Microbiological
Communication

Microbiota of Cattle Buildings in the Northern Trans-Urals

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ABSTRACT

Microbiocenoses of livestock buildings affect not only animals, reducing their resistance and reactivity, causing diseases of various etiologies, but the staff and nearby residents. The objective of the research was to study the state of livestock breeding, the reasons for the withdrawal of animals, the likelihood of infectious diseases and the composition of microbiocenoses in livestock buildings for various purposes. The studies were conducted at an industrial cattle breeding enterprise (breeding reproducer) in the Northern Trans-Urals (Tyumen region) in 2018-2019. The subject of research was the microbial content of the air in the premises of the pedigree breeding unit with cattle of various technological groups of the Holstein breed. The main reasons for the withdrawal of young cattle are digestive and respiration disorders – 43.21% and 41.60%, respectively. Withdrawal of adult cattle is due to digestive diseases, metabolic disorders, and orthopedic problems and injuries – 25.6%, 25.4%, and 17.2%, respectively. Cattle leukemia and rabies have long been the problems for the Tyumen region. There is a likelihood of particularly dangerous diseases such as anthrax, infectious dermatitis nodosa, tuberculosis, Pasteurellosis, brucellosis, and foot and mouth disease. The composition of the microflora of the surveyed livestock buildings has been found to consist of three types of bacteria – *Staphylococcus aureus, Streptococcus faecalis,* and *Escherichia coli* and three genera of fungi – *Mucor, Candida* and *Aspergillus.*

KEY WORDS: CATTLE, MICROBIOCENOSES, EPIZOOTIC SITUATION, LIVESTOCK DISPOSAL, OPPORTUNISTIC MICROFLORA, LIVESTOCK BUILDINGS.

INTRODUCTION

The most important factor in the high quality of work, biological safety, and resulting products is the well-organized veterinary service of farms. An inadequate sanitary condition poses a risk of various diseases that can compromise the rhythm of production, and cause economic losses. An essential factor influencing the development of agricultural enterprises is the quality of air, an integral part of the habitat of most living organisms (Seedorf et al., 1998; Feingold et al., 2012; Masclaux et al., 2013; Mkrtumyan et al., 2018; Alvarado et al., 2019; Kochetova et al., 2020; Dhiman et al., 2021). On going through the literature it becomes it imperative to monitor the condition and control the degree of air pollution in the context of intensification of animal husbandry. Achieving a high level of sanitary condition of the industrial complex is one of the main tasks in animal husbandry. To predict more accurately the development and spread of various diseases, both the qualitative and quantitative composition of the populations of microorganisms, as well as the elements of the external environment that affect the production and processing of livestock products should be considered.

To ensure the biological safety of animal husbandry, it is necessary to control the number of pathogenic microorganisms in the air and reduce their number by means of veterinary and sanitary measures (Dungan et al., 2011; McEachran et al., 2015; Sancheza et al., 2016; Morozov et al., 2017; Navajas-Benito et al., 2017 Saleeva et al., 2018; Sintiurev et al., 2020). Unfortunately, various livestock enterprises underrate the composition of the community of air microorganisms (spores of microscopic fungi, bacteria, saprophytes and various exotoxins), which adversely affects the body of animals and humans (Casey et al., 2016; Borlee et al., 2017; Schaeffer et al., 2017; Borlee et al., 2018; Glazunova et al., 2018; Stolbova et al., 2018; Myrna et al., 2019; Stolbova, 2019; Domatsky

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et al., 2020; Glazunova et al., 2020; Kochetova et al., 2020; Stolbova, 2020; Bogado et al., 2021).

The factors affecting the quality of livestock products are both the sanitary condition of the premises and the environment, the resistance and reactivity of the animal organism, and the epizootic situation of the agricultural enterprise. Therefore, part of the preventive measures is medical examination of animals and monitoring of infectious diseases of animals at a modern livestock enterprise. Another fact to consider is the people who are constantly exposed to the microflora in the contaminated premises, which in turn can cause sensitization, asthma, atopy, allergic rhinitis, pneumonia, exacerbation of chronic infections and many other pathologies (Hiranuma et al., 2011; Smit et al., 2014; Casey et al., 2015; Borlee et al., 2017; Zomer et al., 2017; Borlee et al., 2018; Freidl et al., 2019; Domatsky et al., 2020; Gagarin et al., 2021). This is another reason for a detailed study of the microbiota of livestock buildings and the development of methods for its correction.

MATERIAL AND METHODS

The studies were conducted at an industrial cattle breeding enterprise (breeding reproducer) in the Northern Trans-Urals (Tyumen region) in 2018-2019. The subject of research was the microbial content of the air in the premises of the pedigree breeding unit with cattle of various technological groups of the Holstein breed. Microbiological and bacteriological studies were conducted in an accredited laboratory. The object of the study was various livestock premises: a dairy building, a building for replacement heifers, a maternity pen and a calf barn.

Air in each room was sampled in the morning, when the animals were at relative rest (before feeding, changing bedding, feeding calves and milking cows), and in the daytime, when the listed activities were carried out. Bacterial species were differentiated based on their morphological, tinctorial, cultural, and biochemical properties. Microbiological studies were carried out in compliance with the methodological manual and (Masclaux et., et al 2013; Kochetova et al., 2020). The identification of the isolated cultures was carried out in compliance with the requirements set out in the Bergey's Manual of Systematic Bacteriology (1997). For inoculation, diagnostic media were used: enterococcus agar (for *Streptococci*), salt agar (for *Staphylococci*), Saburo (for fungi), Endo's medium (for *E. coli*). Biochemical studies of the isolated cultures were carried out on Api test systems (bioMérieux, France).

QMAFAnM – Quantity of Mesophilic Aerobic and Facultative Anaerobic Microorganisms was determined by pour plate method. The numerical data were processed using BIOSTAT and Microsoft Excel. All manipulations with animals were in compliance with Directive 2010/63/EU of the European Parliament and the Council of the European Union "On the protection of animals used for scientific purposes". During the studies, we used the generally accepted methods of scientific knowledge, such as interrelation and interdependence; synthesis and analysis; generalization and comparison; observation, measurement and interpretation; and special methods: bacteriological, clinical, biochemical, and hematological. The results were analyzed using the statistical and mathematical methods to ensure the reliability and objectivity of the data.

RESULTS AND DISCUSSION

The second most developing industry in the Tyumen region is the agro-industrial sector; despite the harsh climate, both crop production and animal husbandry are actively developing. Over the past fifteen years, the number of cattle has been stable and varied within 250-265 thousand heads. For many years, the average duration of the use of cows at dairy enterprises has been very low and averaged 2.4-2.6 lactations (Seedorf et al., 1998; Dorozhkin et al., 2018; Sheveleva et al., 2020; Patra and Kar, 2021). This testifies to the colossal economic losses of livestock enterprises and the industry in general. Such a difficult situation with the disposal of animals is characteristic of intensive livestock farming technology, where the concentrate type of feeding is practiced, animals are subject to physical inactivity, technogenic stress and receive less solar insolation. These factors and many others lead to profound metabolic disorders and immunodeficiency states (Sidorova et al., 2020; Sintiurev et al., 2020; Dhiman et al., 2021).

Losses of cattle occur due to the high culling of young animals from the herd. 75.4% of the culled head of cattle are young. The livability of young animals in the Tyumen region was 82.1%. The main reasons for the withdrawal of young cattle are digestive and respiratory diseases – 43.21% and 41.60%, respectively. The number of adult cattle is the most stable; however, there are much more factors leading to culling in this group of animals than in young animals. The main reasons for the withdrawal of adult cattle in the Tyumen region are digestive and metabolic disorders – 25.6% and 25.4%, respectively. Every sixth cow in the region (17.2%) leaves the herd due to orthopedic problems and injuries. Due to respiratory and reproductive diseases, 11.8% and 10.9% of animals, respectively, are withdrawn. The problem of animal poisoning in production remains urgent, which has caused the withdrawal of 9.1% of animals. In addition, the resulting immune deficiency states determine the infectious and invasive susceptibility of animals.

Epizootic situation in the Tyumen region is tense, characterized by constant problem of rabies (including cases in farm animals) and leukemia. Diseases such as anthrax (2016 in the Yamal-Nenets Autonomous Okrug), Pasteurellosis (2018), infectious nodular dermatitis (2019), brucellosis (2020) are sporadically recorded; tuberculin-positive animals are regularly detected. In addition, there is a high likelihood of FMD, which can be introduced from border areas. Considering the multifactorial nature of infectious diseases, we have studied the microbiota of cattle breeding premises to identify the likelihood

of diseases caused by opportunistic microflora. The microbial composition of the studied livestock premises consists of three types of bacteria – *Staphylococcus aureus, Streptococcus faecalis*, and *Escherichia coli* and three genera of fungi – *Mucor, Candida*, and *Aspergillus* (Table 1).

Table 1. Qualitative and quantitative composition of the microbiota of the cattle-breeding premises of the industrial enterprise

Microorganisms	The total number of microbial colonies in five Petri dishes, sampled from...		
	maternity pen and calf barns	dairy building	replacement calf building
Total viable count	535.5±11.23	409.3±8.44	263.1±6.02
Staphylococcus aureus	215.1±9.28	454.0±18.09	126.0±6.11
Streptococcus faecalis	95.5±2.06	76.1±2.62	82.4±3.01
Escherichia coli	17.1±0.41	5.3±0.33	9.3±1.33
Aspergillus spp.	32.5±2.00	5.0±0.33	49.9±1.12
Mucor spp.	8.1±0.20	3.0±0.12	5.4±0.14
Candida spp.	1.1±0.04	2.2±0.08	1.1±0.07
Total colonies	904.9±7.42	954.9±11.07	537.2±6.89

The total number of colonies of microorganisms in five Petri dishes sampled from the maternity pen and calf barns where calves were kept from 0 to 6 months was 904.9 ± 7.42 colonies, in the dairy building with cows aged two years and older the total number of colonies was 954.9 ± 11.07, and the rearing building for replacement calves aged from 6 to 12 months showed the lowest quantitative indicator 537.2 ± 6.89. Staphylococcus aureus dominated in the microbial community, it was found in the air of the housing where dairy cows were kept – 454.0 ± 18.09 colonies, in the maternity pen and in the rearing building – 215.1 ± 9.28 and 126.0 ± 6.11, respectively. *Streptococcus faecalis* sub dominated in the air of livestock buildings; the quantitative indicators of the total number of colonies differed slightly in different rooms and amounted to 95.5 ± 2.06, 82.4 ± 3.01, and 76.1 ± 2.62 colonies in the maternity pen, rearing building, and dairy building, respectively.

Colonies of *Escherichia coli* were least represented, while the total number of colonies also had small fluctuations – 17.1 ± 0.41; 9.3 ± 1.33 and 5.3 ± 0.33 colonies, respectively. Among the representatives of fungi, the growth of *Aspergillus* was most abundant, with the total number of colonies in the air of the rearing building was 49.9 ± 1.12, the maternity pen and the calf barn – 32.5 ± 2.00, and the dairy building – 5.0 ± 0.33 colonies. The number of colonies of fungi *Mucor* and *Candida* did not exceed 10 colonies in five Petri dishes. Considering that livestock buildings must be disinfected only when completely free from animals, which is practically impossible under intensive agriculture, enterprises often neglect the preventive disinfection. This approach to preventive measures does not provide biological safety for both animals and the staff, as well as those living nearby. Therefore, it is necessary to develop acceptable methods of disinfection in the presence of animals.

CONCLUSION

The main reasons for the withdrawal of young cattle turned out to be digestive and respiratory diseases – 43.21% and 41.60%, respectively. Withdrawal of adult cattle is due to digestive diseases, metabolic disorders, and orthopedic problems and injuries – 25.6%, 25.4%, and 17.2%, respectively. Cattle leukemia and rabies have long been the problems for the Tyumen region. There is a likelihood of particularly dangerous diseases such as anthrax, infectious dermatitis nodosa, tuberculosis, pasteurellosis, brucellosis, and foot and mouth disease. The composition of the microflora of the surveyed livestock buildings has been found to consist of three types of bacteria – *Staphylococcus aureus, Streptococcus faecalis*, and *Escherichia coli* and three genera of fungi – *Mucor, Candida*, and *Aspergillus*.

The study has shown differences in the quantitative indicators of microorganisms based on the purpose of the premises. The constant presence of a significant number of opportunistic microorganisms in livestock buildings increases the likelihood of respiratory and digestive diseases, and undermines the natural resistance of animals. Given that most manipulations with animals are carried out at the same place of their keeping, this casts doubt on the compliance with the rules of asepsis and antisepsis during any surgical procedures, and especially during surgical interventions. In addition, the animal-care staff, being in constant contact with opportunistic flora, is exposed to significant risk of occupational diseases. The data obtained dictate the need to develop a universal method for disinfection of livestock buildings in the presence of animals.

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