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EVALUATION OF THE SAFETY AND QUALITY OF POULTRY CARCASSES FOR CONTAMINATION *BY CAMPYLOBACTER SPP.*

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Effective poultry meat quality control is based on forecasting, identification of dangerous factors and risk management. The article presents experimental studies indicators of safety and quality of poultry meat due to contamination Campylobacter spp. The level has been studied bacterial insemination of meat. Defined microbiological indicators of the safety of poultry meat of different conditions: boneless pieces, pieces with bones and mechanical deboning. Low-quality and dangerous products were identified according to microbiological indicators, which accounted for 27.45% of the total number of samples examined. The dominant number of positive results of microbiological studies of product samples according to the indicators of KMAFAnM and bacterias of the E. coli group were registered when selling mechanically deboned meat in a chilled state. In the vast majority of cases, bacteria were isolated from poultry carcasses in association. During the investigation of the quality of poultry meat, 27.45% of samples of low-quality and dangerous products according to microbiological indicators were found. Based on the results of identification of 29 isolates family Enterobacteriaceae: Salmonella – 31.0%, E.coli – 20.7%, Listeria – 20.7%,P. aeruginosa– 13.8%, C. jejuni and C. coli – 13.8% and 6.9%, respectively, P. vulgaris – 81 (96.4%). The isolates had a high and medium degree of pathogenicity: Salmonella – 22.2%, E.coli – 33.6%, Listeria – 66.6%, C. jejuni – 100%. Meat samples were studied had signs of poor quality according to organoleptic indicators. The surface of carcasses is wet, yellowish-gray in color; subcutaneous and internal adipose tissue is pale yellow; the serous membrane of the thoraco-abdominal cavity is wet, hemorrhages were recorded on the serous covers; skeletal muscles are pale, the cut surface is dry, the pattern is unclear, there are small hemorrhages in the thickness of the muscles. The muscles are flabby, the dimple that forms when pressed with a finger slowly flattens out, the smell of the muscles is specific. Contaminated meats by Camylobacter spp. had unsatisfactory quality indicators: tasting evaluation of meat products and broth has a satisfactory degree of quality of the evaluated indicators: 3.0±0.2 – 3.8±0.1 and 2.5±0.3–3.5 ±0.3 points, degree of quality estimated indicators, respectively; pH 6.9 – 7.0, reactions to ammonia and ammonium salts with Nessler's reagent and peroxidase – negative, the peroxide value of fat is 0.007 ± 0.002% of iodine.

Key words: *poultry meat, quality, safety, contamination, microorganisms.*

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Introduction. In economic aspects in the world, namely the shortage of food products on the world market, the production of high-quality, safe and ecologically clean poultry products is an urgent issue. The production of high-quality food raw materials for industry has become the most important task of the agricultural sector. Food products of animal origin must comply with international quality and safety standards, be free from residues of toxic substances, pathogenic and opportunistic microorganisms (EFSA, 2021; EFSA, 2022; Nauta et al., 2022; Danek-Majewska et al., 2022; Berrang et al., 2020). According to international and national requirements for poultry meat, microbiological indicators are the main criterion of safety for human consumption. International requirements and regulatory documents establish measures for monitoring, risk assessment, and establishing critical limits regarding the contamination of unprocessed raw materials by pathogens of zoonoses (microorganisms of the family *Enterobacteriaceae)*. These norms are implemented throughmonitoring of zoonotic pathogens among broiler and poultry carcasses. Control measures for the prevention of food pathogens as a potential etiological factor of food poisoning for humans should include all stages of food circulation: production, processing, storage and sale of poultry meat. The control strategy for campylobacter infection is implemented according to the "farm to fork" principle. The main aspects that are potentially dangerous for the spread of campylobacter infection are the contamination of poultry carcasses at the stage of processing and the hygiene of poultry meat preparation (Klaharn et al., 2022; Emanowicz et al., 2021; Tang et al., 2020; Pacholewicz et al., 2016; Ellis-Iversen et al., 2020).

Control is implemented through the examination of batches of slaughter poultry and broiler carcasses at the stage of poultry processing. The critical point of control of microorganisms of the genus *Enterobacteriaceae* there is poultry meat compliance with sanitary and hygienic requirements during poultry processing (feeding and cooling). Muscles and slaughter products of healthy slaughter birds must be free

from pathogenic and opportunistic microflora. During poultry slaughter and gutting of carcasses, there are high risks of contamination of poultry meat with bacteria, which is the main aspect of safety and the possibility of human consumption (Śliżewska et al., 2020; Dourou et al., 2021; Burfoot et al., 2016; Stromberg et al., 2017; Ellis-Iversen et al., 2020).

The purpose of research – determine indicators of microbiological safety of poultry carcasses and quality indicators of poultry meat in case of contamination *Campylobacter spp.*

Research materials and methods. Veterinary-sanitary examination of poultry meat was carried out in accordance with the "Rules of veterinary examination and veterinary-sanitary examination of meat and meat products", 2002. To study the insemination of chicken carcasses, washings were taken from the surface of the carcasses (from the back area), from the middle of the carcasses (from the abdominal wall and serous membranes) and from the thickness of the muscle tissue in the thigh area. Determination of meat safety indicators was carried out based on indicators of microbiological contamination, and quality – on the basis of organoleptic evaluation and physicochemical studies of poultry meat samples. Bacteriological studies were carried out according to generally accepted methods. Bacteriological studies on the reisolation of *Campylobacter spp.* conducted according to ISO 10272-1:2007 Microbiology of food products and animal feed. Horizontal method of detection and counting of campylobacter (*Campylobacter spp*.). Part 1. Detection method (ISO 10272-1:2006, IDT). Accounting indicators of poultry carcasses were determined by indicators: carcass categorization, meat yield, yield of edible and inedible parts. Organoleptic research and tasting evaluation of meat and broth from broiler meat were carried out according to generally accepted methods.

The results of the conducted research were processed statistically according to the Student's method, taking into account the arithmetic mean values and their statistical errors, as well as determining the reliable difference of the indicators that were compared.

Results. Poultry carcasses were subjected to the study after the full process of butchering. The results of studies of microbiological contamination of poultry carcasses are presented in tabl. 1.

From meat samples of poultry carcasses, 29 isolates were isolated, which were attributed to *Salmonella* – 9 (31.0%), *E.coli* – 15 (20.7%), *Listeria* – 6 (20.7%), *P. aeruginosa*– 4 cultures, *C. jejuni* – 4 (13.8%), *C. coli* – 2 6.9% and *P. vulgaris* – (96.4%).Microbiological indicators of the safety of poultry meat of different thermal conditions were also studied: 105 samples of boneless poultry meat, 73 samples of bone-in poultry meat, including legs, and 128 samples of mechanically deboned poultry meat. In the vast majority of cases, bacteria were isolated from poultry carcasses in association, which created certain difficulties in the identification of isolates. In the vast majority of cases, violations of the microbiological criteria for the safety of mechanically deboned poultry meat were detected. It should be noted that the chicken in a chilled state was mostly contaminated with mesophilic aerobic and facultatively anaerobic microorganisms. Such raw materials had no signs of poor quality according to organoleptic indicators. It was also established that the greatest degree of contamination by microorganisms was found in chilled products. The results of studying the pathogenicity of isolated isolates from chicken carcasses are presented in tabl. 2.

Among the isolates there are microorganisms with a high and medium degree of pathogenicity.

We also conducted chemical studies of poultry meat samples contaminated with bacterial microflora

Table 1

Bacterial contamination poultry carcasses

Category		Season				
		summer	autumn	winter	spring	Amount, %
carcasses without pathological changes	the carcass was examined	8	14	15	12	5.0
	the number of carcasses from which pathogens were isolated	2	3	1	3	
	%	4.0	8.0	-	8.0	
poultry carcasses with leukemia	the carcass was examined	4	3	3	4	6.0
	the number of carcasses from which pathogens were isolated	2	1	1	2	
	%	8.0	4.0	4.0	8.0	
poultry carcasses with cirrhosis of the liver	the carcass was examined	6	5	4	5	9.0
	the number of carcasses from which pathogens were isolated	2	2	3	2	
	%	8.0	8.0	12.0	8.0	
poultry carcasses with peritonitis	the carcass was examined	6	4	4	5	9.0
	the number of carcasses from which pathogens were isolated	3	1	3	2	
	%	12.0	4.0	12.0	8.0	
all contaminated	the number of carcasses	8	6	7	8	29.0
	%	32.0	24.0	18.0	32.0	

Campylobacter spp. (experiment). As a control, meat was used in the absence of insemination with opportunistic and pathogenic microflora (Tabl. 3).

During the study of the quality and safety of poultry meat samples, samples of low-quality and dangerous products according to microbiological indicators were found, which amounted to 27.45% of the total number of samples examined. The dominant number of positive results of microbiological studies of product samples according to the indicators of the number of mesophilic aerobic and facultatively anaerobic microorganisms (NMAFAnM) and bacterias of the E. coli group were registered when selling mechanically deboned meat in a chilled state. The main reasons causing the emergence of dangerous biological factors in poultry meat are: the presence of unacceptable levels of biological pollutants in raw materials of animal origin, prerequisites for the development of microorganisms above permissible levels; re-contamination of raw materials by microorganisms during technological processes of processing.

Poultry carcasses and organs were subjected to veterinary and sanitary inspection. According to the results of organoleptic assessment of poultry carcasses for campylobacter contamination, it was established that the surface of the carcasses is wet, yellowish-gray in color with a bluish tint; subcutaneous and internal adipose tissue is pale yellow; serous membrane of the thoraco-abdominal cavity – moist, shiny hemorrhages on the serous covers; skeletal muscles are pale, the cut surface is dry, the pattern is unclear, there are small hemorrhages in the thickness of the muscles. The muscles are flabby, the dimple that forms when pressed with a finger slowly flattens out, the smell of the muscles is specific. Tasting evaluation of meat products and broth was carried out according to a 5-point system, evaluating each of the indicators on a scale of degrees of quality, expressed in points (table 4).

According to the results of the tasting of contaminated Campylobacter spp. of meat products was evaluated according to the average arithmetic value of evaluations from 2.7±0.2 to 3.9±0.2, which corresponds to a satisfactory degree of quality of the evaluated indicators. It should be noted that the lowest number of points was established when evaluating the smell and aroma: 2.7–2.8 points. Broth from contaminated poultry meat was opaque, with a small amount of flakes, characterized by a pronounced unpleasant aroma, fat drops on the surface of the broth are mostly small, their number is insignificant.The results of the evaluation of the broth according to the average arithmetic value of the evaluations were from2.5±0.2 to 3.5±0.2. In the absence of bacterial contamination mAccording to the organoleptic indicators and the results of the tasting evaluation, poultry meat and broth had few signs characteristic of fresh and good-quality meat. The results of the tasting are evaluated by comparison with quality indicators according to regulatory documents for this type of products. According to the results of the chemical analysis of the meat of the oral groups, the following were established: pH 6.8–7.0; in the reaction to ammonia and ammonium salts with Nesler's reagentthe hood acquired an intense yellow color, sometimes with an orange tint, cloudiness of the environment was observed;the reaction to peroxidase is negative (extract from poultry meat of the experimental group did not acquire a specific blue-green color); the amount of volatile fatty acids in the range from 3.5 to 3.9 mg of KOH; acid strength of fat – 0.78 ± 0.2 – 0.86 ± 0.3 1 KOH; the peroxide value of fat is from 0.007 ± 0.002% of iodine. When studying the chemical indicators of poultry meat for contamination of the control group, according to similar indicators, the results were obtained that corresponded to the norms of fresh and good-quality meat. On the basis of microscopic analysis of poultry meat, signs were revealed destruction muscle tissue, single rods and cocci were recorded in the field of vision. According to the results of the chemical analysis of the contaminated *Camylobacter spp.* meat (experiment) was established: pH 6.84 – 7.0; in the reaction to ammonia and ammonium salts with Nesler's

Table 2

Pathogenicity of cultures of microorganisms isolated from poultry carcasses

Cultures of microorganisms	Degree of pathogenicity							
	high		average		weak		absent	
	n	%	n	%	n	%	n	%
Salmonella	2	22.2	2	22.2	3	33.3	2	22.2
E. coli	5	33.3	7	46.6	2	13.3	1	6.6
L. monocytogenes	4	66.6	2	33.3	-	-	-	-
C. jejuni	–	100	2	50	2	50	–	–
C. coli	3	–	1	-	-	-	-	-
P. vulgaris	-	-	-	-	75	92.59	6	7.4

Table 3

Chemical and sanitary properties of poultry meat of the control and experimental groups, M±m, n = 5

Indexes	Groups	
	control	experiment
smear microscopy (number of microorganisms in one field of view)	Single microorganisms	up to 30 microorganisms in the field of vision
pH	5.74±0.3	6.89±0.1
reaction with CuSO4	–	±
peroxidase reaction	+	–
reaction to ammonia	–	–
formal reaction	–	–

Note:"–" – negative reaction, "+" – positive reaction; "±" is a doubtful reaction.

Table 4

Organoleptic evaluation of the quality of poultry meat and broth on a five-point scale (M±m, n=27)

Indexes	Group		
	contaminated carcasses *C. jejuni*	contaminated carcasses *C. coli*	there is no bacterial contamination
Arithmetic mean value of tasting evaluation of meat products, points			
appearance	3.7±0.2	3.6±0.3	5.0
color	3.8±0.1	3.8±0.2	5.0
scent	3.0±0.2	3.0±0.1	4.9±0.1
aroma	3.0±0.3	3.0±0.2	4.9±0.1
tenderness	3.2±0.2	3.3±0.2	4.8±0.1
taste	3.3±0.1	3.2±0.1	5.0
succulence	3.0±0.2	3.1±0.1	4.9±0.1
Arithmetic mean value of the tasting evaluation of the quality of meat broth, points			
strength	3.3±0.2	3.1±0.3	4.9±0.1
color	3.6±0.1	3.1±0.2	5.0
scent	2.7±0.3	2.8±0.1	5.0
aroma	2.8±0.2	2.5±0.3	4.9±0.1
opportunism	3.5±0.2	3.5±0.1	4.8±0.1
taste	3.2±0.1	3.0±0.2	5.0
transparency	2.5±0.2	2.6±0.1	4.9±0.1

Note: degrees of quality expressed in points: 5 – excellent quality; 4 – good quality; 3 – satisfactory quality; 2 – poor quality; – unsatisfactory quality; p ≤ 0.5

Table 5

The results of veterinary and sanitary studies of poultry meat under the conditions of insemination of *Camylobacter spp.* (M±m), n=27

Indexes	Experiment		CONTROL	
	white muscles	red muscles	white muscles	red muscles
pH	6.95±1.12	6.84±2.13	5.87±1.27	6.19±1.58
peroxidase reaction	negative	negative	positive	positive
reaction to ammonia and ammonium salts with Nesler's reagent	negative	negative	positive	positive
amount of volatile fatty acids, mg KOH	8.93±2.05	9.21±1.23	4.28±1.03	3.92±0.61
fatty acids, mg KOH	3.17±0.09		1.83±0.05	
fat peroxide value, %	0.623±0.04		0.322±0.03	
smears-imprints of muscles	more than 30 cocci and rods are present in the field of vision		there is no microflora in the field of view	
KMAFAnM, CFU / 1 g	0.9×104	1.1×104	3.5×102	3.7×102
pathogenic microorganisms	*C. jejuni*	*C. jejuni*	not highlighted	not highlighted

Note: p≤ 0.05

reagentthe hood acquired an intense yellow color, sometimes with an orange tint, cloudiness of the environment was observed; the reaction to peroxidase is negative (extract from poultry meat of the experimental group did not acquire a specific blue-green color); the amount of volatile fatty acids in the range from 8.93 to 9.21 mg of KOH; acid content of fat – 3.17±0.09 mg KOH; the peroxide value of fat is from 0.583 ± 0.663% of iodine (Tabl. 5).

In the study of physico-chemical parameters of poultry meat in the absence of bacterial contamination (control) according to similar parameters, results were obtained that corresponded to the norms of fresh and good-quality meat. Therefore, effective quality control of poultry meat is based on forecasting, identification of dangerous factors and risk management.

Conclusions. When examining the quality of poultry meat, samples of low-quality and dangerous products were found according to microbiological indicators, which accounted for 27.45% of the total number of samples examined, of which, according to NMAFAnM indicators, 84%; and bacterias of the *E. coli* group – 31%; *Salmonella* – 23%; listeria – 20.7%; *P. aeruginosa* and C. jejuni – 13.8%, respectively. Contaminated *Camylobacter spp.* poultry carcasses had unsatisfactory quality indicators: dtasting evaluation of meat products and broth has a satisfactory degree of quality of the evaluated indicators: 3.0±0.2 – 3.8±0.1 and 2.5±0.3–3.5 ±0.3 points, degree of quality estimated indicators, respectively; pH 6.9 – 7.0, reactions to ammonia and ammonium saltswith Nessler's reagent and peroxidase – negative, the peroxide value of fat is 0.007 ± 0.002% of iodine.

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Оцінка безпечності та якості тушок птиці за контамінації Campylobacter spp.

Ефективний контроль якості м'яса птиці базується на прогнозуванні, ідентифікації небезпечних чинників та управлінні ризиками. В статті представлено експериментальних досліджень показників безпеки та якості м'яса птиці за контамінації Campylobacter spp. Досліджено рівень бактеріального обсіменіння м'яса. Визначено мікробіологічні показники безпеки м'яса птиці різного стану: безкісткового кускового, кускового на кістках та механічної обвалки. Визначено неякісної та небезпечної продукції за мікробіологічними показниками, що склало 27,45% від загальної кількості досліджуваних проб. Домінуючу кількість позитивних результатів мікробіологічних досліджень зразків продукції за показниками КМАФАнМ та БГКП реєстрували при реалізації м'яса механічної обвалки в охолодженому стані. В переважній більшості випадків бактерії ізолювалися із тушок птиці в асоціації. При дослідженні якості м'яса птиці виявлено 27,45% зразків неякісної та небезпечної продукції за мікробіологічними показниками. За результатами ідентифікації 29 ізолятів родини Enterobacteriaceae: Salmonella – 31,0%, E.coli – 20,7%, Listeria – 20,7%, P. aeruginosa – 13,8%, C. jejuni та C. coli –13,8% та 6,9%, відповідно, P. vulgaris – 81 (96,4%). Ізоляти мали високий і середній ступінь патогенності: Salmonella – 22,2%, E.coli – 33,6%, Listeria – 66,6%, C. jejuni – 100%. Досліджені проби м'яса мали ознаки недоброякісності за органолептичними показниками. Поверхня тушок волога, жовтувато-сірого кольору; підшкірна і внутрішня жирова тканина блідо-жовтого кольору; серозна оболонка грудо-черевної порожнини – волога, реєстрували геморагії на серозних покривах; скелетні м'язи бліді, поверхня розрізу суха, малюнок нечіткий, в товщі м'язів – дрібні крововиливи. М'язи в'ялі, ямка, що утворюється при натисканні пальцем, вирівнюється повільно, запах м'язів специфічний. Контаміноване Camylobacter spp. м'ясо птиці мали незадовільні показники якості: дегустаційна оцінка м'ясних продуктів та бульйону має задовільний ступінь якості оцінених показників: 3,0±0,2 – 3,8±0,1 та 2,5±0,3–3,5 ±0,3 бали, ступеня якості оцінених показників, відповідно; pH 6,9 – 7,0, реакції на аміак і солі амонію з реактивом Неслера та на пероксидазу – негативні, перекисне число жиру –0,007 ± 0,002 % йоду.

Ключові слова: *м'ясо птиці, якість, безпечність, контамінація, мікроорганізми.*