Dangerous bacterial infections of farm animals in Russia and the Tyumen region

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Abstract. In the 21st century, there is a clear trend of growth in quantitative and qualitative indicators of Russian animal husbandry. The Tyumen region is distinguished by the sustainable development of the agro-industrial complex. In conditions of intensive development of animal husbandry in Russia and the Tyumen region, it is of particular importance to preserve the health of livestock at enterprises and in private subsidiary farms. The article examines particularly dangerous bacterial infectious diseases of farm animals. Such diseases include anthrax, tuberculosis, brucellosis and leptospirosis. The main epidemic characteristics in dynamics over the past five years, including the incidence of animals and the spread of infections in Russia and the Tyumen region, have been analyzed, peaks in morbidity and main trends have been identified. Brief characteristics of diseases are presented, the main preventive measures and measures provided for by legislation are analyzed.

1 Introduction

Among the priority goals of the livestock industry is to provide the population with food products of animal origin and raw materials of some industries. The structure of consumption is dominated by livestock products (milk and beef) – 45.6% and poultry (egg and poultry meat) – 34.6% and pig farming (pork) – 18.8% in third place.

In the 21st century, there is a clear trend of growth in quantitative and qualitative indicators of Russian animal husbandry. The optimal industry structure and intensification of animal husbandry in a short time ensured saturation of the market with animal products in the desired range and created prerequisites for the profitable management of all industries [1].

The Tyumen region is a region with sustainable development of the agro-industrial complex. Thus, by the end of 2021, the region took 2nd place in the UFD in terms of agricultural output per capita. More agricultural products per capita were produced than the average in Russia and the Ufa region. There is a tendency to increase the volume of exports of agricultural products, the Tyumen region supplies 47 types of products to foreign markets. The Tyumen region entered the top 10 regions of Russia in terms of dairy exports [2].

In conditions of intensive development of animal husbandry in Russia and the Tyumen

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region, it is of particular importance to preserve the health of livestock at enterprises and in private subsidiary farms.

Viral infectious diseases play a leading role in animal pathology. In this regard, great attention is paid to the study of viruses, the analysis of their spread and preventive measures [3]. At the same time, dangerous bacterial infections that pose an economic and social threat are also of great importance.

The purpose of the scientific work was to study particularly dangerous bacterial infectious diseases of farm animals in Russia and the Tyumen region.

2 Materials and Methods

The scientific research was conducted in 2024 at the Department of Infectious and Invasive Diseases of the State Agrarian University of the Northern Urals. Methodological approaches in solving the tasks are based on the application of both general scientific methods – theoretical and methodological analysis of literary sources, normative legal acts adopted in Russia and regulating measures for the prevention of bacterial infectious diseases, and empirical research methods in the form of description and comparative and retrospective analysis of statistical data. The analysis of the epizootic situation for bacterial infectious diseases was carried out on the basis of the reporting data of the Rosselkhoznadzor information and analytical center.

3 Results and Discussion

The causative agent of anthrax is a gram-positive stationary large Bacillus antracis of the genus Bacillus, family Bacillaceae. Anthrax in animals is characterized by a variety of symptoms. The leading sign is the developing septic process and the formation of carbuncles on the body. The duration of the disease incubation period most often does not exceed 1-3 days, but there may be cases of both shortened incubation and a longer duration of this period [4]. Sick animals secrete the pathogen with urine, feces, saliva, etc. In animals with anthrax, hemafecia is noted, at slaughter – the blood is liquid, and the meat is red. The pathogenesis and pathanatomy of the disease are determined by the general nature of the infection (toxemia), the body reactivity and the specific mechanism of infection. The entrance gates of infection are damaged skin and mucous membranes, gastrointestinal tract, and respiratory tract. Serous hemorrhagic processes develop in tissues and organs at the insertion site [5].

The situation regarding the incidence of anthrax over the past five years has been characterized as stable, with the presence of soil foci of infection. The affected animals are cattle. As can be seen from Fig. 1, in 2022 and 2023, there was an increase in the number of foci of infection from 1 to 6 settlements, and the incidence from 1 to 11. In 2023, the epidemic threshold for trouble was exceeded: the disease was detected in the territories of the Volga and Central Federal Districts (Republic of Chuvashia, Republic of Tyva, Tambov region, Ryazan region, Voronezh region) [6].
Tuberculosis is an infectious, chronically occurring disease of animals of all kinds and humans, characterized by damage to organs and tissues with the formation of tuberculosis in them. The causative agent is bacteria from the genus Mycobacterium, which includes more than 38 independent species. The disease in animals is caused by Mycobacterium tuberculosis of bovine (M. bovis), human (M. tuberculosis) and avian (M. avium) species. Each of them is pathogenic to animals of the corresponding species or humans, and cross-infection is possible. Clinical signs of tuberculosis in animals after infection can appear in terms from 30 days to several months or even years, which depends on many factors. In most cases, it is not possible to establish the incubation period for natural infection. On average, it is believed that 2 to 6 weeks after infection, the animal already reacts positively to tuberculin. The animals at this time look clinically quite healthy. The presence of clinical signs indicates a prolonged course of the disease. There is an open (active) tuberculosis, when mycobacteria are excreted with milk or sputum, feces of a sick animal, and closed (latent) one, in which the pathogen is not isolated. In cattle, the lungs are affected in most cases. At the same time, a dry cough is noted, accompanied by groans. Pathoanatomic changes in tuberculosis are characterized by the formation of granulomas (tuberculosis) in organs and tissues. The tubercles are dense, light gray or grayish-yellow in color with a curd mass in the center (caseous necrosis), partially or completely calcified, surrounded by a connective tissue capsule [7].

The incidence of tuberculosis in cattle in recent years has been endemic. As can be seen in Fig. 2, over the past five years, the peak incidence is in 2020, the epidemic threshold for morbidity has been overcome. In 2022, no infection was registered in the country, but in 2023, 4 foci and 120 infected animals were identified. The disadvantaged regions are the Republics of Tatarstan and Mordovia (Volga Federal District) [6].
Brucellosis is a chronic infectious disease, often manifested by abortions, retention of the afterbirth, endometritis and a disorder of the reproductive ability of animals. The pathogen according to the Bergey classification (2001) belongs to the Brucellaceae family, Alphaproteobacteria class, and the genus Brucella. There are 6 known types of brucellosis pathogens. Br. melitensis affects mainly small cattle, Br. abortus bovis – mainly cattle, Br. Abortus suis – pigs, Br. ovis – sheep, Br. canis – dogs, Br. neotomae – rats [8]. The incubation period ranges from 25-30 days, in young animals received from sick mothers 12-14 months. Clinical signs in case of brucellosis are uncharacteristic and latent. During the examination, attention is paid to the presence of abortions, soreness, bursitis and other clinical signs in the herd, and the age of the aborted fetuses is clarified. Sick and positively reacting animals are isolated and slaughtered within days [9].

Brucellosis of farm animals is a disease that is constantly being registered in certain territories. As can be seen in Fig. 3, the incidence of animal diseases has been increasing in recent years. The epidemic threshold for the ill-being of cattle was overcome in 2020, as well as the thresholds for the morbidity of cattle and the ill-being of small cattle were overcome in 2023. Over the past three years, the number of sick animals has increased 3 times. Rosselkhoznadzor specialists have noted persistent problems with brucellosis in the country. In 2023, bovine brucellosis was registered in 34 regions, and small cattle in 18 regions. The largest number of foci is in the Southern (12), Central (6), North Caucasus (6), Siberian (4) Federal districts [6].

![Fig. 3. The annual dynamics of the problem and incidence of brucellosis.](image)

Leptospirosis (Weil disease, field fever, swamp fever, canicola fever, swineherd disease) is an acute zoonotic naturally focal bacterial infection characterized by wave-like fever, intoxication, damage to the liver, kidneys, nervous system, the development of jaundice and hemorrhages. Leptospira belong to the Gracilicutes division of the order Spirohaetales, the family Leptospiraceae, the genus Leptospira. There are 2 species (nomenpecies) in this genus: - L. interrogans – pathogenic leptospira that cause diseases in humans and animals; - L. biflexa – saprophytic leptospira that live in the water of open reservoirs and in moist soil (swampy terrain, flood meadows, etc.). These leptospires are not pathogenic for warm-blooded people [10]. Under the effect of bacterial toxins, necrotic and degenerative foci and hemorrhages are formed in internal organs, in particular in the liver. With leptospirosis, red blood cells are destroyed, as a result of which hemoglobin in the blood grows. Liver damage causes bilirubin retention, which causes the tissues to turn yellow. The incubation period lasts from 2 to 20 days. The rate of infection growth depends on the pathogenicity of bacterial strains and the general health of the animal [11].

The situation regarding the incidence of leptospirosis over the past five years has been endemic. The disease has been detected in cattle, small cattle, horses, pigs, as well as dogs and cats. Against the background of a decrease in the total number of sick animals, as can
be seen in Fig. 4, almost annually the epidemic threshold was exceeded for the welfare of cattle, for the welfare of pigs — in 2020 and 2021. The geography of the disease is extensive and covers 25 regions, the largest number of foci in the Siberian (6), Central (4), Southern (3), Far Eastern (3), Volga (3), North Caucasian (3) federal districts [6].

Fig. 4. The annual dynamics of the problem and incidence of leptospirosis.

Outbreaks of brucellosis and leptospirosis have been reported in the Tyumen region over the past five years. Brucellosis of cattle in 2020 was detected in 9 settlements, 28 animals became ill. The disease of farm animals with leptospirosis was registered annually: 2019 — 2 settlements, 125 sick animals; 2020 — 1 settlement, 9 sick; 2021 — 3 settlements — 32 sick; 2022 — 5 settlements — 35 sick; 1 half of 2023 — 4 settlements, 44 sick. In 2023, outbreaks occurred in Armizonsky, Tobolsk, and Tyumen districts [6].

As a measure aimed at preventing the spread of infectious animal diseases in accordance with the Law of the Russian Federation "On Veterinary Medicine", in 2015, by Order of the Ministry of Agriculture, veterinary rules for the regionalization of the territories of the Russian Federation were approved. Regionalization is the determination of the status of a contagious animal disease of the territory of the Russian Federation or its part. The status of a region for a contagious animal disease characterizes a region by the presence of a pathogen of a contagious disease on its territory, by vaccination against a contagious disease in the region, by the level of risk of introducing the disease (its causative agent). The Rules establish the procedure and features of animal husbandry, movement of controlled goods across the territory of the Russian Federation, the list and procedure for additional anti-epizootic measures. The studied bacterial infections are included in the approved list of infectious animal diseases for which regionalization is carried out. An example of regionalization in the Tyumen region is presented in Table 1 [12].

Table 1. Statuses of the Tyumen region for some infectious animal diseases.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Status of the region by disease</th>
<th>Status of the region by vaccination</th>
<th>Exclusion zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax</td>
<td>Region with an uncertain status</td>
<td>With vaccination</td>
<td>No exclusion zones</td>
</tr>
<tr>
<td>Tuberculosis of cattle</td>
<td>Region with an uncertain status</td>
<td>without vaccination</td>
<td>No exclusion zones</td>
</tr>
<tr>
<td>Brucellosis of cattle</td>
<td>Unfavorable region</td>
<td>With vaccination</td>
<td>No exclusion zones</td>
</tr>
<tr>
<td>Brucellosis of pigs</td>
<td>Region with an undefined status</td>
<td>With vaccination</td>
<td>No exclusion zones</td>
</tr>
<tr>
<td>Cattle leptospirosis</td>
<td>Unfavorable region</td>
<td>With vaccination</td>
<td>No exclusion zones</td>
</tr>
<tr>
<td>Pig leptospirosis</td>
<td>Region with an undefined status</td>
<td>With vaccination</td>
<td>No exclusion zones</td>
</tr>
</tbody>
</table>
Preventive measures against bacterial infections: anthrax, tuberculosis of cattle, brucellosis and leptospirosis are defined by sanitary and veterinary rules approved by Orders of the Ministry of Agriculture of the Russian Federation. The rules regulate the establishment of quarantine, restrictive, therapeutic and other measures aimed at eliminating foci of infection, as well as preventing its spread.

In accordance with veterinary regulations, routine vaccination against anthrax and leptospirosis is carried out as a preventive measure in farms of all forms of ownership. Vaccination against brucellosis is carried out with the exception of animals kept in farms with the status of a "safe area without vaccination" for brucellosis. Vaccinated livestock is monitored at the federal level.

To confirm the absence of circulation of the causative agent of tuberculosis in farms, specialists of the state veterinary service carry out routine allergic studies of animals for tuberculosis.

4 Conclusions

A significant degree of contagion and a high level of influence of diseases on the productivity of farm animals include anthrax, tuberculosis of cattle, brucellosis, leptospirosis as particularly dangerous diseases that pose an economic and social threat.

The epidemic situation for the studied diseases is endemic and naturally focal in nature. The situation is controlled due to the implementation of the current veterinary legislation.

The regionalization of the territories of the Russian Federation makes it possible to prevent the spread of infectious animal diseases, as well as to organize preventive measures in accordance with the characteristics of a particular territory.

The veterinary rules defined for each disease under study regulate a clear procedure for all interested authorities and agricultural producers both in the field of prevention of diseases, and in case of suspicion of disease presence or its detection.

At the same time, in 2023 in the territory of the Russian Federation there is an increase in the number of sick farm animals due to bacterial infections — anthrax, tuberculosis of cattle and brucellosis. The problem of the incidence of brucellosis in animals is particularly acute. This situation necessitates strict compliance with current legislation on the part of agricultural producers and government services. On the part of the Rosselkhoznadzor authorities, it is necessary to update the data on the regionalization of the territories of the Russian Federation and conduct control and supervisory measures in terms of compliance by agricultural producers with the current legislation.

A certain positive preventive effect can be provided by conducting targeted information and educational work among the owners of personal subsidiary farms in certain territories. To do this, it is possible to use visual demonstrations of both video and printed materials, publications in the media and other ways of disseminating information.

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