

Characteristic, Evolution And Influence On Epizootic Process Of Microorganisms In Biocenoses Of Livestock Farms

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ABSTRACT

Background. The paper presents data on the variability and relationship of microorganisms in the biocenosis of livestock farms.

Methods. The analysis of the available literature on the formation, operation, correction, and diagnosis of biocenoses of livestock farms.

Results. It is shown that the animal organism is constantly exposed to the environment. A special place among the environmental factors affecting the animal body is microorganisms – causative agents of infectious diseases. Survey available of the literature on the evolution and relationship of microorganisms in different natural habitats. So, in the process of evolution to parasitism in tissues and organs of animals have adapted a variety of microorganisms: viruses, bacteria, fungi, protozoa, helminths, and arthropods. In the nature of a lot of evidence on the phylogenetic relationships of pathogenic microbes from nonpathogenic to the emergence in the evolution of new pathogenic forms of bacteria under favorable environmental conditions and organisms.

Conclusion. Recommended livestock farms are to be regarded as ecosystems, artificially created by man. In them, there are special relationships between animals, protozoa, a diverse microflora, which are fundamentally different from those in vivo. In artificial biocenoses, the Association of conditionally pathogenic microorganisms that circulate in the economy can cause various diseases in farm animals.

Keywords: habitats, animal farm, the evolution of bacteria, parasites, diagnosis, epizootic process.

1. INTRODUCTION

Despite the disaggregation of the cattle ranches in the reform process of agriculture, gastrointestinal and respiratory diseases in farm animals remain the number one problem for specialists of veterinary medicine.^{22,23,48,84,75} This is because in reorganized collective farms

used the traditional technology of production of milk, preserved, enshrined in the evolution of the ecosystems, including Association of conditionally pathogenic bacteria that cause various pathological processes in animals in the farm.^{35,70,77,78,79,85}

So far, among the private practitioners of veterinary medicine, it is believed that one disease is caused by a single pathogen.^{55,84} However, not accounting for at least one of the followers of parasitocenosis that participates in the etiology of the disease, in our opinion, leads to a significant reduction of the efficiency measures that are specific to agriculture.^{14,31,48,69,92,95}

Underestimation of microorganisms as living beings, capable of complex relationships, has led to the fact that to date there are no clinical guidelines that clearly regulate the actions of the veterinarian to combat diseases caused by associations of microorganisms. The microbiological principle of rational antimicrobial therapy in veterinary medicine is still based on the postulates of Robert Koch and is reduced to the identification of a pure culture of the pathogen and determine its antibiotic resistance before prescribing an antimicrobial drug.³⁷ However, working with a pure culture makes it impossible to observe the complex bacterial interactions and to study their group behavior. This principle restricts the fight against all followers of parasitocenosis and does not take into account the complex behavior of microorganisms in the host organism. Therefore, assessment of farmer communities, the study of parasitocenosis in various pathologies, caused by conditionally pathogenic bacteria in the farm, as well as adequate differential diagnosis will be both to improve the effectiveness of health-epizootic measures and the livestock industry in the Russian Federation.

Characteristics of farm communities

Every part of our planet life is possible only in the form of associations or complexes of interrelated populations of species belonging to different taxonomic categories.^{16,29,43,70,79,98}

On this basis, infectious and epizootic processes are influenced by both natural and socio-economic economic factors that are secondary or mediocre driving forces of the epidemic process. Therefore, one cannot consider infectious diseases, divorced from the environment.^{23,44,49,87}

Biocenoses can be divided conditionally into natural and artificial. Heterotrophs that eat vegetable and animal weight in natural biocenoses are presented by microbes, mushrooms, amoebas, helminths, mollusks, rodents and animals of many types.^{7,28,35,94} Among the last, the leading part is assigned to wild hoofed animals and their relatives – pets. As a natural component, hoofed animals take part in the functioning of biocenoses which actively affect the biological efficiency of other objects.⁴⁹ In artificial biocenoses the conditions which are brought closer to nature not always take place. Animals are deprived of active exercise, solar lighting, and the free choice of forage. All this negatively affects a physiological condition of an organism, especially young. At the same time possibilities of an organism and its reaction to factors of the external environment are not always considered. The microclimate in rooms is also of great importance. At the big density of placement of livestock and the equipment of farms by cars sharply, in comparison with traditional, such indicators as the physical and chemical and microbic composition of air, lighting, noise change. At stall contents, the animals isolated from the external environment are fed monotonously which leads to metabolic disorders.^{23,76,82,90,94}

Distribution of causative agents of the diseases capable to influence people, livestock and wild animals threatens environmental safety more and more. A cattle livestock urbanization in close proximity to the activity of the person, can start a chain of transmission of infection, promote the emergence of pathogenic microorganisms and promotes the emergence of new outbreaks of diseases.⁹⁷ Along with it, livestock farms make emissions of gases, dust, toxins in the atmosphere which represent a risk for workers and can do harm to the population, living nearby.¹⁰⁰

At the same time at stall keeping of animals in areas they are protected from adverse weather and climatic factors – cold rains, snow, winds, heat and many infectious diseases, including rabies and diseases transmitted transmissible.^{27,46,94} On the background of reducing the

resistance of the organism of animals in housing, often recorded gastrointestinal and respiratory diseases, the etiology of which play an important role of conditionally pathogenic and saprophytic microorganisms.^{42,58,68,83}

It should also be noted that when the content of pasture decreases the density of animals in the territory. Crowding keeping animals in livestock buildings leads to constant stress that along with the above stressors leads to the development of cannibalism, stomach ulcers, "liquid pork" from pigs, drop in egg production and the percentage of output from poultry, and the development of infertility in mammals.^{17,38,41,64,89}

Currently, the emergence of diseases in animals contained in livestock farms, is considered from new positions as the influence of multifactorial etiology factors. When animal disease scientists have become more deeply investigate and analyze all possible deviations from the norm that can upset the balance in the body. Many years existing monoacylglycerol the concept of "one agent – one disease – one medicine", researchers have reconsidered, because in vivo in the patient animal is not a pure culture of the pathogen, and the Association of different species of symbionts, including opportunistic and saprophytes.^{13,20,22,39,61}

The evolution of parasitocenosis

Due to constant natural selection was a more complex and stable Association of microorganisms, which have filled various biological substances. So in the process of evolution arose microecological system, which inhabited the inner and outer surfaces of the body, forming complex symbiotic systems, which are the most sustainable and appropriate.^{40,47,51,90} In the first moments of life the skin and mucous membranes of the body populated with microorganisms, the number and variety of which are determined by the autoflora of the mother, delivery mechanisms, sanitary environment, and in the future and the type of feeding of the newborn.^{11,18,62} Microorganisms living on the skin and mucous membranes, are in a state of dynamic equilibrium with each other and the body of the animal. Normal, balanced microflora is called eubiosis.^{10,30,87} However, if adverse factors (Exo-and endogenous origin) exceed the compensatory potential environmental systems "the owner and his eubios", there is a change in the spectrum of microorganisms inhabiting it, with the result that can happen microecological disorders, accompanied by immunodeficiency States, purulent-inflammatory complications and other pathological processes in different organs and tissues.⁸⁸ In the process of evolution, and as a result of the interaction of followers of parasitocenosis host organism and improved system of protection of the organism against infection. In addition appeared and were fixed by selection of the properties that provide the parasite the possibility of life in the body of the host, i.e. virulence factors.^{3,8}

Due to a large number of parasitic forms in the environment increases the possibility of combining multiple pathogens in a single host. A combination of several pathogens in the host is a parasitic system, or parasitoses. The relationship between the parasites and host are in the context of the associative part of parasitocenosis and is an open, unstable, ever-changing group of ecologically interrelated macro - and microorganisms. Therefore in a complex set of relationships of the representatives of parasitocenosis not limited to the definition of action on microorganism-specific infectious agents. The development of the disease of different etiologies, primarily depends on the species composition of parasitocenosis.^{45,71}

In recent years, great interest was aroused by reports of the ability of the microorganisms to the formation of biofilms. The vast majority of bacteria that live in natural ecosystems, there are in an immobilized condition in which microbial cells fixed on a solid surface and tightly pressed against each other, forming a specific formation, called biofilms. Subsequently, it was found that along with the resident microflora of different biotopes of the organism in the form of biofilms, there are pathogenic microorganisms. Biofilm is a living, constantly changing community of microorganisms irreversibly attached to a biogenic or abiogenic substrate and to each other, surrounded by an extracellular polymeric matrix produced by these same bacteria and protects them from aggressive environmental influences. Such bacterial

communities can be formed by bacteria of one or more types, and consist of actively functioning cells, and resting, uncultivated forms.^{4,14,25,43,50,59,73,93}

In microbial associations between bacteria can be various relations. Association of conditionally pathogenic microflora may enhance the virulence of pathogenic microbes to cause a more severe course of the disease, but there is also a reverse process – inhibition of complex microbial virulence and even the viability of the main causative agent. There are many associated diseases, which etiology is represented by a combination of several low pathogenic pathogens, but they mutually reinforce each other and the disease is more malignant.^{15,19,68,72}

Participation of indigenous microorganisms

A number of authors indicate that the etiology of many infectious diseases that are found on livestock farms, a special place is the "normal" microflora.^{9,34,48,53,84,92} Significant stability in the environment conditionally pathogenic microflora allows it to quickly adapt to various adverse factors and to improve its pathogenic properties. At the same time, Chow J., Lee S. M., Shen Y., Khosravi, A., Mazmanian, S. K. suggests that formed in the evolution of the relationship between the resident microflora and the host, have created mutually beneficial partnership mechanisms.¹⁶ The intestine is a complex ecosystem consisting of an extraordinary number of commensal bacteria existing in homeostasis with the immune system of the host. The intestinal microbiota provides critical signals that promote the maturation of immune cells and tissues, leading to protection against pathogens.

The first data on bacteremia nonspecific – "intestinal translocation of the microorganisms" appeared in the late nineteenth century.²¹ In the future, enteric translocation of microorganisms was discovered under stress, traumatic injuries, burns, hepatitis, acute pancreatitis, endometritis, various immunosuppressive States.^{40,47,53,54,60,67,78,85,99} Translocation is the result of the interaction of physical, immunological and microbiological features of the gut.⁸⁰ Various factors contribute to its occurrence: violation of the "ecological balance" of the body, which leads to increased reproduction of the minor group of microorganisms in the intestine, functional liver failure, which leads to the ingress of microorganisms into the general bloodstream, impaired immune response of the patient, increased permeability of the mucous barrier, and also as a result intestinal epithelial destruction. The above mechanisms can act simultaneously, leading to fatal sepsis. With physically intact intestinal epithelium, microorganisms intracellularly reach the lymphatic system and move through it to the mesenteric lymph nodes. In the presence of physical damage to the epithelium, translocation of microorganisms occurs between cells directly into the bloodstream.^{1,6}

Relationships in microbial populations

In populations of microorganisms occupy a special place in hybrid forms of viruses and bacteria. They help infectious agents to overcome vaccine-induced immunity and cause the pathological process in the organism of animals. An infectious agent can withstand the impact factors of immunity in the form of hybrids with bacteria, which reside in the animal body (commensals and symbionts). With the weakening of a tension of immunity is a revival of pathogenic bacteria as a result of complex, sequential processes to random matings. The more microbial Association circulates hybrids, the faster change the properties of the population. It should be noted that under the influence of highly active, highly potent antimicrobial agents may also be a change of the properties of pathogens (mutation). This explains the emergence of drug-resistant strains of microbes, resulting in the changing landscape of pathogens on a livestock farm. The disease may occur in atypical form.^{2,15,24,33,56,65,70,81,90}

It should also be borne in mind that to cause infectious processes in the host organism the parasite is capable only if it has certain properties. It is the overcoming of natural barriers, including environmental (intestinal peristalsis, the bactericidal action of gastric juice, the secrets of the mucous membranes, the antagonistic action of the normal microflora), as well as the actions of the humoral and cellular factors of immunity of the host; attaching the

relevant parts of the organism (interaction with the epithelium, penetration into cells and tissue) reproduction; production of toxins or toxic products.^{12,32,63}

At many infectious and invasive diseases, the activator operates not separately, and as a part of a parazitosenoz. At the owner parasites are in difficult and various relationships. In this difficult complex of the relationship between representatives of a parazitosenoz, it is impossible to be limited to the definition of influence on an organism only of the specific infectious or invasive agent. In other words, the macroorganism needs to be considered as the closed biosphere within which is micro parasite cenosis which has interdependence with parasite cenosis of groups, herds, farms, farms.^{5,14,17,52,57,73,78,84,92}

As reported by a number of scholars, the creation of large herds of domestic animals and birds has led to violations of the evolutionary "proven" ecosystems, the proportions of the number of parasites.^{36,66,75,92,96} In contrast, when the animals are kept in groups, the quantitative composition of which is close to the evolutionary conditions of existence (subsistence farming, small farms), microflora of animal organism often appears in the form of symbiosis, which prevents the occurrence of infectious and parasitic diseases.

So the parasitism is a common biological phenomenon that all living beings face in the process of evolution. Animals act as hosts for many endoparasites that make up parasitoses, including different variations of viruses, bacteria, fungi, protozoa, helminths. Thus, parasitoses is the evolutionary relationships among the causative agents of different nature in conjunction with other agents that inhabit a host. Association of pathogens is the first stage in the formation of parasitocenosis, when there was mutual adaptation of agents which often manifests itself even within the joint of the antigenic groups of microorganisms. During this period, becoming particularly clear antagonistic and synergistic properties.

Evaluation of parasitocenosis is based, primarily, on the knowledge of its individual components (parasites). If the same host to a number of pathogens, their total negative impact is made up of many different factors (effect of parasites on the host, their effect on each other). All this must be taken into account in the fight against any pathology in the animal, which is caused by the association of pathogens.^{14,73} So, Sinkovics J.G. indicates: "coexistence, submission and subjugation, borrowing its most useful qualities or symbiosis with useful associates, remain the basic rules of living together."⁸¹

Thus, the artificial concentration of animals on farms causes a number of significant changes in the patterns of epizootic processes and amends the nosological profile of infectious diseases. Instead of mono-infectious diseases caused by obligate parasites, diseases of associated etiology appeared, caused by conditionally pathogenic microorganisms, and in some cases saprophytes. The artificial keeping of animals that are homogeneous in appearance, breed, age, natural resistance, and other indicators leads to the appearance of the same sensitivity to the action of infectious agents, thereby creating favorable conditions for the rapid re-passage and repeated passage of pathogens through susceptible animals. In addition, in artificially created biocenoses, constant breeding is carried out, the purpose of which is the breeding of new, highly productive farm animals. This does not take into account a decrease in the adaptability of the breeds to adverse environmental factors and an increase in sensitivity to the effects of infectious agents.

Diagnosis communities

Diagnosis – this is the crown of the medical art. The diagnosis of mixed infections should be a holistic method that involves the study of epizootological data, clinical features, pathomorphology, and laboratory tests. The complex method allows, not a clear the results of one research method to use the results of other methods to clarify or confirm the diagnosis. Biocenotic diagnosis is based on recognition of the etiology of mass diseases that occur in animals due to adverse changes in ecosystems. In the assessment of disease at the level of the animal organism must be considered: species, age and gender susceptibility of animals, and

presence of clinical manifestations and course of the disease in different age groups, morbidity and mortality of animals at different stages of the process.

During biocenotic diagnosis enzooty, it is necessary to evaluate animals, their organs, tissues, cells, subcellular structures of animal populations (herds); ecosystems (ecological systems, landscapes). After evaluation of the disease at the level of the body is necessary to assess the population of animals in which there is an infectious disease, to determine age, sexual, ethological structure of the herd, fertility, and other indicators in assessing populations. The status of the population shows incidence, mortality, lethality, infertility, twins, ugly. In the diagnostic process of biocenosis study documents that characterize the population dynamics of animals (livestock, their productivity, etc.). More detailed information on the population getting in the analysis of clinical and laboratory studies of clinically ill and healthy animals, the autopsy of the corpses.

The next stage of the diagnostic process is to evaluate farmers' biocenosis, which has any disease. While taking into account the type of dysfunctional ecological community (agricultural, pasture, farm, etc.), its features (grassland meadow, steppe, cultural, stockyards, farms, livestock complexes), the presence of geochemical zones according to the results of soil testing, fodder, the prevalence of goiter and other endemic diseases. It is known that the excess or deficiency of macro- and micronutrients in the environment in plants and animals arise an endemic disease, which in turn leads to a decrease in resistance of the organism of animals.

At the assessment of farmer, biocenoses pay attention to a microclimate and food chains which are involved in a field of activity of the person. Adverse changes in a microclimate (impurity products of metabolism of animals, light insufficiency) can become a cause of infringement of metabolism and to developing of the diseases caused by conditionally pathogenic microflora (factorial infections). In the analysis of food, chains pay attention to all links of production, storage and conservation of forages as these processes influence their chemical composition and, eventually, the health of animals (resistance or susceptibility to diseases). The importance also should be attached to the assessment of reservoirs which are used for a livestock watering of animals. The biocenotic diagnosis allows to the prediction of a disease that is important for the development of preventive actions. Antiepzootic actions which are carried out taking into account data estimates of a biocenosis in which animals of unsuccessful herd live have big cost efficiency. Without a condition of an organism of animals, the use of vaccines and other biological drugs gives to its resistance a low performance.

Practical veterinary science raised a question of the associated infections for a long time, and the science had a definite answer in this respect not at once. Many examples when developing an associative disease the virologist considered a disease of a virus etiology, the parasitologist – parasitic are known, and the bacteriologist established a bacteriological disease. It indicates the probability of the statement of the insolvent diagnosis. Quite often the diagnosis reflects not the valid participation of the allocated activator in developing of disease, and the width of the distribution of this parasitic look and simplicity of its detection. Such a statement confirms unpreparedness of a scientific and methodical basis at diagnostics of parazitotsenoz in general and the associated infections in particular. Proceeding from it, integration of knowledge first of all of three disciplines is necessary for diagnostic testings at the parasite cenosis: virology, microbiology and parasitology. For a statement of the exact diagnosis, it is necessary to study the epizootic situation, clinical signs, a pathoanatomical picture allowing to make the indicative diagnosis. The establishment of the final diagnosis, as a rule, requires carrying out laboratory researches including virologic, bacteriological, mycologic, and parasitological researches. Important if not it is decisive, serological methods of diagnostics matter, and carrying out the histopathological researches for identification the pathognomonic signs in certain cases is required.

An integrated approach in diagnostics of parazitosenoz has the advantage that at the ambiguity of the results received by one method it is possible to meet such lack at the expense of other methods of research. Comparison of the received results for the correct final conclusion is not less important. Such requirements are caused by versatility and variability of manifestation of parazitosenoz. However on any and at the final stage of diagnosis, there can be new data which cannot be rejected, and it is necessary to take cognizance and, perhaps, to revise earlier accepted medical conclusion. Besides, by rules of judicial and veterinary examination change the conclusion the judicial expert can even during the court session. In such cases when obtaining new essential information correction of the diagnosis is possible, the new empirical base according to concrete data is created and the diagnostic process can repeat on the same cycle.

2. CONCLUSION

Thus, the livestock farms should be viewed as ecosystems, artificially created by man. In them, there are special relationships between animals, helminths, protozoa, a diverse microflora, which are fundamentally different from those in vivo. Parasitic forms have a special place in the composition of biocenoses, where they combined different systematic groups of living organisms. In artificial biocenoses, Association of conditionally pathogenic microorganisms that circulate in the economy can cause various diseases in farm animals.

Diagnosis in artificial biocenoses always has to have creative character. The ability to generalize all available information on a disease and to establish a true etiology can do to a well erudite expert having analytical thinking and the ability to integrate all links of diagnostic testings.

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Competing Interests

The authors declare that they have no competing interests.

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