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ECOLOGO-EPIZOOTOLOGICAL CHARACTERISTICS OF ERYSIPELAS MANIFESTATION IN NORTHWESTERN BLACK SEA REGION

As a result of generalized epizootic analysis of the region to total level of erysipelas manifestation has been found 5 zones with different epizootic activity. Activity dynamics of natural sources of erysipelas infection (during perennial period) are significantly different from dynamics of this infection among domestic animals, indicating on clear enzootic nature of it.

A significant difference between amount of material samples and indicated cultures in rodents and pigs is defined. Seasonal dynamics of the research period show two peeks of activity – spring and autumn.

The Erysipeloid infection, which is better known in stockbreeding area as «swine erysipelas», in the group of natural infections – as mouse erysipelas or Rosenbach's disease. In epidemiology erysipelas as individual infectious nosological human form (code A26 for ICD – 10) is often described as zoonotic erysipelas, cutaneous erysipeloid, Baker's creeping erythema, naturalists' rubella [1, 10, 25].

Swine erysipelas is part of the group of typical zoonoses of bacterial origin with overall distribution in mid-latitudes of Northern hemisphere [2, 3, 13]. Today it's one of the most described and successfully prevented animal infections. But there are some problems in purely epizootiological regard, so approaches to understand it specificity have a lot of contradict questions.

Clinical signs of erysipelas in animals and humans were already known from Middle Ages, but in that time they were taken as single stages of developing of other diseases, such as non-contagious arthritis, anthrax, plague and so on. Nosological and etiological independence of infectious mouse disease, today known as erysipelas, were approved for the first time by R. Koch in 1878, when he identified the pathogen which caused mouse septicemia (*B. murispticus*). Appeared that discovered infectious agent was similar in morphological, cultural and serological properties to agent that caused swine erysipelas, which was discovered by L. Pasteur and L. Thiele. These scientists at once conducted series of laboratory researches and created several variants of inactivated and attenuated anti-erysipelas vaccines [4, 5, 8, 14]. Search of effective anti-erysipelas vaccines periodically become a topical problem, which indicate that wild strains are in continuous transformation and development [13, 21, 24].

The disease is caused by fixed, Gram-positive, rod bacteria without spores *Erysipelothrix rhusiopathiae* (*E. insidiosa, Bact. rhusiopathiae suis*) – genus *Erysipelothrix*, family *Corynebacteriaceae*, phylum *Firmicutes*. It's successfully cultivated on nutrient agar, where it forms small dewdrop colonies (S-form) after 16-24 hours of incubation, but recently it often found to form colonies of rough type (R-form) with wavy edges and numerous appendages. Besides, there are more and more cases of isolation of transitional forms between O-R – and S-R – forms, with irregular edges and wavy surface, which are more typical for chronicle articular lesions [4, 10, 22].

To the beginning of 80s of last century it was known about 2 antigenic variants of *E. rhusiopathiae* (*suis* and *murisepticum*), «swine» variant was circulating among domestic animals, and «mouse» variant – among wild animals. Later were defined three other antigenic serotypes – A, B, N, which strains were different by some ratio of specific antigens and haptens. Representatives of the serotype A have high virulence and when infect pigs cause disease in 95 % of cases. Representatives of the serotype B demonstrate relatively low virulence, but save their immunogenic properties, that's why the majority of attenuated vaccines are based on these strains. Cultures of the serotype N were isolated from clinically healthy domestic and wild animals.

Further researches of different strains of Erysipelothrix inside species *E. rhusiopathiae* differentiated 24 serological variants, of which representatives of 1st and 2nd are the most widely spread, and cause clinical forms of swine erysipelas. Herewith all representatives of erysipelothrix preserve very tight affinity with listerias [16, 17, 23].

The presence of these pathogen variants cause ambiguity of interpretation of key epizootiological characteristics of infectious pathology induced by them. Thus, perception of ability of existence of agents, which are able to initiate clinically similar disease in domestic and wild animals, can't be explained in ecological regard. Pathogenic agents of infectious diseases seek to cause latent forms in primary reservoir. They are greatly limited by body barriers, and activity of their hotbeds also limited by complex mechanisms of biocenotic self-regulation. In the farm hotbeds prevail septic (in young stock) and local sub-acute (in adult stock) forms of infectious process.

Of course, representatives of different eco-groups of erysipelas agents should have opposite properties and lead by different initiative factors. Herewith it's clearly that, thanks to variety of the pathogen strains, in practice arise typically zoo-

notic and sapronose processes of epizootic spread. And so it's naturally that "swine" variant of the agent of erysipelas is most likely only reverse-selected species-adapted form of wild strain, and it's not individual ecotype with formed antigenic specificity [9, 18–20].

Detailed investigation of ecological and epizootological aspects of primary manifestation of eryzipelas whithin natural resorvoir were conducted in the middle of last century by coryphaeuses of soviet theoretical school. Eryzipeloid was investagated in natural hotbeds by T.N. Dunayev, N.G. Olsufyev, O.S. Emelyanova, V.V. Kucheruk. They have formed basic ideas about this infection, as a typical factor of biocenotical self-regulation in conditions of middle lattitudes of Eurasia [7].

Unfortunately, so far there were no researches of erysipelas' hotbed on such level. Thus, main energies of researchers in veterinary medicine were concentrated on creation of effective vaccines, and in human medicine — on developing of diagnostical test-systems and medication [21]. And so the question about existence of clinical forms of infection, as resulting variants of ecological regularity of interaction of macro- and microorganisms in specific conditions remainig out of sight.

Respectively, **the main purpose of this work** is to investigate ecological and epizootic characteristics of eryzipelothrix manifestation in conditions of Northwestern Black Sea region. One of the **main goals** is analytical generalization of data about ecological and epizootological characteristics of cases of illness or isolation of *E. rhusiopathiae* culture from animals and objects of environment. The main **object** of research is phenomenon of enzootic circulation of *E. rhusiopathiae* in environment, and **subject** — investigation of ecological and epizootological characteristics of erysipelas manifestation in conditions of Northwestern Black Sea region.

MATERIALS AND METHODS

Main materials for conducting of analytical generalizations were accumulated during explorations of natural and farm hotbeds of zoonotic erysipelas, which were conducted in a period of 2004–2014

Fig. 1. Landscape and geographical specificity of erysipelas manifestation in the region during 1961–2014 (all objects): 1 – zones of the steadily highest infection activity; 2 – zones of the steadily lowest infection activity; 3 – zones of the unstable cyclic disease manifestation; 4 – zones of locally-forest type with the steadily high level of disease manifestation; 5 – zones with absence of disease registration

on territory of Odessa, Mykolaiv and Kherson region.

The specificity of this work, which oriented on disclosure of interelemental relationship in natural, farmstead, synanthropical and mixed hotbeds of infection, provide analytical generalization of zoological, populational, microbiological, epizootic and epidemiological data. The official reporting data, since 1961, when erysipelas was for the first time added to list of infectious human diseases, which belong to obligatory registration, was used for comparative investigation [12, 15, 16].

During the given period were investigated zoological, stational, epizootic and landscape-biotopical characteristics of available geographical zones and provinces of Northwestern Black Sea region. Annual reports of veterinarian and sanitary-epidemiological services of taken regions were analyzed, also were analyzed reports of laboratories and research institutions, which were engaged in control of soils and climatic conditions. One of the key materials was 27 cultures of *E. rhusiopathiae* which were isolated from different sources of the region.

Material samples for laboratory researches were manually selected from control objects. Laboratory researches were performed in conditions of practical laboratories of veterinary service. During processes of laboratory examination of animals were conducted more than 3 thousand of primary expertise, including 708 autopsies, 318 bacteriological, 19 biological and 2011 serological.

There were using entirely standard methods described in NSU, instructions and attitudes regarding to conducting of laboratory-diagnostic investigation in search of *E. rhusiopathiae*. All results were subject to statistical processing and further analytical generalization using power of modern electronic calculating tools and methods of operative landscape mapping based on remote-space probing [6].

RESEARCH RESULTS AND THEIR DISCUSSION

The Main biotopic and landscape-state variations of territory of investigated region created conditions for functioning of numerous infectious communities, which are generally typical for climatic zones. It is naturally that indicated infectious communities are supported by some certain reservoiric species, population state of which is determinative in regard of activation of available hotbeds of infectious diseases, include erysipelas. Therefore, considering

tasks, an attempt was used to combine all available information regarding results of erysipelas registration in the region, regardless to infected object — domestic, wild and synanthropic animals and humans. Herewith, all the summary information regarding to the region (1961–2014) was taken as 100 %, and local amount of cases of registration by regions and by single districts was calculated as it percent part. Obtained data was undergone to simple cluster analysis, forming clusters by similar biotope, landscape and soil conditions of individual land areas of the region (fig. 1) [11].

Results of generalized epiozootic analysis of the region's territory on total level of erysipelas manifestation (fig. 1) gave the opportunity to establish several patterns. The first one caused by that almost half of all cases of erysipelas registered among domestic animals (pigs), synanthropic and exanthropic rodents and humans were fixed on areas (zone 1), which total area is 11,7 % of region's area. In landscape and biotope regard this zone is clearly «related» to areas of river valleys, almost not affected by anthropogenic transformation. Respectively, these territories are exploited as pasturages, recreational zones, in which are exists tight populations of murine rodents, water related and natatorial birds. It's credibly that existence of powerful poly-species natural reservoirs and sources of the the pathogen and availability of optimal conditions for intensive circulation of it – are key reasons of high activity of erysipelas.

The second regularity that approves the first one — the smallest amount of erysipelas registration (zone 2) occur in arid (rainfall level less than 250–300 mm/year) plain territories of coastal regions, where conditions for permanent existence of tight populations of rodents are absent. Beside this, for given zone the absolute majority of illness cases were registered exclusively in domestic pigs with dominance of sporadic manifestation and small outbreaks in groups of young stock of 4–6 months. From the middle of 90s of last century there were no registered cases of erysipelas illness among humans on this territory, also attention was accented

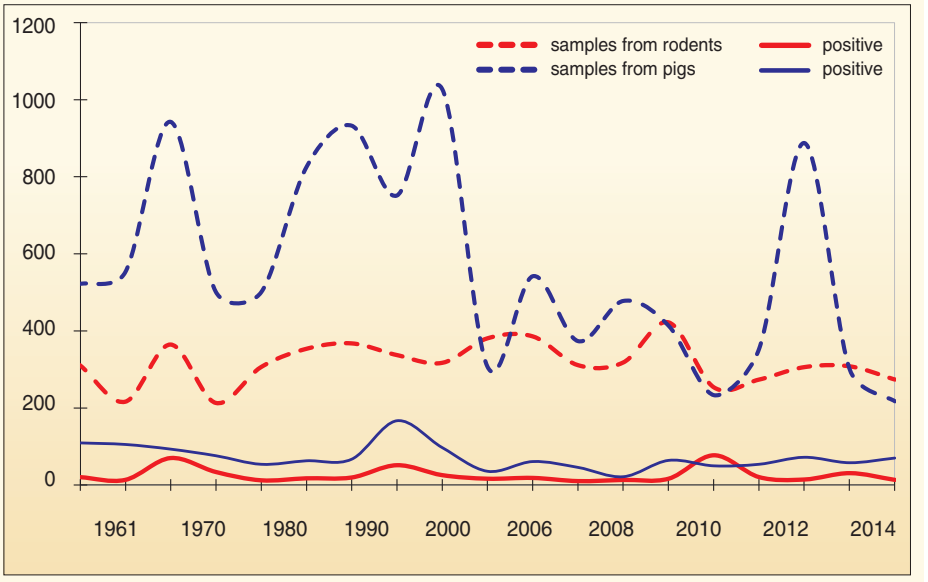

Fig. 2. Total amounts and results of bacteriological control of materials regarding to erysipelas of mice and pigs

on tendency to disappearance of erysipelas among pigs. An important feature of areas of this region, which were converged to zone 2, is prevalence there of saline and red soil, which were got under almost 100 % tillage.

The third regularity caused by straight relations between amount of erysipelas registration and level of humidity of environment and availability of forest biotopes (zone 4) on powerful black soil. Thus, on the extent of latitudinal increase of level of rainfall from minimum (on the edge of 256–290 mm/year), that situated in districts of Mykolaiv and Kherson regions, to maximum (on the edge of 600–625 mm/year) – in Northern districts of the region, the percentage amount of erysipelas registration increase in 15,7 %.

The zone of the unstable cyclic disease manifestation (zone 3) covers the field agrolandscape with level of tillage on the edge of 87–92 % area. Under such conditions the activation of level of tillage carries only periodical nature, which comes up once in a 3–4 years on the background of humidity (12–15 % higher than among perennial).

As for Northern-forested districts of the region distinctive features are: late-autumn epizootic outbreak of erysipelas manifestation with clearly saprozoonotic type of progress; relatively high part (on the level of 2,9–8,1 %) of infected by *E. rhusiopathiae* murine rodents; prevalence of root vegetables in pig rations, that could serve as a main factor of the pathogen transmission.

The regularity of rapid self-elimination of erysipelas infection at disappearance of the secondary reservoir and the source of the pathogen in the form of domestic pigs is not less expressed. Elimination of pig farms and minimizing of quantity of pigs in private segment during last decades — are main reasons of epizootic and epidemiologic welfare of Odessa, Mykolaiv and Kherson regions. Thus, main areas (zone 5) during 2000–2014 are erysipelas free, regarding to exanthropic and domestic animals and humans.

Such a situation directly point to role and value of support of activity of erysipelas hotbeds to numerous factors of landscape, soil, climatic, biocenotic and social-economic regards.

On the next research stage analytic generalization were done for the purpose of rating of possible dependence, of epizootic process of erysipelas in pig farming, from activity of natural and synathropic hotbeds of this infection. Generally, theoretical basics of epizootic and epidemic manifestations of the natural-hotbed zoonoses indicate on availability of such relative dependence. So, to check theoretical approaches and to rate perennial epizootic tension of the region's area regarding to erysipelas infection was conducted an

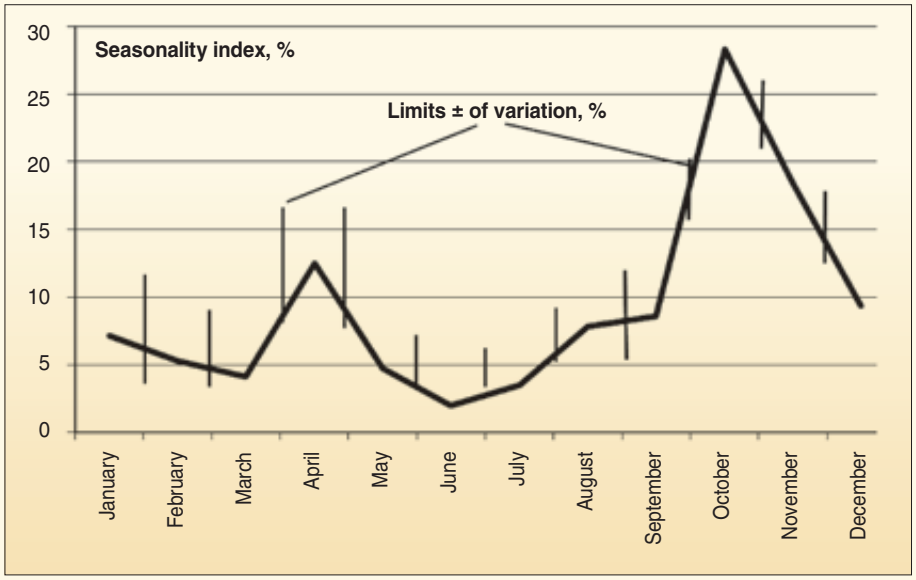

Fig. 3. Seasonality of swine erysipelas manifestation in pig farming of the region during 1961–2014

analysis of available data regarding to amount of laboratory (bacteriologic) researches and their results taken from all laboratories of the region. There are detailed values of control of epizootic situation regarding to erysipelas presence among murine rodents (exanthropic and synathropic) and domestic pigs (from farms of all forms of ownership) during period from 1961 to 2014 displayed on graphics on fig. 2.

Presented data (fig. 2) show us some sort of stabilization of epizootic situation in the pig farming of taken region, which was high to the beginning of 70s of last century. The last statement is clearly regular in conditions of prevalence of relatively small farms (under 1–2 thousands of heads) with primitive technologies of extensive type and low level of prophylaxis.

Logical aggravation of epizootic situation in pig farming took place in 90s of last century, when in conditions of depravation of prophylaxis and sanitary culture of stockbreeding, amounts of animal's morbidity reached peak numbers. By the way, as elimination of small farms and abrupt animals' deaths took place, also were eliminated favorable conditions for manifestation of the majority of infectious diseases in pig farming at all.

Unlike the swine erysipelas, situation with spreading among exanthrope and synanthrope rodents remains practically unchangeable, this points to the **primary** value of natural sources and nutrition factors of regarding transmission of the pathogen to the pig stock of the region. *Also, similar situation directly points on* ***secondary*** *role of sources and the pathogen strains, which are kept by rodents and domestic animals. In another words, swine erysipelas clearly manifests as closed binominal, single host and etiologically specified epizootic process, which kept by it reservoir, source and agent, which existence exclusively connected with their hosts among domestic pigs.* Clear confirmation of such a variant of the appearance and epizootic spreading of pathogenic strains in pig farming automatically provides apprehension of erysipelas primary saprozoonotic nature with consecutive creation of clearly zoonotic circles of circulation. Respectively, such a notion will cause revision of basics of disease control and naturally accent them on sphere of specific prophylaxis.

It's necessary to note an existence of considerable, almost tenfold gap between amount of material samples and isolated cultures. The last one show us stable tendency to laboratory exclusion of erysipelas in clinical and autopsy cases of disease manifestation with suspicion to poisoning, septic infection or classical swine fever.

Generalized data about seasonal dynamics of swine erysipelas cases registration on the territory of the region (1961–2014) is shown on the graphics on fig. 3.

Obtained data (fig. 3) give us an interesting material, which generally shows an absence of significant dependence of seasonal indexes of pigs morbidity from state of the industry, its technology level, number and density of the stock. Regardless to sharp changes of these parameters, there are two clearly preserved activity waves – spring and autumn, which indicate on epizootic role of wild and synanthrope murine rodents, which are the most active in these seasons. Herewith, difference in maximum fluctuations (±) of average perennial seasonality indexes, which are also different for individual month, are also noticeable. Thus, the highest fluctuation amplitude (up to 17% mainly towards growing) are accounted for winter months and August of 60–70 s of last century, and deviation of indexes (4–7%) of autumn season remains minimal for practically 53 years. And generally average perennial seasonality tendencies are remain remains constant, which points to some similarity to natural situation (dependence on similar sources of the pathogen and activity of hosts and carriers), and also limiting influence of seasonal amounts of young stock (dependence of process on density of objects of affection).

CONCLUSIONS

The researches, according to the specified purpose, gave us results, which allow characterizing erysipelas as infectious nosoform, which is able to dynamically change saprozoonotic and zoonotic spreading link. Indicated links could form binominal process (saprozoonosis ®Dynamical state of epizootic process takes place in natural conditions, and also in hotbeds of farming type, which are kept by pigs. This requires more detailed study of issues of general prophylaxis and the infection control, in conditions of intensive stockbreeding.

In ecological regard inability of enzootic circulation of highly pathogen strains of *E. rhusiopathiae* is cause by danger of infectious destabilization and elimination of the pathogen reservoir, so absolute majority of such strains in natural conditions

has exclusively secondary appearance and origin — from domestic pigs.

Prospects for further research are consist in detailed processing of the role of infection agent as a part of mechanisms of biocenotic self-regulation and their possible role in conditions of artificial ecosystems of farming type.

REFERENCE

1. **Ананьина Ю.В.** Природно-очаговые бактериальные зоонозы: современные тенденции эпидемиологического проявления / Ю.В. Ананьина // ЖМЭИ. – 2002. – № 6. – С. 86–90.
2. **Бактериальные** и вирусные зоонозы: Доклад комитета экспертов ВОЗ // Серия технических докладов ВОЗ. – Женева, 2007. – № 682. – 218 с.
3. **Бакулов И.А.** Рожа свиней / И.А. Бакулов, В.А. Ведерников, А.Л. Семенихин // Эпизоотология с микробиологией / Под ред. И.А. Бакулова. – М.: Колос, 2000. – С. 357–359.
4. **Воронин Е.С.** Рожа свиней: профилактика и меры борьбы / Е.С. Воронин, М.В. Романова. – М.: ВНИИТЭИагропром, 1987. – 115 с.
5. **Воронин Е.С.** Инфекционные болезни животных / Е.С. Воронин, Б.Ф. Бессарабов, А.А. Вашутин. – М.: Колос, 2007. – 671 с.
6. **Далматов В.В.** Применение методов математической статистики при проведении эпидемиологического анализа / В.В. Далматов, Р.Н. Готвальд, В.Л. Стасенко. – Омск, 2002. – 68 с.
7. **Дунаева Т.Н.** Изучение эпизоотии эризипелоида среди водяных крыс в природных условиях / Т.Н. Дунаева, О.С. Емельянова В.В. Кучерук // Вопросы краевой, общей и эксперимент. паразитологии и мед. зоологии / Под ред. И.Г. Галузо. – М.: Изд-во АН СССР, 1953. – Т. 8. – С. 175–181.
8. **Карасева Е.В.** Методы изучения грызунов в полевых условиях / Е.В. Карасева, А.Ю. Телицына – М.: Наука, 1996. – 227 с.
9. **Коренберг Э.И.** Основы современных представлений о природной очаговости болезней / Э.И. Коренберг // Журн. РЭТ–ИНФО. – 2000. – № 3. – С. 18–20.
10. **Корнієнко Л.Є.** Сапронозні інфекційні хвороби тварин / Л.Є. Корнієнко, В.В. Недосєков, В.О. Бусол, Л.М. Корнієнко, В.О. Ушкалов, А.М. Головко. – Біла Церква: Білоцерк. держ. аграр. у-т, 2009. – 300 с.
11. **Лопач С.Н.** Статистические методы в медико-биологических исследованиях с использованием Excel / С.Н. Лопач, А.В. Чубенко, П.Н. Бабич. – К.: Морион, 2000. – 320 с.
12. **Олсуфьев Н.Г.** Об эпизоотологии рожистой инфекции среди грызунов и насекомоядных / Н.Г. Олсуфьев, Т.Н. Дунаева // Вопросы краевой, общественной и экспериментальной паразитологии и мед. зоологии. – 1951. – Т. 7. – С. 244–276.
13. **Отчёт** ВОЗ по зоонозам // Доклад комитета экспертов ВОЗ. – Серия технических докладов ВОЗ. – № 763. – Женева, 2009. – 217 с. (англ.).
14. **Павловский Е.Н.** Современное состояние учения о природной очаговости болезней человека / Е.Н. Павловский // Природно-очаговые болезни человека / Под ред. Н.Н. Павловского. – М.–Л.: Медгиз, 1960. – С. 6–40.
15. **Пашкина Ю.В.** Методология научных исследований в эпизоотологии (уч.-метод. пособие для практ. занятий) / Ю.В. Пашкина, Е.А. Грачева, А.В. Пашкин [и др.]. – Н. Новгород, 2006. – 136 с.
16. **Сайт** ВОЗ в Интернете [Электронный ресурс]. – Режим доступа: http://www.who.int.
17. **Сайт** МЭБ в Интернете [Электронный ресурс]. – Режим доступа: http://www.oie.int.
18. **Сомов Г.П.** Некоторые аспекты экологии возбудителей сапронозов / Г.П. Сомов, Л.С. Бузолева // Эпидемиол. инфекц. бол. – 2002. – № 1. – С. 8–11.
19. **Терских В.И.** Сапронозы (о болезнях людей и животных, вызываемых микробами, способными размножаться вне организма во внешней среде, являющейся для них местом обитания) // Журнал микробиол., эпидемиол. и иммунобиол. – 1958. – № 8. – С. 118–122.
20. **Третьяков А.М.** Особенности краевой эпизоотологии доминирующих бактериальных инфекций сельскохозяйственных животных в республике Бурятия: автореферат дис. … докт. вет. наук: 06.02.02. – Барнаул, ПО Бурятская государственная с.-х. академия им. В.Р. Филиппова, 2011. – 40 с.
21. **Ярцев М.Я.** Иммуногенные свойства сухой живой вакцины из штамма ВР-2 против рожи свиней / М.Я. Ярцев, В.П. Шишов, Р.В. Душук // Научные основы производства ветеринарных препаратов: Сб. науч. тр. – М., 1989. – С. 74–77.
22. **Classification** of Erysipelothrix strains on the basis of restriction fragment length polymorphisms / S. Ahrne, I.M. Stenstrom, N.E. Jensen et al. // International J. of Systematic Bacteriology. – 1995. – Vol. 45 (2). – P. 382–385.
23. **Kumar J.** Optimizing the culture medium formula of Erysipelothrix rhusiopathiae / J. Kumar, K. Rae, R. Lindjaerv // Veterinary-Medicine. – 1998. – P. 122–128.
24. **Perotska L.V.** Ekological-epizootic features of sapronose infections (on the example of listeriosi and erysipelas) / L.V. Perotska, V.V. Nedosekov // Ветеринарна медицина України. – 2014. – № 5. – С. 15–18.
25. **Smith R.M.** Erysipeloid / R.M. Smith // Zoonoses: biology, clinical practice and public health control. – Oxford University Press, 1998. – P. 83–87.

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Еколого-епізоотичні характеристики прояву бешихи в умовах Північно-Західного Причорномор'я. *Л.В. Пероцька, В.В. Недосєков*

За результатами узагальненого епізоотичного аналізу території регіону за сумарним рівнем прояву бешихи встановлено 5 зон із різною епізоотичною активністю. Динаміка активності природних джерел бешихової інфекції (за багаторічний період) суттєво відрізняється від динаміки даної інфекції серед свійських тварин, що вказує на явну ензоотичність останньої.

Встановлено значну різницю між обсягами проб матеріалу та обсягами виділених культур у гризунів і свиней. Сезонна динаміка за досліджуваний період демонструє два піки активності – весняний та осінній.

Эколого-эпизоотические характеристики проявления рожи в условиях Северо-Западного Причерноморья. *Л.В. Пероцкая, В.В. Недосеков*

В результате обобщенного эпизоотического анализа территории региона по суммарному уровню проявления рожи установлены 5 зон с различной эпизоотической активностью. Динамика активности природных источников рожистой инфекции (в многолетнем плане) значительно отличается от динамики данной инфекции среди домашних животных, что указывает на явную энзоотичность последней.

Установлена значительная разница между объемами проб материала и объемами выделенных культур у грызунов и свиней. Сезонная динамика за исследуемый период демонстрирует два пика активности – весенний и осенний. ○

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