактеріальне забруднення збільшилося більше ніж у 1500 разів порівняно із першим днем. Виявлено, що пробіотичні бактерії Bacillus spp. є ефективним засобом для боротьби із патогенними мікроорганізмами Listeria spp, Salmonella spp, E. coli, Pseudomonas spp, St. aureus, а також пригнічували ріст пліснявих грибів і дріжджів в умовах м'ясопереробних підприємств. Через 8 годин після оброблення пробіотиком мікробне обсіменіння лотків, інвентарю, дошок, холодильників стало меншим у відповідно 5,2; 10,3; 18,9; 5,2 разів порівняно з обробленням хлоровмісним дезінфектантом.

Ключові слова: *пробіотик, Bacillus spp., обсіменіння, м'ясо, субпродукти, органолептичні зміни.*