The relevance of salmonellosis risk control in the population of turkeys of the Russian Federation

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Abstract. Outbreaks of Salmonella infections caused by poultry products have been quite common in recent years. With current trends in the development of turkey farming in the Russian Federation, it is necessary to pay attention to the products of this industry imported into the country. In the US 60% of chickens and 23% of turkeys are infected. In particular, in the United States in 2011, Salmonella heidelberg infection spread, affecting more than 150 people in 34 states. As the laboratory tests showed, it was caused by the infected turkey minced meat. In November 2011, 179 cases of the disease were reported, caused by the same salmonella serovar, but already due to products made from the liver of kosher chickens. Many cases were severe and required hospitalization.

1. Introduction

There is no doubt that in the near future countries with developed agriculture will have an increasing influence on world politics and economics, since food is becoming one of the main levers of political and international pressure in international relations. In this situation, Russia needs to improve food security in order to create conditions for conducting an independent international policy.

Since 1995, in order to implement measures of customs and tariff regulation WTO member countries have been instructed to ensure that their sanitary and phytosanitary measures are based on an assessment and analysis of risks to human health and life that arise during the production of food. At the same time, FAO and WHO began the development of a formalized microbiological risk analysis framework (MRA), but there are still no officially approved detailed international or national guidelines. There are only a lot of publications and a number of advisory documents of the executive body of FAO/WHO - Codex Committee on Food Hygiene (CCFH).

In accordance with the requirements of Codex Alimentarius and in connection with the special importance of risk control for bacteria of the genus Salmonella spp., MRA must take into account information from both national and international laboratory research processing systems, as well as the results of epizootic monitoring and control of microbiological risks in turkey livestock at all stages of production.

The food safety doctrine developed by the Ministry of Agriculture of the Russian Federation and the Russian Academy of Agricultural Sciences was approved by the board of the ministry and the Government Commission on Agrarian Issues in November 2008. This doctrine is the basis for the regulations and programs for the agribusiness development [1].
As part of the development of state programs for import substitution, export support and supplying the population of the country with high-quality and dietary food products, the production of meat and edible offal from turkey is the fastest growing area of the poultry industry.

It should be noted that the detection of violations of safety requirements in food products is taken into account in the international system of competent authorities and affects the status of the country’s veterinary service. Microbiological risk control provides the ability to export poultry and food products in accordance with international requirements.

In accordance with WTO rules, the isolation of bacteria of Salmonella spp. genus in food products is the basis for the introduction of restrictions on exports from a sovereign country. Evaluation of the data on the circulation of bacteria of Salmonella genus and the determination of the species of the isolates are an element of risk indication for subsequent analysis and communication of microbiological risks in accordance with international practice for ensuring the safety of turkey food products for export.

Errors in the indication and control of food safety related to the detection of bacteria of Salmonella genus can lead to a prolonged export restriction, which is an economic and political risk to a country’s security.

Salmonella outbreaks caused by poultry products in recent years are quite common. Special attention to ensuring the safety of poultry products is explained by the volume of production.

Poultry products are in demand because of their relatively low cost compared to products from other livestock industries. The directions of development and species differentiation of the poultry industry should determine the specifics and measures to support all areas in the industry in order to ensure the food security of the country. Now we observe a dynamic development of turkey farming which is a new direction of the poultry industry for Russia.

Products derived from turkey are popular with the population and have the potential to further increase the share in total production due to the special dietary characteristics. There are significant practical advantages of choosing turkey meat compared to other types of poultry meat. According to its biological and economic characteristics, it is one of the most valuable. An increase in the consumption of turkey meat in Russia in the total amount of meat consumed was revealed. Based on the analysis of studies of the turkey industry, the dynamics of the number of turkeys in agricultural organizations in 2006-2016 is presented. Summary data and benefits of choosing turkey meat are as follows:

- the ratio between live and slaughter weight of turkey is 81%, in broilers, these figures are equal to 72%, in cattle - 60%;
- compared to other birds, turkey is highly resistant to diseases, which guarantees less burdensome and more affordable veterinary care;
- the average daily weight gain in a female turkey is about 90 grams, in a male turkey - 145 grams;
- compared to broiler farming, the production of turkey meat requires less energy and a relatively low production cost per 1 kg of meat. Compared to broiler meat, pork and beef, turkey meat wins in protein content, and also has high taste and nutritional properties with low cholesterol and fat content.

These benefits have led to an increase in turkey production, while the forecast of turkey meat production for the coming years suggests the continued pace of development of the industry.

A significant increase in the number of turkeys in the Russian Federation is confirmed by departmental statistics, information on the expansion of production capacity and the results of the agricultural census conducted in the Russian Federation in 2006 [2] and 2016 [3].

The growth dynamics of the turkey population in Russia over ten years from 2006 [3] to 2016 [2] in the private and manufacturing sectors is presented in table 1.
Table 1. Growth dynamics of turkeys in the Russian Federation.

| No | Year | Type of ownership     | Livestock, heads | Growth, % |
|----|------|----------------------|------------------|-----------|
| 1  | 2006 | Private peasant farms | 1415500          | 40.24     |
| 2  | 2016 |                      | 2368800          |           |
| 3  | 2006 | Industrial holdings  | 2116300          | 420.5     |
| 4  | 2016 |                      | 8900300          |           |

As it can be seen from the data presented, there is a rapid increase in the number of birds. In the private sector, during this period there was an increase in turkeys by 953 thousand heads, which is 40.24%. The increase in livestock in industrial holdings is even more rapid; for 10 years the livestock has more than quadrupled, reaching almost 9 million heads.

In addition to the increase in the number of turkeys, significant changes can be observed in the changing structure of the poultry industry, which also confirms the demand for the industry’s products from the population. The results of the study of the structure are presented in table 2.

Table 2. The structure of the species diversity of birds in the private sector.

|                | Chickens | Ducks | Geese | Turkeys | Guinea fowls | Pheasants | Ostriches |
|----------------|----------|-------|-------|---------|--------------|-----------|-----------|
| 2006           | 77.9     | 9.9   | 6.3   | 1.6     | 0.4          | 0.46      | 0.6       |
| 2016           | 76.8     | 5.6   | 6.8   | 2.4     | 0.2          | 0.2       | 0.0       |

As it can be seen from the presented material, the species structure of the poultry population in peasant farms and individual entrepreneurs (in % of the total poultry population) shows an increase in turkey production in relation to other types of agricultural poultry. For example, over ten years, there was a decrease in ducks by 4.3%, the number of chickens and geese remained at about the same level, and the number of turkeys’ annual growth increased by 0.8%.

The structure of the poultry population by species, in holdings (in % of the total poultry population) also shows a percentage increase in the industrial production of turkeys relative to other areas of the poultry industry by more than three times. The data are presented in table 3.

Table 3. The structure of the species diversity of poultry in industrial poultry farming.

|                | Chickens | Ducks | Geese | Turkeys |
|----------------|----------|-------|-------|---------|
| 2006           | 90.8     | 5.6   | 2.8   | 0.5     |
| 2016           | 92.1     | 3.9   | 1.7   | 1.6     |

The dynamics of growth and development of the industry will continue. At present, construction is underway and new turkey-growing complexes are being put into operation, which confirms the growing popularity of turkey meat among consumers.

However, the increase in the number of turkey livestock and the increasing popularity of the products of turkey breeding are accompanied by an increase in the number of detected violations of the food safety requirements of the products. An increase in the production of turkey production proportionally increases the risk profile of this type of product. At the same time, the nosological structure of the infectious pathology of a turkey is not identical to that of other types of industrial poultry, which requires an assessment and risk analysis.

With current trends in the development of turkey farming, it is necessary to pay attention to the safety of products of the industry imported into the country.

AMP, the indication of which takes place during diagnostic activities, as part of state monitoring: epizootic and monitoring the quality and safety of food products and feed, is key to ensuring the safety
of human and animal health. Follow-up activities to control the spread of salmonellosis are due to the results of AMP.

On the example of turkey production, the risks of introducing new pathogens are obvious. Most of the hatching eggs and young stock in turkey breeding are of imported origin, which significantly increases the risk of importing new turkey-adapted salmonella serovars.

2. The relevance of the study of the properties, distribution and species composition of Salmonella spp. isolates

The problem of controlling salmonellosis in growing turkey is of particular importance in food production, as an important element in ensuring the food safety of the population of the Russian Federation.

Even in the last century, it was found that the dynamics of the spread of salmonellosis in animals, including birds, is directly related to the development of mass toxic infections in humans.

Over the past 50 years, the literature has accumulated data on changes in the etiological structure of human salmonellosis. At the same time, Salmonella of various serovariants are important as pathogens.

Giving a retrospective assessment, it can be stated that in the 70s of the last century, the increase in the incidence was mainly due to S. Typhimurium serovar. In the 1980s, outbreaks of Salmonella enteritidis began to dominate.

Recent studies indicate that among the circulating Salmonella isolates, there has been a serious drift towards the spread of pathogens with multiple antibiotic resistance. The clinical picture, variability and kinetics of modern genera of Salmonella in recent years require additional study.

The effectiveness of antimicrobial chemotherapeutic drugs of various groups, including drugs attributed to the reserve group of drugs according to some classifications, is decreasing. This brings to the forefront of animal health protection specific prevention. The dynamics of pathogen detection reveals an increase in the detection of some genera of Salmonella, such as S. heidelberg, S. arizonae and some others, probably due to the temporary acquisition of virulence due to the penetration of additional genetic material at the plasmid level.

The clinical picture of modern Salmonella infections is also variable. Meanwhile, advanced diagnostic measures, including microbiological and molecular genetic studies, are required to make a differential diagnosis. The low effectiveness of preventive measures used in humanitarian medicine for salmonellosis, which is associated with high viability, genetic flexibility and a variety of sources of Salmonella spp.

According to data provided by the relevant agencies of the Russian Federal Service for Consumer Protection and Human Welfare, the incidence of food toxic infections of Salmonella etiology in people after 2006 stabilized at the level of 31.96 per 100 thousand of population with a periodic increase in the incidence of Salmonella infections among people to 2.4%, acute intestinal infections of established etiology up to 17.3%. Salmonellosis is the second after dysentery in the structure of acute intestinal infections in humans. Salmonella of D group (more than 80%) dominates in the etiological structure of salmonellosis - Salmonella enterica serovariant enteritidis and serogroup B - Salmonella enterica variant typhimurium. Every year up to 30 large outbreaks of food-borne salmonellosis occur in the country, with the number of victims ranging from 500 to 1,500 people. The causative agents of Salmonella spp. are the cause of the frequent contact-food epidemic outbreaks, a significant part of which is associated with the defeat of the most sensitive populations, in particular, children and the elderly. According to the above reports, about half a million children in the Russian Federation suffer diarrheal diseases annually, the majority of which occur in young patients, causing the majority of deaths in this age group.

Emergency messages of the European RASFF warning system demonstrate food safety requirements in poultry products caused by rare and exotic species of Salmonella spp.

We receive urgent FDA reports about the identification of cases of violation of safety requirements in turkey food products in the USA.
Indication of risks associated with the spread of bacteria of Salmonella spp. on the territory of the Russian Federation is carried out by analysing data from the State Information System in the field of veterinary medicine.

Timely species identification of isolates of Salmonella spp. acquires particular importance in the implementation of measures for the control of microbiological risks in turkey products in addition to identifying the pathogen.

In accordance with the results of the analysis of data from sources, major domestic and foreign information systems, production control results for the indium industry, we can conclude that the following Salmonella types are most important: Salmonella enteritidis, Salmonella typhimurium, Salmonella arizonae, Salmonella heidelberg, Salmonella virchow, Salmonella kentucky [4-7].

The statement of changes in the species composition and properties of Salmonella spp. isolates, in modern conditions, in the turkey industry isolated from live poultry, in the material and finished turkey products, is explicable including:

- the difference in the technologies of microbiological risk control and the timing of turkey growing;
- features of keeping and feeding turkeys;
- peculiarities of the composition and origin of feeds and feed additives, corresponding to the species needs of turkey, the existing differences from the feed used in broiler and egg livestock in poultry farming;
- differences in the sources and logistic chains of receipt of breeding material, parent livestock, productive crosses.

When analysing the properties and sources of pathogens, it can be concluded that most often Salmonella serovariants circulating in poultry farms are low pathogenic for people due to their unadaptability [13]. Reproduction of Salmonella in food products is not directly related to the deterioration of organoleptic characteristics and physicochemical properties determined by the methods of veterinary-sanitary examination, and heat treatment is not an exhaustive method to guarantee the inactivation of toxins and pathogens.

According to the WHO classification, all Salmonella serovars are divided into three main groups:

The first group includes pathogens of Salmonella typhi and Salmonella paratyphi "A", "B", "C". This group of bacteria is the most dangerous for humans.

The second group of bacteria includes pathogens of primary salmonellosis, which have a certain species predisposition and mainly specific pathogenicity in relation to these species: for chickens - gallinarum-pullorum, for horses - abortusequi, in sheep - abortusovis, etc.

The third group of Salmonella included serovars, which cause all other Salmonella diseases of farm animals, including Birds, and humans: Salmonella spp.; enteritidis, typhimurium, Thompson, choleraesuis, brandenburg, dublin, etc., whose pathogens are often isolated from the meat of chickens, eggs, and pathological material from a sick and fallen bird.

However, the above classification of Salmonella in relation to human susceptibility and pathogen pathogenicity is not absolute due to the possibility of simultaneous manifestation of the pathogenic properties of a single Salmonella isolate for different types of animals, birds and humans.

3. Conclusion
The conclusion from the data is the need to solve the following tasks:

- to summarize and conduct an analysis of the dynamics of the development of the industry of turkey breeding, compare data on cases of detection of Salmonella spp. in turkey products obtained from domestic and major international information systems;
to analyse the species identification data of microorganisms of the genus Salmonella spp. including isolate properties;

- to prepare proposals on measures to control the microbiological risk of circulation of new species of Salmonella spp. in the population of industrial livestock turkey based on the proposed change in the number and structure of the livestock.

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