https://doi.org/10.29326/2304-196X-2024-13-2-171-176

On occurrence of some avian bacterial diseases and biosafety provision

Tamara V. Kurmakaeva[1], Sergey S. Kozak[2], Evgeniya S. Baranovich[3]

[1] Russian Academy of Personnel Support for the Agroindustrial Complex, 15B Orenburgskaya str., Moscow 111622, Russia

[2] "All-Russian Scientific Research Institute of Poultry Processing Industry" – Branch of FSC "All-Russian Research and Technological Poultry Institute" of RAS, building 1, Rzhavki, Solnechnogorsk 141552, Moscow Oblast, Russia

[3] Russian Timiryazev State Agrarian University, 49 Timiryazevskaya str., Moscow 127550, Russia

ABSTRACT

The proportion of infectious diseases in general avian pathology is known to vary significantly, while bacterial infections play a critical role in avian disease occurrence and incidence. Most of them are registered in the country's large-scale poultry holdings, poultry farms and backyards and pose a serious risk in terms of epidemic and veterinary-sanitary aspects. This paper presents the results of analysis of avian colibacillosis and salmonellosis occurrence in 2018–2022, taking into account the number of outbreaks and diseased poultry for each disease. A retrospective analysis showed that these infections are registered annually in poultry farms of the Russian Federation, within a 5-year-period the number of poultry with colibacillosis ranged from 66.18% in 2018 to 0.15% in 2021 of the total number of diseased birds, and the number of *Salmonella*-infected poultry ranged from 65.91% in 2019 to 0.57% in 2021. In 2018–2020 219,020 samples of poultry meat and poultry products were tested for *Salmonella*, while *Salmonella enteritidis, Salmonella typhimurium, Salmonella infantis* were detected in 0.80% cases. It should be noted that in accordance with the requirements of Technical Regulations TR CU 021/2011 and TR EAEU 051/2021, no *Salmonella* is allowed in 25 g of poultry meat. According to the VESTA automated system, during the study period, incompliances with microbiological safety parameters were detected in 16.11% of poultry meat and poultry product samples, of which 10.98% of the samples contained mesophilic aerobic and facultative anaerobic microorganisms, and 5.13% contained *Escherichia coli*. The data obtained indicate the need for a retrospective analysis of the occurrence of some avian bacterial infections in order to study the animal disease situation in poultry farms for the purpose of improving the set of measures to ensure the disease freedom in poultry industry, while addressing the laboratory test results.

Keywords: colibacillosis, salmonellosis, occurrence analysis, poultry meat and poultry products, biosafety parameters

Acknowledgements: The study was carried out in accordance with the research and development plans and within the scope of the topic: Animal disease freedom and biosafety.

For citation: Kurmakaeva T. V., Kozak S. S., Baranovich E. S. On occurrence of some avian bacterial diseases and biosafety provision. *Veterinary Science Today.* 2024; 13 (2): 171–176. https://doi.org/10.29326/2304-196X-2024-13-2-171-176

Conflict of interests: The authors declare no conflict of interests.

For correspondence: Tamara V. Kurmakaeva, Cand. Sci. (Biology), Associate Professor, Professor of the Department of Agrobiotechnology, Russian Academy of Personnel Support for the Agroindustrial Complex, 15B Orenburgskaya str., Moscow 111622, Russia, *e-mail: t.kurmakaeva@rako-apk.ru*

УДК 619:616.98:578:636.5

К вопросу о заболеваемости птицы отдельными бактериальными болезнями и обеспечение биобезопасности

Т. В. Курмакаева[1], С. С. Козак[2], Е. С. Баранович[3]

[1] ФГБОУ ДПО «Российская академия кадрового обеспечения агропромышленного комплекса» (ФГБОУ ДПО РАКО АПК), ул. Оренбургская, 15Б, г. Москва, 111622, Россия

[2] «Всероссийский научно-исследовательский институт птицеперерабатывающей промышленности» – филиал ФГБНУ Федерального научного центра «Всероссийский научно-исследовательский и технологический институт птицеводства» Российской академии наук (ВНИИПП), стр. 1, р. п. Ржавки, г. о. Солнечногорск, 141552, Московская область, Россия

[3] ФГБОУ ВО «Российский государственный аграрный университет – МСХА имени К. А. Тимирязева» (ФГБОУ ВО РГАУ – МСХА имени К. А. Тимирязева), ул. Тимирязевская, 49, г. Москва, 127550, Россия

РЕЗЮМЕ

Известно, что доля инфекционных болезней в общей патологии птицы значительно варьирует, причем в структуре неблагополучия и заболеваемости бактериальные инфекции имеют решающее значение. Большая их часть регистрируется в крупных птицеводческих хозяйствах, на птицефабриках и в личных подсобных хозяйствах нашей страны и представляет серьезную опасность в эпизоотическом и ветеринарно-санитарном отношении. В данной работе представлены результаты анализа заболеваемости птицы колибактериозом и сальмонеллезом за период с 2018 по 2022 г. с учетом количества неблагополучных пунктов и заболевшей птицы по каждой болезни. Ретроспективный анализ показал, что в птицеводческих хозяйствах Российской

Федерации данные бактериозы регистрируются ежегодно, за 5 лет количество заболевшей колибактериозом птицы варьировало от 66,18% в 2018 г. до 0,15% в 2021 г. от общего количества заболевшей птицы, а количество заболевшей сальмонеллезом птицы – от 65,91% в 2019 г. до 0,57% в 2021 г. В 2018–2020 гг. на наличие сальмонелл исследовано 219 020 проб мяса птицы и птицеводческой продукции, из них в 0,80% случаев обнаружены *Salmonella enteritidis*, *Salmonella typhimurium*, *Salmonella infantis.* Следует обратить внимание, что в соответствии с требованиями технических регламентов ТР ТС 021/2011 и ТР ЕАЭС 051/2021 не допускается присутствие сальмонелл в 25 г мяса птицы. По данным автоматизированной системы «Веста», за исследуемый период несоответствия по микробиологическим показателям безопасности выявлены в 16,11% проб мяса птицы и птицепродуктов, из них в 10,98% образцов содержались мезофильные аэробные и факультативно анаэробные микроорганизмы, в 5,13% – бактерии группы кишечной палочки. Полученные данные свидетельствуют о необходимости проведения ретроспективного анализа заболеваемости птицы отдельными бактериальными инфекциями для изучения эпизоотической ситуации в птицеводческих хозяйствах с целью совершенствования комплекса мероприятий по обеспечению ветеринарного благополучия птицеводства, при этом следует обращать внимание на результаты лабораторных исследований.

Ключевые слова: колибактериоз, сальмонеллез, анализ заболеваемости, мясо птицы и птицеводческая продукция, показатели биологической безопасности

Благодарности: Работа выполнена в соответствии с планами НИР и в рамках тематики научно-исследовательских работ «Ветеринарное благополучие и обеспечение биобезопасности».

Для цитирования: Курмакаева Т. В., Козак С. С., Баранович Е. С. К вопросу о заболеваемости птицы отдельными бактериальными болезнями и обеспечение биобезопасности. *Ветеринария сегодня*. 2024; 13 (2): 171–176. https://doi.org/10.29326/2304-196X-2024-13-2-171-176

Конфликт интересов: Авторы заявляют об отсутствии конфликта интересов.

Для корреспонденции: Курмакаева Тамара Владимировна, канд. биол. наук, доцент, профессор кафедры агробиотехнологий ФГБОУ ДПО РАКО АПК, ул. Оренбургская, 15Б, г. Москва, 111622, Россия, *e-mail: t.kurmakaeva@rako-apk.ru*

INTRODUCTION

Commercial poultry farming is known to remain the leading branch of agricultural production, providing the population with valuable dietary food. Despite the fact that veterinary specialists pay special attention to the prevention and control of zooanthroponous avian diseases, as well as ensuring veterinary and sanitary safety of poultry products, infectious diseases are still detected in poultry farms of the Russian Federation. Researchers agree that avian infectious diseases pose a potential risk of mass distribution in the population all over the country's territory and result in decreased weight gains and egg yield, livestock reduction, increased microbial contamination and deterioration of poultry product quality. According to some authors, infectious diseases such as Newcastle disease, avian influenza, Marek's disease, Gumboro disease, avian infectious bronchitis, avian infectious laryngotracheitis, colibacillosis, salmonellosis, pasteurellosis and others take a significant place in the formation of the nosological profile of avian infectious pathology and deteriorate the animal health situation in commercial poultry industry. Many foodborne pathogens are widespread in nature, may persist in the environment for a long time and remain facultative parasites for warm-blooded, including food-producing animals. According to veterinary reports, bacterial diseases (colibacillosis, salmonellosis, pasteurellosis, etc.) play a significant role in poultry disease occurrence and incidence and develop when maintenance and feeding conditions are incompliant and the overall animal body resistance is decreased; they can also be secondary infections or a result of the virus latently circulating in poultry body, which exacerbates the development of infectious process. Such pathogenic bacteria as *Salmonella*, *Listeria*, pathogenic *Escherichia coli* strains and other microorganisms occupying a specific place among pathogens common to animals (including birds) and humans and being risk factors for occurrence of foodborne toxicoinfections, still present the greatest danger to poultry farms and poultry processing establishments [1, 2, 3, 4, 5, 6, 7, 8, 9, 10].

According to the statistics of the Federal Service for Surveillance on Consumer Rights Protection and Human Wellbeing (Rospotrebnadzor), salmonellosis is one of the most common zoonotic bacterial infections transmitted through food (predominantly through poultry products for most pathogens) and the main cause of group morbidity among the population. For instance, in 2022 the Rospotrebnadzor registered 27 outbreaks of foodborne salmonellosis in 22 Subjects of the Russian Federation, whereas 1,204 people were affected, and 36 major salmonellosis outbreaks were recorded within 11 months of 2023. Level of infection in people due to consumption of substandard products (meat, eggs) varies within significant limits.

Colibacillosis (escherichiosis, colisepticemia, dysentery) detected in birds is an acute infectious disease caused by enteropathogenic *Escherichia coli*, which occurs in the form of septicemia and is characterized by diarrhea. *Escherichia coli* originally called *Bacterium coli* was first identified in 1885 by the Austrian scientist Theodor Escherich after whom it received its name. *Escherichia coli* are small, polymorphic, gram-negative rod-shaped bacteria with rounded ends, they have no spores, are well cultivated on conventional nutrient media and belong to facultative anaerobes. Diseased and convalescent birds are the source of infection, and the pathogen can also be transmitted by wild birds and rodents. The routes of infection can be aerogenic, alimentary and transovarial. According to the researchers, chickens, turkeys, ducklings and goslings up to 90 days of age are most susceptible to the infection, adult birds rarely get diseased, humans may be susceptible. The pathogen persists in the environment for up to 4 months, dies within 1–2 minutes when heated to 100 °C, it is sensitive to conventional disinfectants. Clear 2% active chlorine solution, 5% chloraminum B solution, 3% caustic soda hot (45–50 °C) solution, 2% formaldehyde

solution, 20% suspension of freshly slaked lime (by double whitewashing with an interval of one hour) are used. The ante-mortem diagnostic examination of young birds reveals depression, cyanosis of the head skin, dyspnea, wheezing, diarrhea, fever, intoxication signs. During post-mortem examination cyanosis of muscle tissue is observed, the liver is enlarged, there are fibrin films on the liver surface, multiple small spot hemorrhages are found on the serous membranes of internal organs, and the lungs are hyperemic. Peritonitis and enteritis are recorded in adult birds [1, 11, 12, 13, 14, 15, 16]. It should be noted that the final diagnosis is confirmed by laboratory tests conducted in accordance with regulatory documents.

Young poultry and wild birds are most susceptible to *Salmonella* infection, resulting in salmonellosis (paratyphoid) – an infectious disease that occurs mainly in the gastrointestinal form and, less often, may be systemic. *Salmonella* agents belong to the *Enterobacteriaceae* family of intestinal bacteria, the *Salmonella* genus. Salmonellas are morphologically rod-shaped bacilli with rounded ends that do not form spores and capsules, are well stained with aniline dyes, gram-negative, cultured on conventional nutrient media, classified as aerobic or facultative anaerobes. The pathogen is quite resistant to environmental factors and sensitive to conventional disinfectants. Thus, bacteria can survive in soil within 1–9 months, in frozen meat – within 6–13 months, in eggs – within up to 13 months, in egg powder – within up to 9 months; *S. enteritidis*, *S. typhimurium*, *S. gallinarum*, *S. pullorum*, *S. infantis* are the major species in the etiological structure of avian salmonellosis. Diseased and convalescent birds can be a reservoir of the pathogen, that is, they can be *Salmonella* carriers for a long time, which is especially dangerous as this is a latent source of infection. The disease can be acute, subacute, chronic and sometimes asymptomatic (in adult chickens, ducks and geese). Diseased birds demonstrate lethargy, inappetite, weight loss, conjunctivitis, rhinitis, diarrhea, arthritis, dyspnea, comb and wattle cyanosis; ducks and geese demonstrate swelling of the head. During post-mortem examination enlarged liver, small necrotic foci in the spleen and kidneys are found in adult birds, inflammations of ovaries, oviduct, and cloaca are frequently observed as well. In chicks the serous membrane of the intestine is red, the mucous membranes of the digestive tract are catarrhally inflamed, there are streaky hemorrhages in places, the liver is enlarged, with fibrinous depositions on the capsule and multiple small necrotic foci. Liver degeneration is noted in goslings, whereas in ducklings the liver is enlarged and has many small necrotic foci [2, 5, 13, 17, 18, 19]. *Salmonella* bacteria cause food toxicoinfections in humans; poultry meat, edible eggs and other poultry products are the pathogen transmission factors.

The Department of Microbiology of the All-Russia Scientific Research Veterinary Institute of Poultry Science (A. N. Borisenkova, T. N. Rozhdestvenskaya, O. B. Novikova) has developed a control system for prevention of bacterial diseases in commercial poultry farming, which establishes the main technological links and includes 11 main aspects: diagnostic monitoring (serological tests, microbiological tests of faeces samples, cloaca smears); microbiological monitoring during chicken hatching and rearing; epizootological monitoring of the production technological cycle; antibiotic therapy; probiotic-based prevention, disinsection, desacarization; deratization; specific prevention; HACCP-based analysis of critical control points and risk management (microbiological control of feed, technological facilities, product yield) [2, 20, 21].

Thus, colibacillosis and salmonellosis are the most common avian bacterial diseases currently posing a risk to poultry farming and, in particular, to food product consumers. Therefore, the analysis of colibacillosis and salmonellosis occurrence in poultry farms in the country, as well as the results of poultry meat and poultry product laboratory tests are essential for development of the veterinary and sanitary service activities to ensure poultry disease freedom and biosafety, and that determined the direction of our research.

MATERIALS AND METHODS

Based on statistical data of the Ministry of Agriculture of the Russian Federation, a retrospective analysis of the colibacillosis and salmonellosis occurrence in poultry farms in the country in 2018–2022 was carried out, taking into account the detected outbreaks and the number of infected birds for each disease. The results of laboratory tests of *Salmonella* contamination of poultry meat and poultry products in 2018–2020 are analyzed.

RESULTS AND DISCUSSION

It was established that in 2018–2022, 827,442 poultry in 190 outbreak areas got infected with colibacillosis in the Russian Federation, 176 poultry in 18 outbreak areas got infected with salmonellosis.

In 2018 colibacillosis was registered in 87 outbreak areas, salmonellosis – in 7 outbreak areas, while the number of chicks and young birds infected with colibacillosis amounted to 547,561 birds, with salmonellosis – 33 birds, the percentage of the total number of diseased birds for each disease was 66.18 and 18.75%, respectively.

In 2019 the number of poultry infected with colibacillosis amounted to 242,410 birds in 103 outbreak areas (29.30% of the total number of colibacillosis-infected poultry), salmonellosis – 116 birds in 6 outbreak areas (65.91% of the total number of salmonellosis-infected poultry). In 2020, 2021 and 2022 no new colibacillosis-infected areas were identified in the Russian Federation, while the number of diseased birds was 33,560 (4,06%), 1,204 (0,15%) and 2,707 (0.33%) respectively.

In 2020 the number of salmonellosis-infected areas decreased to 4 and the number of diseased birds amounted to 22 (12.50% of the total number of diseased birds with salmonellosis). In 2021 no new salmonellosis-infected areas were identified in the Russian Federation, while there was one diseased bird accounting for 0.57% of the total number of diseased birds. In 2022 salmonellosis was registered in one outbreak area, where the number of diseased poultry was 4 birds (2.27% of the total number of salmonellosis-infected poultry).

Thus, the data provided indicate that these nosological units are registered annually in the Russian Federation, but as a result of veterinary and sanitary measures, the number of colibacillosis-infected poultry in the RF Subjects decreased from 66.18% in 2018 to 0.33% in 2022, and the number of salmonellosis-infected poultry decreased from 65.91% in 2019 to 2.27% in 2022 (Fig.). At the same time, the data obtained suggest that bacterial diseases still occupy a specific place in the nosological profile of poultry infectious pathology and may pose a danger to poultry

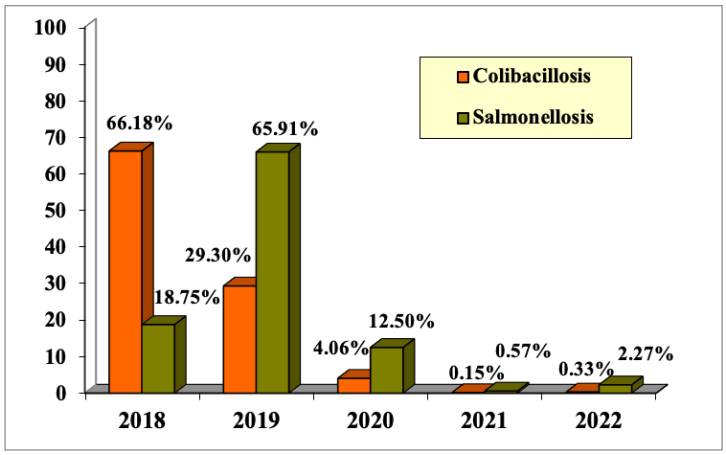

Fig. Avian colibacillosis and salmonellosis occurrence in the Russian Federation in 2018–2022 (mean percentage of the total number of diseased poultry for each disease)

Table 1
Results of tests of poultry meat and poultry products for *Salmonella* contamination in 2018–2020

Product name	Number of collected samples	Number of positive samples
Poultry meat	120,923	1,716 ± 15
Chicken eggs	87,259	21 ± 1
Melange, egg powder	10,838	20 ± 1
Total	219,020	1,757 ± 17

$p \leq 0.05$

Table 2
Results of tests of poultry meat and poultry products for mesophilic aerobic and facultative anaerobic microorganisms and coliforms (Total Viable Count)

Parameter	Number of collected samples	Number of positive samples	%
Total Viable Count	2,340	257 ± 12	10.98
Coliforms	2,340	120 ± 6	5.13

$p \leq 0.05$

establishments. Therefore, in order to ensure the animal disease freedom of poultry population and timely implement a complex of preventive, veterinary and sanitary measures, it is necessary to constantly monitor and analyze the data on colibacillosis and salmonellosis occurrence in poultry.

At the next stage of the study, a retrospective analysis of data on *Salmonella* contamination of poultry meat and poultry products obtained during laboratory tests in 2018–2020 was carried out. Results of tests of poultry products for *Salmonella* contamination are presented in Table 1.

According to the data obtained, 219,020 samples of poultry meat and poultry products were collected for testing, which included 120,923 samples of poultry meat, 87,259 samples of chicken eggs, 10,838 samples of melange and egg powder. It was established that *Salmonella* bacteria were detected in 1,716 ± 15 poultry meat samples, which is 1.42% of the total number of meat samples collected for testing. *Salmonella* was detected in chicken eggs in 0.02% of cases, the proportion of egg product samples (melange and egg powder) containing bacteria was 0.18%. Based on analysis of data on *Salmonella* contamination in 2018–2020, the following *Salmonella* serovars were most often found in poultry products: *S. enteritidis*, *S. typhimurium*, *S. infantis*.

The data from the automated VESTA system (laboratory testing of regulated product samples) in 2018–2020 were used for the retrospective analysis of the level of contamination with mesophilic aerobic and facultatively anaerobic microorganisms and coliforms (total viable count) and *Escherichia coli* bacteria (coliforms) in poultry meat and poultry products. It should be noted that these microbiological safety parameters are specified in the Technical Regulations of the Customs Union "On Food Safety" (TR CU 021/2011) and the Eurasian Economic Union "On Safety of Poultry Meat and Processed Products Thereof" (TR EAEU 051/2021): the total viable count in fresh meat shall not exceed 10 CFU/g (cm^3), in chicken and quail eggs – not more than 100 CFU/g (cm^3); no coliforms are allowed in 1.0 g (cm^3) of fresh meat and 0.1 g (cm^3) of chicken and quail eggs.

During the specified period 2,340 samples were tested. As the data in Table 2 show, a significant number of samples do not meet the requirements of regulatory documents according to the VESTA automated system.

CONCLUSION

According to the Ministry of Agriculture of the Russian Federation, the retrospective analysis of colibacillosis and salmonellosis occurrence in poultry farms in the country in 2018–2022 showed that 827,442 birds got infected with colibacillosis in 190 outbreak areas, salmonellosis was registered in 176 birds in 18 outbreak areas during the entire study period. In 2018–2020 219,020 samples of poultry meat and poultry products were subjected to bacteriological testing for the presence of *Salmonella*. It was found that *Salmonella* bacteria were detected in 1.42% of poultry meat samples of the total number of meat samples collected for testing, in 0.02% of chicken egg samples, in 0.18% of egg product (melange and egg powder) samples. Despite the seemingly small percentage of bacterial detections, it should be remembered that *Salmonella* is a pathogenic microorganism and its presence is not allowed in 25 g of meat products, therefore, the aspects of bacterial avian disease prevention have not lost their relevance to date.

Based on the results of our own research and literature data, we came to the conclusion that deterioration of the animal health situation in poultry farms may affect the public health due to consuming unsafe *Salmonella*-contaminated poultry products. Therefore, it is necessary to ensure assessment of the animal health situation in poultry farms, epizootic monitoring in regions with developed poultry farming, improvement of measures for the prevention and control of poultry infectious diseases and compliance with veterinary and sanitary requirements at each production stage to achieve the biological safety of poultry meat and poultry products.

REFERENCES

1. Gerasimova A. O., Novikova O. B., Savicheva A. A. Avian colibacillosis – current aspects. *Veterinary Science Today*. 2023; 12 (4): 284–292. https://doi.org/10.29326/2304-196X-2023-12-4-284-292

2. Ruzina A. V., Rozhdestvenskaya T. N., Pankratov S. V. Epizootological and epidemiological aspects of avian

salmonellosis. *Poultry & Chicken Products*. 2022; (5): 35–37. https://elibrary.ru/ddbzya (in Russ.)

3. Spiridonov A. N., Petrova O. N., Irza V. N., Karaulov A. K., Nikiforov V. V. Epizootic situation on infectious avian diseases based on analysis of data from veterinary reports. *Veterinary Science Today*. 2015; (4): 18–28. https://elibrary.ru/vodnwv

4. Kurmakaeva T. V., Baranovich E. S., Yenshin A. V., Sautkin A. V. The importance of individual bacterial diseases for farmers engaged in poultry breeding and processing. *Dopolnitel'noe professional'noe obrazovanie APK: nauchnoe i konsul'tatsionnoe obespechenie (informatsionnoe i konsul'tatsionnoe obespechenie pri realizatsii gosudarstvennoi agrarnoi politiki): materialy 4-i Mezhdunarodnoi nauchno-prakticheskoi konferentsii (8 fevralya 2023 g.) = Advanced professional training in the agro-industrial complex: scientific and advisory support (information and advisory support in the implementation of state agricultural policy): proceedings of the 4th International Scientific and Practical Conference (8 February 2023).* Moscow: Russian Academy of Personnel Support for the Agroindustrial Complex; 2023; 223–233. https://elibrary.ru/vhtdpy (in Russ.)

5. Kozak S. Prevention of toxic infections during poultry processing. *Animal Husbandry of Russia*. 2021; (7): 15–18. https://doi.org/zzr.ru/zzr-2021-07-005 (in Russ.)

6. Seregin I. G., Baranovich E. S., Kurmakaeva T. V., Gusarova M. L. Infektsionnye bolezni, vyyavlyaemye pri vyrashchivanii i pererabotke ptitsy = Infectious diseases detected during poultry raising and processing. *BIO*. 2019; (6): 14–17. https://elibrary.ru/kgakzy (in Russ.)

7. Sochnev V. V., Pashkina Yu. V., Kozyrenko O. V., Pashkin A. V., Nikulin V. V., Filippov V. N., et. al. Evidence-based epizootology (scientific research methodology): study guide. Ed. by A. G. Samodelkin, V. V. Sochnev. 4th ed., revised and supplemented. Nizhny Novgorod; Nizhny Novgorod State Agricultural Academy; BIKAR; 2016. 160 p. https://www.elibrary.ru/download/elibrary_28775604_13415048.pdf (in Russ.)

8. Shilkina L. V., Kozyrenko O. V., Kolobov E. A., Piuncina V. V., Pomazov E. A., Jezlova N. V., et al. Episootic particularities of forming of nozoprofile of infectious and invasive pathology in Nizhniy Novgorod area conditions. *Veterinarian*. 2012; (6): 2–4. https://elibrary.ru/ptzucn (in Russ.)

9. Seryogin I. G., Nikitchenko D. V., Abdullaeva A. M. About illness of foodborne diseases. *RUDN Journal of Agronomy and Animal Industries.* 2015; (4): 101–107. https://doi.org/10.22363/2312-797X-2015-4-101-107 (in Russ.)

10. Hafez H. M., El-Adawy H. Foodborne diseases of poultry and related problems. *Journal of Food Nutrition and Metabolism*. 2019; 1 (1): 2–5. https://doi.org/10.31487/j.JFNM.2018.01.005

11. Novikova O. B., Pavlova M. A., Bartenev A. A. O probleme kolibakterioza v ptitsevodstve = On collibacillosis in poultry industry. *Effektivnoe zhivotnovodstvo.* 2018; (6): 64–66. https://elibrary.ru/uyqkce (in Russ.)

12. Rozhdestvenskaya T. N., Ruzina A. V., Pankratov S. V., Tomina E. V. Kolibakterioz ptits: faktory patogennosti vozbuditelya i profilaktika bolezni = Avian colibacillosis: pathogenicity factors and disease prevention. *Sovremennye nauchnye razrabotki i peredovye tekhnologii dlya promyshlennogo ptitsevodstva: sbornik statei nauchno-prakticheskoi konferentsii (12–14 ijulya 2023 g.) = Modern scientific developments and advanced technologies for industrial poultry farming: a collection of papers of a scientific and practical conference (July 12–14, 2023).* Saint Petersburg: Mediapapir; 2023; 100–104. https://www.elibrary.ru/uvolms (in Russ.)

13. Zhitenko P. V., Seregin I. G., Nikitchenko V. E. Meat inspection and poultry processing technology: study-book. Moscow: Akvarium; 2001. 350 p. (in Russ.)

14. Oliveira G. da S., McManus C., dos Santos V. M. Control of *Escherichia coli* in poultry using the *in ovo* injection technique. *Antibiotics*. 2024; 13 (3):205. https://doi.org/10.3390/antibiotics13030205

15. Manges A. R. *Escherichia coli* and urinary tract infections: the role of poultry-meat. *Clinical Microbiology and Infection*. 2016; 22 (2): 122–129. https://doi.org/10.1016/j.cmi.2015.11.010

16. Mitchell N. M., Johnson J. R., Johnston B., Curtiss R. 3rd, Mellata M. Zoonotic potential of *Escherichia coli* isolates from retail chicken meat products and eggs. *Applied and Environmental Microbiology*. 2015; 81 (3): 1177–1187. https://doi.org/10.1128/AEM.03524-14

17. Novikova O. B., Pavlova M. A. System of control of bacterial diseases of birds in modern conditions of industrial poultry. *Innovations in Agricultural Complex: problems and perspectives*. 2017; (4): 153–159. https://elibrary.ru/zvzphb (in Russ.)

18. Alexandrova Ya. R., Kozak S. S., Borovkov M. F., Baranovich E. S., Kozak Yu. A. Detection of salmonella in biological material of animals, poultry and livestock products. *Vestnik Chuvash State Agrarian University*. 2023; (1): 45–49. https://doi.org/10.48612/vch/859n-x394-vdea (in Russ.)

19. Antunes P., Mourão J., Campos J., Peixe L. Salmonellosis: the role of poultry meat. *Clinical Microbiology and Infection*. 2016; 22 (2): 110–121. https://doi.org/10.1016/j.cmi.2015.12.004

20. Javadov E. J., Novikova O. B., Kraskov D. A., Berezkin V. A. Bolezni ptits, vyzyvaemye uslovno-patogennoi mikrofloroi = Avian diseases caused by some opportunistic microorganisms. *Effectivnoe zhivotnovodstvo.* 2023; (6): 8–12. https://doi.org/10.24412/cl-33489-2023-6-8-12 (in Russ.)

21. Ruzina A. V. Microbiological monitoring of the spread of avian salmonellosis in poultry farms of the Russian Federation. *Proceedings of the All-Russian Research Institute of Experimental Veterinary Sciences named after Ya. R. Kovalenko.* 2023; 83: 121–127. https://www.elibrary.ru/gmmgst (in Russ.)

Received 20.03.2024
Revised 22.04.2024
Accepted 14.05.2024

INFORMATION ABOUT THE AUTHORS / ИНФОРМАЦИЯ ОБ АВТОРАХ

Tamara V. Kurmakaeva, Cand. Sci. (Biology), Associate Professor, Professor of the Department of Agrobiotechnology, Russian Academy of Personnel Support for the Agroindustrial Complex, Moscow; Russia; *https://orcid.org/0000-0002-2639-2933, e-mail: t.kurmakaeva@rako-apk.ru*

Курмакаева Тамара Владимировна, канд. биол. наук, доцент, профессор кафедры агробиотехнологий ФГБОУ ДПО РАКО АПК, Москва, Россия; *https://orcid.org/0000-0002-2639-2933, e-mail: t.kurmakaeva@rako-apk.ru*

Sergey S. Kozak, Dr. Sci. (Biology), Professor, Leading Researcher, Head of the Testing Laboratory Centre, "All-Russian Scientific Research Institute of Poultry Processing Industry" – Branch of FSC "All-Russian Research and Technological Poultry Institute" of RAS, Rzhavki, Solnechnogorsk, Moscow Oblast, Russia;
https://orcid.org/0000-0001-7823-7719,
e-mail: viippkozak@gmail.com

Evgeniya S. Baranovich, Cand. Sci. (Veterinary Medicine), Associate Professor of the Department of Morphology and Veterinary and Sanitary Examination, Russian Timiryazev State Agrarian University, Moscow, Russia;
https://orcid.org/0000-0003-4689-2510,
*e-mail: ebaranovich@rgau-*msha.ru

Козак Сергей Степанович, д-р биол. наук, профессор, ведущий научный сотрудник, руководитель испытательного лабораторного центра ВНИИПП, р. п. Ржавки, г. о. Солнечногорск, Московская обл., Россия;
https://orcid.org/0000-0001-7823-7719,
e-mail: viippkozak@gmail.com

Баранович Евгения Сергеевна, канд. вет. наук, доцент кафедры морфологии и ветеринарно-санитарной экспертизы института зоотехнии и биологии, ФГБОУ ВО РГАУ – МСХА имени К. А. Тимирязева, г. Москва, Россия;
https://orcid.org/0000-0003-4689-2510,
e-mail: ebaranovich@rgau-msha.ru

Contribution: Kurmakaeva T. V. – literature search and analysis, research concept, methodology, data analysis and interpretation, graphic data preparation, final conclusions; Kozak S. S. – literature search and analysis, research concept, data analysis and interpretation; Baranovich E. S. – literature search and analysis, research concept, data analysis and interpretation, graphic data preparation, text preparation and editing.

Вклад авторов: Курмакаева Т. В. – поиск и анализ научной литературы, концепция исследования, развитие методологии, анализ и интерпретация данных, подготовка графического материала, итоговые выводы; Козак С. С. – поиск и анализ научной литературы, концепция исследования, анализ и интерпретация данных; Баранович Е. С. – поиск и анализ научной литературы, концепция исследования, анализ и интерпретация данных, подготовка графического материала, подготовка и редактирование текста.