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# Control of Chilled Meat of Broiler Chickens by Bacterioscopic Method

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**Abstract**. The relevance of this study is conditioned upon ensuring proper risk-based control over the safety and quality of chilled broiler chicken meat at its production facilities, where a system of hazard analysis and control at critical points should be implemented. In this regard, this study was aimed at identifying the issue of control of chilled broiler chicken meat for conducting research to establish the freshness of broiler chicken meat at sales facilities – agri-food markets and supermarkets. The leading approach to the study of this issue was the developed patented bacterioscopic method, which allows comprehensively establishing the freshness of chilled broiler chicken meat. The presented method is simple to perform, with obtaining quantitative indicators for establishing the freshness of chilled meat of broiler chickens for 5 days, 6-7 and 8 days at a temperature of 0-4 °C, as well as with establishing the number of microorganisms in the field of view of a microscope and by the degree of muscle tissue decay, by staining one smear-imprint according to Gram in Hooker's modification, and by counting the number of microorganisms in 10 fields of view, followed by deriving the average value per field of view, as well as determining the shape of the cells. The reliability of the results in tests using this method is 99.9%. It was found that the highest content of microorganisms was in stale chilled carcasses of broiler chickens on Day 8: in the chest muscles – 45 ± 3 ($P<0.001$), in the thigh muscles – 52 ± 5 ($P<0.001$) compared to fresh meat. Rod-shaped gram-positive microorganisms dominated stale meat, in some places single cocci were recorded, including a considerable breakdown of muscle tissue. The content of volatile fatty acids in the chilled meat of broiler chickens and the acid value of fat increased significantly ($P<0.001$) on the 8$^{th}$ day of sale at a temperature of 0-4 °C, respectively – 11.05 ± 0.37 – 10.97 ± 0.33 and 2.83 ± 0.33 mg of NaOH. During the examination of the freshness of the meat of broiler chicken carcasses, the highest percentage of fresh meat of broiler chickens during its sale in agri-food markets was 79.3%, in supermarkets – 75.0%, stale meat, respectively – 3.8% and 5.4%. The materials of this paper are of practical value for the work of state inspectors of veterinary medicine when using the bacterioscopic method to determine the freshness of chilled meat of broiler chickens

**Keywords**: microbial count, organoleptic assessment, pectoral muscles, thigh muscles, meat freshness

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## Introduction

Violation of the temperature regimes of cooling broiler chicken carcasses (the norm of the temperature regime of cooling poultry carcasses – from 0 to 4 °C – no more than 5 days, increasing the temperature above 4 °C and extending the period for more than 5 days) during sale or storage is important a critical control point for the effectiveness of the hazard analysis and control system at critical HACCP points (Hazard Analysis and Critical Control Point). Market operators should implement this safety system throughout the food chain of production and circulation of broiler chicken meat [1].

The traceability system, which is a component of the HACCP system, provides identification and analysis of hazardous risks, management of critical control points, and improvement of sanitary and hygienic requirements for the production and turnover of broiler chickens. To ensure the quality and safety of meat and meat products, constant sanitary, microbiological, and hygienic monitoring of the cold chain is required [2].

The safety and quality of broiler chicken meat depends on the poultry feeding, cultivation and slaughter technology, temperature and shelf life. Thus, during the breeding of poultry in private farms, the indicators of meat safety and quality were better than in farms, namely: an increase in protein content by 1.24%, and fat by 3.61% [3]. The consumer prefers chilled poultry meat since it retains all the nutrients necessary for a full-fledged diet [4].

For the effectiveness of the HACCP system, it is necessary to follow European and national regulations [5; 6] on the implementation of risk-based control of chemical, biological and physical hazards, hygiene of production, storage, and sale of broiler chicken meat. However, deviations from the temperature regime above 4°C and delay in sale and storage (more than 5 days) of broiler chicken meat is a daily issue, which leads to spoilage of products, deterioration of organoleptic properties and consumer characteristics of meat [7].

The temperature and duration of refrigerated storage (4 °C) of broiler chicken meat depends on its quality and safety in terms of microbial insemination and changes in physical and chemical parameters [8]. The cooling temperature of broiler chicken meat is one of the key factors in the entire food chain to ensure high-quality and safe products [9]. The quality of poultry meat with an extended shelf life in a chilled state correlates with freshness indicators [10].

Poultry meat is a perishable product, a considerable number of microorganisms multiply in it, organoleptic changes occur, namely the discolouration of muscle tissue, the formation of an unpleasant smell. One of the most effective methods is the use of infrared spectroscopy for the identification and characterisation of bacterial microorganisms that cause spoilage of poultry meat during refrigerated storage, considering the level of mesophilic microorganisms: 102–103 CFU/g – the initial content of microorganisms, and after 107 CFU/g – changes organoleptic indicators (doubtful freshness of meat) and more than 108 CFU/g – an unpleasant rotten smell appears (stale meat) [11].

Spoilage of broiler chicken meat leads to an increase in microorganisms, deterioration of organoleptic and physico-chemical parameters, and therefore it is necessary to develop more effective methods for controlling the freshness of meat products [12]. Changes in the quality of chicken fillet meat due to hypothermia at temperatures from 0 to 4 °C for 8-10 days during storage are expressed in the deterioration of organoleptic indicators, fat oxidation [13].

Antioxidants of plant origin are often used in the meat industry to increase the amount of meat raw materials and extend the shelf life of refrigerated storage up to 14 days, to reduce spoilage of meat and meat products in the absence of oxidation of lipids and proteins [14].

Scientists claim that the addition of various biological additives to poultry feed, such as probiotics and prebiotics, improves the quality of broiler chicken meat and extends its shelf life and improves freshness indicators [15].

Implementation of risk-oriented control of food market operators for the production and circulation of broiler chicken meat by veterinary medicine specialists requires effective and reliable methods of controlling its safety and quality [16].

The scientific originality of this study lies in the development of a bacterioscopic method for determining the freshness of meat of broiler chickens using the Gram staining method in Hooker's modification and counting the number of microorganisms in 10 fields of view, which ensured the reliability of the indicators in the tests, reduced the cost of reagents and reduced the time spent on tests for one sample. Currently, the development of new optimised methods in the system of laboratory control of the safety and quality of chilled broiler chicken meat is important and relevant for veterinary medicine inspectors using simple tests.

*The purpose of this study* was to develop, test and approbate a method for bacterioscopic assessment of the freshness of meat from chilled broiler chicken carcasses to identify the number of microorganisms.

## Materials and Methods

After slaughter, broiler chickens were cooled in cold storage rooms at a temperature of 0-4 °C for further sale in supermarkets (ATB chain) and agri-food markets (city of Bila Tserkva) of the Kyiv Oblast within 5 days according to the current regulatory document DSTU 3143:2013 [17]. The study was conducted on 36 samples of broiler chickens. Later, on the 6-7$^{th}$ and 8$^{th}$ day of sale, spoilage of chilled meat of broiler chickens was determined with obtaining indicators for different degrees of freshness: questionable and stale.

To determine the different degrees of freshness of chilled meat of broiler chickens, generally accepted methods were used: organoleptic examination, determination of the content of volatile fatty acids and the acid number of fat, ammonia, and ammonium salts with Nessler's reagent, reaction with copper sulphate, according to the requirements of DSTU 8253:2015 [18].

During the organoleptic assessment, the appearance of broiler chicken carcasses was determined – the degree of exsanguination, the condition of the surface of the carcasses (surface cleanliness); degree of plumage removal (state of plumage removal); skin condition (clean, dry, unweathered, without scratches, tears, and bruises); the state of the bone system (without fractures and deformations);

the consistency of the chilled meat of broiler chickens (the muscles are dense, elastic, when pressed with a spatula, the pit is quickly levelled); muscle tissue colour (pale pink or with changes); skin colour (pale yellow or with changes); colour of subcutaneous and internal adipose tissue (pale yellow and yellow or with changes); the smell on the surface of the carcass (characteristic of good-quality fresh poultry meat, without extraneous odours or with changes); cooking test (broth with a pleasant smell, transparent, a significant number of fat balls on the surface of the broth, without extraneous odours or with changes).

The content of volatile fatty acids in poultry meat was determined by their separation by distillation and titration with a solution of potassium hydroxide with a mass fraction of 0.1 mol/dm$^3$ and subsequent calculation according to the formula in milligrams of potassium hydroxide per 100 g of meat.

The acid number of fat was determined by dissolving a melted sample of fat with a mixture of diethyl ether and ethyl alcohol with a mass fraction of 96% and titrating free fatty acids with a solution of potassium hydroxide with a mass fraction of 0.1 mol/dm$^3$, and expressing it in cubic centimetres (cm$^3$) of potassium hydroxide, spent on neutralisation of free fatty acids contained in 1 g of fat, and calculated according to the formula in milligrams of potassium hydroxide.

The method for determining ammonia and ammonium salts was based on the ability of ammonia and ammonium salts formed as a result of autolysis of meat to form yellow-brown mercurammonium iodide with Nessler's reagent (10 drops of Nessler's reagent were added to 1 cm$^3$ of aqueous extract from meat, the contents were shaken tubes and observed the colour: greenish-yellow – fresh meat; intense yellow colour – meat of questionable freshness; yellowish-orange – stale meat).

According to the reaction with copper sulphate, 60 cm$^3$ of distilled water was added to 20 g of minced meat in the broth to determine the products of the primary breakdown of proteins. The contents were mixed, covered with glass, and put in a boiling water bath for 10 minutes. The broth was then filtered through a layer of cotton wool. If the broth is cloudy and after filtering, protein flakes remain in it, then the broth was additionally filtered through filter paper. 2 cm$^3$ of filtrate and 3 drops of 5% copper sulphate solution were poured into the test tube. The test tube was shaken three times. The reaction was read after 5 min. The meat is fresh – the broth remains transparent; of questionable freshness – slight cloudiness of the broth; stale – significant turbidity of the broth, the formation of flakes in it or the loss of a jelly-like clot.

The developed bacterioscopic method of determining the insemination of poultry meat by microorganisms and determining the freshness of chilled broiler chicken carcasses was based on the change in the number of smears-imprints from poultry meat, their Gram staining in the Hooker's modification [19], as well as the change in the number of fields of view of the microscope under time of counting microorganisms. Ukrainian utility model patent 147996 was obtained for this technique.

Based on the results of own research, a bacterioscopic method for establishing the insemination of poultry meat with microorganisms and determining the degree of freshness of chilled meat of broiler chickens was developed, which is based on determining the number of microorganisms by counting in smears-imprints from meat samples and their Gram staining in the Hooker's modification.

According to the bacterioscopic method of establishing the insemination of poultry meat by microorganisms and determining the degree of its freshness, a piece of poultry meat with an area of 2.0 x 2.1 cm$^2$ was used, cut to a depth of 1.0-1.5 cm with a sterile scalpel or scissors, and which was applied the cut surface to the surface of a sterile slide to obtain 1 smear-imprint. Later, this smear-imprint was fixed over the flame of an alcohol still, by passing it three times through the flame for no more than 1-2 seconds, and was stained by Gram in Hooker's modification, and a microscopic study was carried out using immersion oil with a magnification of x90 and an eyepiece – with x10 magnification to count the number of microorganisms in 10 fields of view of the microscope. Next, the average value per field of view of the microscope was calculated, as well as the shape of the cells (cocci, micrococci, rod-shaped bacteria), sporulation was determined, and the emergence of the corresponding Gram colouring was observed (gram-positive microorganisms acquire a purple colour, gram-negative – red), which allows determining the degree of freshness of poultry meat.

An essence of this method is the staining of a smear-imprint according to Gram in Hooker's modification. The following steps can be described:

– application of a strip of filter paper, then a few drops of Hooker's basic staining solution to the paper for 0.5-1.0 min so that the filter paper is completely wet;

– washing with a jet of distilled water the slide with the painted smear-imprint from the meat;

– application of Burke's iodine solution for 0.5-1.0 min.

– washing the smear-print with ethyl alcohol with a mass fraction of 96%, then immersing the slide in a chemical beaker with a capacity of 100 cm$^3$ with ethyl alcohol with a mass fraction of 96% for 0.5-1.0 min;

– washing with distilled water a smear-imprint from meat;

– application of an alcoholic solution of fuchsin with a mass fraction of 0.5% for 2-3 min on a washed smear-imprint from meat and washing with distilled water and drying with filter paper.

The reliability of the obtained research results is confirmed using certified equipment, modern test methods, and the use of statistical processing. Variational and statistical processing of the results was carried out using computer software packages "Microsoft Excel", "Maple-12" (Maplesoft, 2008). The probability of the obtained results was determined by Student's test considering the significance criteria: $P<0.05$; $P<0.01$, $P<0.001$.

## Results and Discussion

Research has established that the organoleptic indicators of fresh chilled carcasses of broiler chickens at 0-4 °C for 5 days for sale in agri-food markets and supermarkets were as follows: the carcasses were well bled, their surface was clean, dry, without damage and haemorrhages, specific smell, the muscles were well bled, dense, elastic, the pit was quickly levelled when pressed with a spatula; the plumage was completely removed from the carcasses; bone system

without fractures and deformations; the colour of muscle tissue was pale pink; skin colour – pale yellow; the colour of the subcutaneous adipose tissue was light yellow, the internal adipose tissue was white; the smell on the surface of the carcass was characteristic of good-quality poultry meat, without extraneous odours; the broth had a pleasant smell, was transparent, on the surface of the broth there were many fat balls, without extraneous odours.

At the same time, it was established that the organoleptic indicators of questionable freshness of chilled carcasses of broiler chickens at 0-4 °C on the 6th-7th day of sale in agri-food markets and supermarkets were as follows: bleeding of the carcass was satisfactory, a slight sliminess of the surface of the carcasses and a sour smell on the surface of the carcasses were observed; the consistency of the muscles was less elastic – the pit slowly flattened out when pressed with a spatula, the colour of the meat was pinkish-grey; the colour of the subcutaneous and internal adipose tissue was pale yellow with a grey tint, with a slight sour smell; the broth had an unpleasant smell, with an extraneous sour smell, cloudy, a few fat balls on the surface of the broth.

Therewith, it was established that the organoleptic indicators of stale chilled carcasses of broiler chickens at 0-4 °C on the 8th day of sale in agri-food markets and supermarkets were as follows: the carcasses were poorly bled, their surface was slimy, and there was an acidic unpleasant smell on the surface carcass; the consistency of the muscles was not elastic – the pit did not align when pressed with a spatula, the colour of the meat was greyish; the colour of the subcutaneous and internal adipose tissue was yellow-grey with a smell of oxidation; the broth had an unpleasant smell, with an extraneous musty smell, was cloudy, no fat balls were found on the surface of the broth.

The prototype of the developed bacterioscopic method for determining the insemination of poultry meat with microorganisms and determining the freshness of meat of broiler chickens is a method of determining the freshness of meat of slaughter animals (beef, pork, lamb, goat) by the bacterioscopic method [20], which is based on determining the number of microorganisms and the degree of breakdown of muscle tissue by Gram staining and subsequent microscopic examination in 25 fields of view in three smears-prints on two slides. The disadvantage of this method is that it is cumbersome and gives an error of 10-15%.

A comparative evaluation of the test results of the above-mentioned methods of determining the freshness of poultry meat by the bacterioscopic method of establishing the insemination of chilled poultry meat with microorganisms and determining its freshness to the prototype are presented in Table 1.

**Table 1**. Comparison of the indicators of the prototype and the invention of determining the freshness of broiler chicken meat using the developed bacterioscopic method

| Indicator for comparison | Conventional method | Newly created method |
|---|---|---|
| Method components:<br>Meat cutting depth, cm:<br>Area of a piece of meat, $cm^2$<br>Number of smears-prints from meat | <br>1.0-1.5<br>2.0x2.5<br>6 | <br>1.0-1.5<br>2.0x2.1<br>1 |
| Time for fixing smears-prints from meat, s | 2-3 | 1-2 |
| The method of staining smears-imprints of meat | According to Gram | According to Gram in the Hooker's modification |
| Exposure of staining, min | 10.0-11.0 | 4.0-5.0 |
| Microscopy of smears-impressions using immersion oil | $90^x$ magnification; eyepiece with $10^x$ magnification | $90^x$ magnification; eyepiece with $10^x$ magnification |
| Number of visual fields studied | 25 | 10 |
| Experiment detection rate, min | 50-60 | 20-22 |
| Stability of indicators for determining the number of microorganisms in broiler chicken meat, % | 80.2 | 99.9 |
| % Ratio of research results to indicators of the content of volatile fatty acids in the meat of broiler chickens | 81.5-85.3 | 98.5-99.6 |
| % Ratio of research results to quantitative indicators of the acid number of fat of broiler chickens | 80.5-83.1 | 99.2-99.7 |

The data in Table 1 suggests that the developed bacterioscopic method of establishing the insemination of poultry meat with microorganisms and determining the freshness of chilled meat of broiler chickens has the statistical significance of 99.9%. The results of determining the freshness of broiler chicken meat according to the developed method and generally accepted methods are presented in Table 2.

**Table 2**. Safety and quality indicators of chilled broiler chicken meat at sales facilities using the developed bacterioscopic method and generally accepted methods, M ± m, n = 36

| Indicator | Quality of broiler chicken meat | | | | | |
|---|---|---|---|---|---|---|
| | On day 5 at 0-4 °C | | On days 6-7 at 0-4 °C | | On day 8 at 0-4 °C | |
| | Fresh broiler chicken meat, n = 12 | | Broiler chicken meat of questionable freshness, n = 12 | | Stale broiler chicken meat, n = 12 | |
| | Pectoral muscles | Muscles thighs | Pectoral muscles | Thigh muscles | Pectoral muscles | Thigh muscles |
| Number of microorganisms by meat microscopy per 1 average field of view | 5 ± 1 | 7 ± 1 | 17 ± 2*** | 23 ± 2*** | 45 ± 3*** | 52 ± 5*** |
| Determination of ammonia and ammonium salts with Nessler's reagent | The extract from the meat is greenish yellow in colour, transparent | | Meat extract of intense yellow colour, considerable turbidity with the formation of a thin layer of sediment | | Meat extract is yellow-orange, rapid formation of large flakes falling into the sediment | |
| Content of volatile fatty acids, mg KOH | 2.61 ± 0.24 | 2.70 ± 0.22 | 6.62 ± 0.43*** | 6.70 ± 0.34*** | 11.05 ± 0.37*** | 10.97 ± 0.32*** |
| Acid number of broiler chicken fat, mg NaOH | 0.72 ± 0.04 | | 1.76 ± 0.12*** | | 2.83 ± 0.07*** | |
| Reaction with copper sulphate (determination of the products of the primary breakdown of proteins in the broth) | Meat broth is transparent, blue green in colour | | Meat broth is transparent, blue with a slight turbidity | | Meat broth has considerable turbidity, the formation of flakes or the loss of a jelly-like clot, blue in colour | |

**Note:** *** – *P<0.001, compared to fresh meat indicators*

It was established that the content of microorganisms in the chilled meat of broiler chickens (breast muscles and thigh muscles) with questionable freshness was, respectively, 3.4 and 3.3 times higher (P<0.001) and in stale meat, respectively, 9.0 and 7.4 times higher (P<0.001), compared to the indicators of fresh meat. Single cocci were mainly detected in fresh meat, muscle tissue decay was not detected; in meat of questionable freshness – cocci, diplococci, a small amount of gram-positive and gram-negative rod-shaped microorganisms, slight decay of muscle tissue; in stale meat, rod-shaped gram-positive microorganisms predominated, isolated cocci were found in some places, significant decay of muscle tissue.

The content of volatile fatty acids in the chilled meat of broiler chickens of questionable freshness (breast muscles and thigh muscles) was 2.5 times higher (P<0.001), compared to the parameters of fresh meat. At the same time, in stale chilled meat, the content of volatile fatty acids in pectoral muscles and thigh muscles, respectively, was 4.2 times (P<0.001) and 4.1 times higher (P<0.001) compared to fresh meat.

The acid number of fat in chilled meat of questionable freshness was 2.4 times higher (P<0.001), compared to the indicators of the acid number of fat in fresh meat; in stale chilled meat, the acid number of fat was 3.9 times higher (P<0.001), compared to the indicators of the acid number of fat in fresh meat.

The results of qualitative reactions for determining the content of ammonia and ammonium salts with Nessler's reagent and determining the products of primary breakdown of proteins in the broth using copper sulphate were corrected with indicators for determining fresh, questionable freshness and stale meat of broiler chickens.

The developed method of bacterioscopic study of insemination of poultry meat with microorganisms is easy to perform, and based on quantitative results, reliable indicators can be obtained for establishing the degree of freshness of chilled meat of broiler chickens by counting the number of microorganisms in one smear-imprint from the deep layers of poultry meat and in 10 fields of view of the microscope, and establishing the breakdown of muscle tissue. The proposed quantitative bacterioscopic method for establishing the insemination of poultry meat with microorganisms can be used in the control system for determining the safety and quality of broiler chicken meat in production laboratories at meat and meat processing facilities, wholesale bases during storage, in supermarkets, in state laboratories of the State Production and Consumer Service of Ukraine and in state laboratories of veterinary and sanitary examination in agri-food markets. This method is proposed for establishing the freshness of chilled meat of broiler chickens along with the generally accepted methods of laboratory testing of meat – qualitative reactions for the detection of ammonia and ammonium salts and the determination of the products of the primary breakdown of proteins in the broth using copper sulphate, the content of volatile fatty acids, the establishment of acid number of fat of broiler chickens and organoleptic indicators.

The study was carried out to identify the freshness of broiler chicken meat at sales facilities: agri-food markets and supermarkets. The results are presented in Table 3.

**Table 3**. Microclimate indicators in poultry rearing shops, M ± m, n = 5

| Total samples of broiler chicken meat | Quality of broiler chicken meat | | | | | |
|---|---|---|---|---|---|---|
| | Fresh broiler chicken meat | | Broiler chicken meat of questionable freshness | | Stale broiler chicken meat | |
| | Amount samples | % | Amount samples | % | Amount samples | % |
| | *Agri-food markets* | | | | | |
| n = 53 | 42 | 79.3 | 9 | 17.0 | 2 | 3.8 |
| | *Supermarkets* | | | | | |
| n = 56 | 42 | 75.0 | 11 | 19.6 | 3 | 5.4 |

According to the data in Table 3, the highest percentage of fresh meat of broiler chickens according to generally accepted methods and the developed bacterioscopic method of establishing the insemination of poultry meat with microorganisms was 79.3% for the sale of products in agri-food markets and 75.0% in supermarkets; of questionable freshness, respectively – 17.0% and 19.6%. And the lowest percentage of stale meat of broiler chickens was found during sale in agricultural food markets – 3.8% and in supermarkets – 5.4%.

This bacterioscopic method of establishing the insemination of poultry meat with microorganisms to determine the freshness of chilled meat of broiler chickens has been tested and implemented at the facilities for its production and circulation and is recommended for implementation by state veterinary medicine specialists during the implementation of the state risk-oriented safety and quality control system chilled meat of broiler chickens.

The author's patented bacterioscopic method for establishing the insemination of poultry meat with microorganisms is simple to perform, and its results provide particular quantitative indicators for determining the freshness of chilled meat of broiler chickens for 5, 6-7, and 8 days at 0-4 °C with calculation of the number of microorganisms and the degree of breakdown of muscle tissue: fresh meat – up to 10 microorganisms, no breakdown of muscle tissue is observed; meat of questionable freshness – 11-30 microorganisms, traces of decay of muscle tissue; stale meat – more than 30 microorganisms (rod-shaped gram-positive ones prevailed), considerable breakdown of muscle tissue. To facilitate the work of veterinary medicine specialists, it is necessary to apply simple laboratory tests (organoleptic, chemical, physical) to establish the freshness of meat of broiler chickens during storage and sale when it is cooled under different temperature regimes and terms [21]. In the system of risk-based control of the storage of chilled meat of broiler chickens, research should be directed towards the identification of dangerous food products, which can lead to the development of food poisoning in consumers [22]. For the cooling of broiler chicken carcasses, it is necessary to assess the control of pathogens of food infections, namely *Campylobacter spp.,* in which their number will subsequently decrease under the control of compliance with the cold chain, which will enable the facilities for the production and circulation of poultry meat to comply with the hygiene criteria of the technological process and reduction of meat contamination of broiler chickens [23].

Furthermore, scientists have developed an optimised 99.8% statistically significant method for determining the contamination of fresh, questionable freshness and stale poultry meat with microorganisms by counting the number of microorganisms by preparing two smears-imprints and staining them according to Gram in Hooker's modification and counting the number of microorganisms in 15 fields of view [24].

Due to non-compliance with the temperature regimes of meat cooling of broiler chickens, fat in which aldehydes and peroxides accumulate is primarily subject to spoilage, and therefore it is necessary to control the quality of poultry fat [25]. And in the results of this study, the acid number of fat corresponded to fresh, questionable, and stale meat of broiler chickens. In their studies, scientists demonstrate the positive effect of chlorine-containing oxide on the quality of meat of broiler chickens by cooling the carcasses of broiler chickens at 4 °C on the 4$^{th}$ and 7$^{th}$ day of sale due to the reduction of the contamination of the meat with microorganisms [26]. Deterioration of meat due to non-compliance with temperature regimes is one of the microbiological risks that must be promptly detected and prevented to provide consumers with high-quality and safe meat products [27].

In general, the policy of the Ukrainian national strategy is aimed at implementing control from the farm to the table by introducing new methods in the system of laboratory control of fresh meat and meat products, applying compliance with sanitary and hygienic requirements at the facilities for their production and circulation [28].

## Conclusions

The developed bacterioscopic method of detecting contamination of poultry meat with microorganisms can be used in the laboratory control system to establish the freshness of chilled meat of broiler chickens during production, storage, and sale. This method has 99.9% confidence. At the same time, more reliable data – 98.5-99.6% were obtained according to the results of studies of indicators of the content of volatile fatty acids, and 99.2-99.7% – according to the results of studies of indicators of the acid number of fat of broiler chickens.

According to the developed bacterioscopic method and several generally accepted methods, on the 5$^{th}$, 6$^{th}$, 7$^{th}$, and 8$^{th}$ day, the conformity of the chilled meat of broiler chickens to different degrees of freshness was established: fresh, questionable freshness, and stale. At the same time, the indicators of the number of microorganisms, the

content of volatile fatty acids in the meat of broiler chickens and the acid number of fat of questionable freshness and staleness had a high degree of probability (P<0.001) compared to the indicators of fresh meat and fat of broiler chickens.

At meat sales facilities: agri-food markets and supermarkets, the largest percentage is fresh meat from broiler chickens, respectively – 79.3% and 75.0%; of questionable freshness, respectively – 17.0% and 19.6%; the lowest percentage is stale meat of broiler chickens, respectively – 3.8% and 5.4%.

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## Контроль охолодженого м'яса курчат-бройлерів за бактеріоскопічним методом

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**Анотація**. Актуальність дослідження зумовлена забезпеченням належного ризик-орієнтованого контролю за безпечністю та якістю охолодженого м'яса курчат-бройлерів на потужностях з його виробництва, де має бути впроваджена система аналізу небезпек і контролю у критичних точках. У зв'язку з цим дана стаття спрямована на розкриття питання контролю охолодженого м'яса курчат-бройлерів за проведення досліджень на встановлення свіжості м'яса курчат-бройлерів на потужностях з реалізації – агропродовольчих ринках і супермаркетах. Провідним підходом до дослідження цієї проблеми є розроблений запатентований бактеріоскопічний метод, що дозволяє комплексно виявити свіжість охолодженого м'яса курчат-бройлерів. Представлений метод є простим у виконанні, з отриманням кількісних показників щодо встановлення свіжості охолодженого м'яса курчат-бройлерів на 5 добу, 6–7 і 8 добу за температури 0–4 °С, а також зі встановленням кількості мікроорганізмів в полі зору мікроскопа і ступенем розпаду м'язової тканини, шляхом фарбування одного мазка-відбитка за Грамом у модифікації Хукера, та підрахунком кількості мікроорганізмів в 10 полях зору з подальшим виведенням середнього значення на одне поле зору, а також визначення форми клітин. Достовірність результатів у випробуваннях за даним методом складає 99,9 %. Встановлено, що найвищий вміст мікроорганізмів становив у несвіжих охолоджених тушок курчат-бройлерів на 8 добу: у грудних м'язах – 45 ± 3 ($P<0,001$), у м'язах стегна – 52 ± 5 ($P<0,001$) порівняно з показниками свіжого м'яса. В несвіжому м'ясі – переважали паличкоподібні грам-позитивні мікроорганізми, подекуди фіксували поодинокі коки, значний розпад м'язової тканини. Уміст летких жирних кислот в охолодженому м'ясі курчат-бройлерів і кислотне число жиру достовірно ($P<0,001$) зростали на 8 добу реалізації за температури 0–4 °С, відповідно – 11,05 ± 0,37 – 10,97 ± 0,33 і 2,83 ± 0,33 мг NaOH. За проведення обстеження свіжості м'яса тушок курчат-бройлерів найбільший відсоток свіжого м'яса курчат-бройлерів становив за його реалізації на агропродовольчих ринках – 79,3 %, у супермаркетах – 75,0 %, несвіжого, відповідно – 3,8 і 5,4 %. Матеріали статті становлять практичну цінність для роботи державних інспекторів ветеринарної медицини під час використання бактеріоскопічного методу щодо встановлення свіжості охолодженого м'яса курчат-бройлерів

**Ключові слова**: кількість мікроорганізмів, органолептична оцінка, грудні м'язи, м'язи стегна, свіжість м'яса