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Retrospective analysis of enzootic bovine leucosis spread in Republic of Dagestan considering natural and climatic conditions

A. R. Mustafayev, M. O. Baratov

Caspian Regional Research Veterinary Institute – Branch of Dagestan Agriculture Science Center, Makhachkala, Republic of Dagestan, Russia

ABSTRACT

Retrospective analysis of enzootic bovine leucosis (EBL) data received by the Republic of Dagestan Veterinary Laboratory and Veterinary Department of the Republic of Dagestan was made. From 1988 to 2022, the Republican veterinary laboratories serologically tested 3,205,118 animal sera for the antibodies to bovine leukaemia virus (BLV) antigen, and 76,133 (2.4%) of them were positive. High BLV infection levels were detected in 1988 (32.2%), 1989 (21.3%), 1991 (23.3%), 1993 (23.0%), 2005 (24.2%), 2010 (23.0%), and the lowest ones were reported in the recent years: 2020 – 1.0%, 2021 – 1.0%, 2022 – 0.5%. In 2022, diagnostic testing of 875,312 serum samples was carried out, which included 476,493 sera collected from bovines in high-altitude and mountainous areas of Dagestan. In the plain areas, 255,312 bovine animals were tested for leucosis, and 122,967 animals were tested in the sub-mountain areas. The animal infection with BLV in these natural and climatic conditions was reported as follows: high-altitude and mountainous areas – 0.5% (2,313 animals), plain areas – 0.8% (1,925 animals), sub-mountain areas – 0.1% (109 animals). Additional 20,540 serum samples were tested in the laboratories at the transhumance pasture veterinary units, and 170 BLV seropositive animals (0.83%) were detected. No EBL was diagnosed in the laboratories of the Derbent, Kochubeysk, Ulankholsk, Bakressk veterinary units, but other four laboratories detected high level of BLV seropositive animals (Kizlyarsk – 14.6%, Babayurt – 3.6%, Tarumovsk – 3.0%, Kyzylyurt – 1.06%). Thus, EBL is widespread in animals, especially in the plain areas of the Republic of Dagestan.

Keywords: enzootic bovine leucosis (EBL), epizootic map, natural and climatic zones, dynamics of EBL spread, Republic of Dagestan

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For correspondence: Arkif R. Mustafayev, Cand. Sci. (Veterinary Medicine), Leading Researcher, Laboratory of Infectious Pathology of Farm Animals, Caspian Regional Research Veterinary Institute – Branch of Dagestan Agriculture Science Center, 367000, Russia, Republic of Dagestan, Makhachkala, ul. Dakhadaeva, 88, *e-mail: mustafaev_arkif@mail.ru.*

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Ретроспективный анализ распространения лейкоза крупного рогатого скота в Республике Дагестан с учетом природно-климатических условий

А. Р. Мустафаев, М. О. Баратов

Прикаспийский зональный научно-исследовательский ветеринарный институт – филиал ФГБНУ «Федеральный аграрный научный центр Республики Дагестан» (Прикаспийский зональный НИВИ – филиал ФГБНУ «ФАНЦ РД»), г. Махачкала, Республика Дагестан, Россия

РЕЗЮМЕ

Проведен ретроспективный анализ эпизоотологических данных по лейкозу крупного рогатого скота ГБУ РД «Республиканская ветеринарная лаборатория» и Комитета по ветеринарии Республики Дагестан. С 1988 по 2022 г. в ветеринарных лабораториях республики серологическим методом были проведены исследования 3 205 118 проб крови животных с целью выявления антител к антигену вируса лейкоза крупного рогатого скота, из них 76 133 (2,4%) дали положительный результат. Высокий уровень инфицированности животных вирусом лейкоза крупного рогатого скота выявлен в 1988 (32,2%), 1989 (21,3%), 1991 (23,3%), 1993 (23,0%), 2005 (24,2%), 2010 (23,0%) годах, а наименьший установлен в последние годы: в 2020 г. – 1,0%, в 2021 г. – 1,0%, в 2022 г. – 0,5%. В 2022 г. проведены диагностические исследования 875 312 проб сыворотки крови, из которых 476 493 были отобраны от крупного рогатого скота из высокогорных и горных районов Дагестана. В равнинной части республики на лейкоз было исследовано 255 312 гол. крупного рогатого скота, в предгорных районах – 122 967 гол. Инфицированность животных вирусом лейкоза крупного рогатого скота в данных природно-климатических зонах составила: в высокогорных и горных – 0,5% (2313 гол.), в равнинной зоне – 0,8% (1925 гол.), в предгорной – 0,1% (109 гол.). Еще 20 540 проб сыворотки крови были исследованы в лабораториях ветеринарных станций отгонного животноводства, в результате выявили 170 (0,83%) животных, сероположи-

тельных к вирусу лейкоза крупного рогатого скота. В лабораториях Дербентской, Кочубейской, Уланхольской, Бакресской ветеринарных станций лейкоз у крупного рогатого скота не диагностирован, а в других четырех выявлен высокий уровень серопозитивности животных к ВЛКРС (Кизлярская – 14,6%, Бабаюртовская – 3,6%, Тарумовская – 3,0%, Кизилюртовская – 1,06%). Таким образом, лейкоз крупного рогатого скота имеет повсеместное распространение среди животных, особенно на территории равнинной зоны Республики Дагестан.

Ключевые слова: лейкоз крупного рогатого скота, эпизоотическая карта, природно-климатические зоны, динамика распространения вируса лейкоза крупного рогатого скота, Республика Дагестан

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Для корреспонденции: Мустафаев Аркиф Рамазанович, канд. вет. наук, ведущий научный сотрудник лаборатории инфекционной патологии сельскохозяйственных животных, Прикаспийский зональный НИВИ – филиал ФГБНУ «ФАНЦ РД», 367000, Россия, Республика Дагестан, г. Махачкала, ул. Дахадаева, д. 88, *e-mail: mustafaev_arkif@mail.ru.*

INTRODUCTION

Enzootic bovine leucosis (EBL) is a disease widely spread in many countries of the world and in the regions of the Russian Federation [1, 2, 3, 4]. The disease is caused by bovine leukemia virus (BLV) and specified by long subclinical course. EBL is mostly chronic and seldom acute [5, 6, 7, 8]. Definite time period (3–5 years and more) is necessary for the disease to transform from the subclinical to hematological or clinical phase. This is entirely dependent on the immunological and physiological status of the animal. Reasons or negative factors affecting the immune status of the BLV-infected animal can include concomitant diseases (brucellosis, tuberculosis, etc.), poor feeding, stress (veterinary manipulations, insect bites, injuries, etc.). Effects of radiological elements as well as natural and climatic conditions (temperature, humidity, rarified air, etc.) cannot also be excluded [9, 10, 11, 12, 13, 14].

In 2020, in the Republic of Dagestan, there were over million bovines and the number of cows amounted to 481 thousand of them; in 2021 – 951 thousand animals including 462 thousand cows. In 2022, the veterinary laboratories serologically tested 875,312 bovine blood sera that amounted to 92% of the total bovine population in the Republic. When 5–6-month old calves born from the cows not subjected to EBL testing are included, the coverage of the serologically tested population can reach 100% for the Republic.

The study was aimed at the retrospective analysis of EBL epizootic situation taking into account natural and climatic zones in the Republic of Dagestan.

Based on the aim the following tasks were identified:

1. Retrospective analysis of EBL-situation over the recent 35 years.

2. Examination of BLV spread in animals in different natural and climatic zones of the Republic.

3. Compilation of EBL epizootic map for the municipal raions and okrugs in the Republic.

MATERIALS AND METHODS

In order to conduct EBL epizootological monitoring in municipal raions and okrugs, official statistical data of the GBI RD "Republican Veterinary Laboratory" and the Republic of Dagestan Veterinary Committee were used. EBL situation in the Republic over the past 35 years was studied in the form of a retrospective analysis, taking into account the effect of natural and climatic conditions on EBL spread in animals. The epizootic map of EBL spread in the Republic was compiled taking into account the territorial boundaries of raions and municipal okrugs.

Serological and hematological tests of animal blood for EBL were carried out according to the "Guidelines for bovine leukosis diagnosis" [15], and the BLV spread situation was studied according to the "Guidelines for epizootological survey of bovine leukosis" [16].

RESULTS AND DISCUSSION

In 1988–2022, serological tests of 3,205,118 animal blood samples were performed to detect antibodies to the BLV antigen, and 76,133 (2.4%) test results were positive. A high proportion of BLV infection was detected in animals in 1988 (32.2%), 1989 (21.3%), 1991 (23.3%), 1993 (23.0%) and 2005 (24.2%), 2010 (23.0%). The lowest level of infection was established in the recent years: in 2020 – 1.01%, in 2021 – 1.0%, in 2022 – 0.5% (Table 1). In our opinion, the low level of animal infection with BLV is associated with a high coverage of bovines with diagnostic tests, and the highest percentage of seropositive farm animals is associated with the sampling of animals located on the public farms in the plain zone. At the same time, hematological tests were conducted in veterinary laboratories among the seropositive animals for the detection of persistent leukocytosis. A total of 40,057 samples were hematologically tested. As a result, 5,612 (14.0%) animals demonstrated development of persistent leukocytosis. Over the past 35 years, the largest number of bovine blood samples were subjected to hematological tests in 1988 (9,451), 1989 (9,127), 1990 (4,657) and 2019 (6,070). The proportion of hematologically diseased animals in these years amounted to 9.4% (888), 11.3% (1,031), 11.0% (512), 24.4% (1,482), respectively. In 2006, 2007, 2008 and 2022, hematological tests of animal blood were not conducted in the Republic, and the number of samples tested in other years was insignificant and did not reflect the real situation on EBL incidence. Nevertheless,

Table 1
Retrospective analysis of EBL spread in the Republic of Dagestan

Year	IDA tested			Hematological tests		
	total tested, animals	IDA-positive	seropositive, %	total tested, animals	persistent leukocytosis	%
1988	9,248	2,977	32.2	9,451	888	9.4
1989	31,823	6,783	21.3	9,127	1,031	11.3
1990	18,592	3,678	19.8	4,657	512	11.0
1991	8,613	2,006	23.3	1,277	168	13.2
1992	8,777	1,161	13.2	755	26	3.4
1993	5,157	1,186	23.0	1,039	21	2.0
1994	11,413	1,538	13.5	401	16	4.0
1995	9,575	1,219	12.7	733	8	1.1
1996	6,773	979	14.5	145	–	0
1997	6,041	462	7.6	18	–	0
1998	5,162	384	7.4	128	–	0
1999	4,112	151	3.7	72	–	0
2000	2,553	48	1.9	511	–	0
2001	2,300	68	3.0	49	–	0
2002	2,610	197	7.5	60	13	21.7
2003	2,133	23	1.1	20	–	0
2004	3,287	60	1.8	72	–	0
2005	3,127	758	24.2	286	53	18.5
2006	2,658	335	12.6	–	–	–
2007	–	–	–	–	–	–
2008	20,007	581	2.9	–	–	–
2009	10,109	1,822	18.0	281	103	36.7
2010	9,328	2,148	23.0	451	193	42.8
2011	7,417	1,214	16.4	136	61	44.9
2012	5,977	172	2.9	81	22	27.2
2013	7,210	1,220	16.9	447	135	30.2
2014	5,504	295	5.4	233	39	16.7
2015	7,310	1,016	13.9	79	14	17.7
2016	10,842	1,433	13.2	296	86	29.1
2017	7,466	577	7.7	188	45	23.9
2018	223,293	8,998	4.0	1,202	292	24.3
2019	625,970	15,578	2.5	6,070	1,482	24.4
2020	524,930	5,361	1.0	1,265	251	19.8
2021	720,489	7,188	1.0	527	153	29.0
2022	875,312	4,517	0.5	–	–	–
Total	**3,205,118**	**76,133**	**2.4**	**40,057**	**5,612**	**14.0**

IDA – immunodiffusion assay.

high percentage of the leukemia diseased animals of the number of hematologically tested ones was noted in 2009 (36.7%), 2010 (42.8%), 2011 (44.9%), 2013 (30.2%), 2016 (29.1%) and 2021 (29.0%).

In 2007, EBL diagnostic tests of animal blood were not carried out, and the number of serologically tested animals did not exceed 32 thousand bovines/year until 2018. Large-scale serological EBL tests were started in 2019. Then 625,970 animal serum samples were tested, in 2020 – 524,930, in 2021 – 720,489, in 2022 – 875,312, of which 15,578 (2.5%), 5,361 (1.0%), 7,188 (1.0%), 4,517 (0.5%) samples were seropositive, respectively.

Table 2
Epizootic analysis of EBL spread in 2022 considering the natural and climatic zones of the Republic of Dagestan

Raions and municipal okrugs	Total IDA-tested, animals	IDA-positive, animals	Seropositive animals, %
Plain area			
Babayurtovsky	17,944	91	0.51
Kizilyurtovsky	15,589	2	0.013
Kizlyarsky	24,022	721	3.0
Tarumovsky	29,956	334	1.1
Khasavyurtovsky	56,744	52	0.09
Karabudakhkentsky	15,414	75	0.5
Kumtorkalinsky	6,188	308	5.0
Magaramkentsky	25,693	0	–
Nogaysky	18,163	3	0.02
Kayakentsky	10,534	18	0.17
Derbentsky	12,479	5	0.04
Kaspiysk city	576	0	–
Makhachkala city	15,397	260	1.7
Khasavyurt city	5,222	3	0.06
Derbent city	571	0	–
Dagestanskiye Ogni town	507	0	–
Kizlyar town	313	53	16.9
Total	**255,312**	**1,925**	**0.8**
Sub-mountain area			
Kazbekovsky	18,306	0	–
Kaytagsky	8,559	0	–
Sergokalinsky	7,468	50	0.67
Tabasaransky	20,743	1	0.005
Khivsky	8,790	0	–
Buynaksky	29,327	24	0.08
Novolaksky	10,165	34	0.33
Suleyman-Stalsky	19,609	0	–
Total	**122,967**	**109**	**0.1**
High-altitude and mountainous areas			
Agulsky	7,967	0	–
Akushinsky	58,933	65	0.1
Akhtynsky	10,706	0	–
Kurakhsky	11,492	0	–
Gergebilsky	21,018	107	0.51
Gunibsky	33,855	762	2.3
Kulinsky	25,131	4	0.02
Laksky	25,471	37	0.15
Levashinsky	24,612	2	0.008
Rutulsky	14,673	13	0.09
Untsukulsky	15,817	114	0.7
Khunzakhsky	21,669	20	0.09
Shamilsky	30,780	263	0.9
Botlikhsky	36,994	208	0.6
Gumbetovsky	18,513	0	–
Dakhadayevsky	20,241	96	0.5
Tlyaratinsky	13,892	76	0.5
Charodinsky	20,014	385	1.9
Tsumadinsky	17,247	72	0.4
Tsuntinsky (Bezhtinsky uchastok)	14,680	0	–
Akhvakhsky	22,264	89	0.4
Dokuzparinsky	10,524	0	–
Total	**476,493**	**2,313**	**0.5**

IDA – immunodiffusion assay.

In view of the above, it can be concluded that the number of diagnostic tests is annually increasing, and animal BLV infection rates are decreasing.

In 2022, EBL diagnostic tests were carried out on 875,312 serum samples, of which 476,493 were collected from cattle in the high-altitude and mountainous regions of Dagestan. 255,312 bovines were tested for EBL in the plain part of the Republic and 122,967 animals in the sub-mountain areas (Table 2). BLV seropositivity of cattle in the natural and climatic conditions of the Republic was at the following level: in the plain areas – 0.8% (1,925 animals), in high-altitude and mountainous areas – 0.5% (2,313 animals), in the sub-mountain areas – 0.1% (109 animals). A high degree of BLV infection in animals is mainly reported in the areas located on the plain, as well as in mountainous areas where transhumance farms are located in the flat areas. The highest epizootic BLV spread was reported in the following raions and municipal okrugs: Kizlyar town (16.9%), Kumtorkalinsky (5.0%), Kizlyarsky (3.0%), Gunibsky (2.3%), Charodinsky (1.9%) raions, Makhachkala city (1.7%), Tarumovsky Raion (1.1%). In other raions and municipal okrugs, the animal BLV seropositivity level did not exceed 1.0%. In 2022, the Republican veterinary laboratories did not detect BLV antibodies by diagnostic tools in the blood of animals in 11 raions (Magaramkentsky, Kazbekovsky, Kaytagsky, Khivsky, Suleyman-Stalsky, Agulsky, Akhtynsky, Kurakhsky, Gumbetovsky, Tsuntinsky (Bezhtinsk uchastok), Dokuzparinsky) and in 3 municipal okrugs (Kaspiysk, Derbent, Dagestanskiye Ogni).

Analyzing the data in Table 2, it can be noted that the lowest BLV spread (0.1%) in animals was reported in the areas that are located in the sub-mountain areas

Table 3
EBL monitoring performed by the transhumance pasture veterinary units in the Republic of Dagestan in 2022

Transhumance veterinary stations	Total tested, animals	IDA-positive, animals	Seropositive animals, %
Tarumovsk	4,310	129	3.0
Kizlyar	82	12	14.6
Bakres	3,515	0	–
Kizilyurt	1,228	13	1.06
Babayurt	446	16	3.6
Kochubeysk	5,888	0	–
Ulankholsk	3,892	0	–
Derbent	1,179	0	–
Total	**20,540**	**170**	**0.83**

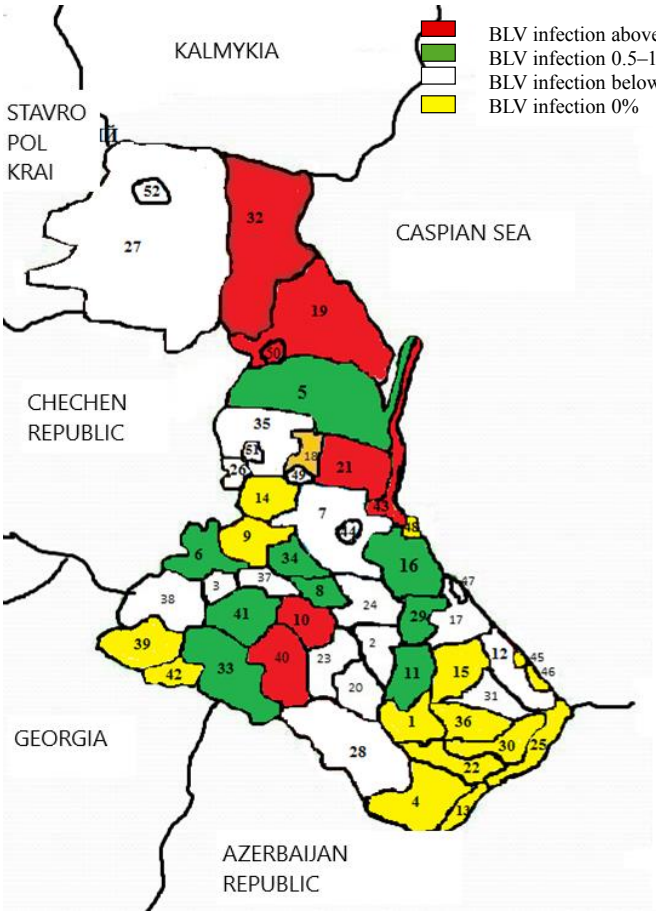
IDA – immunodiffusion assay.

of the Republic. This is due to the fact that the farm animals in these areas have limited contact with the infected animals located in the plain areas of the Republic. However, in the mountainous and high-altitude areas of the Republic, many livestock farmers graze their cattle and small ruminants on mountain meadows in summer, and in the transhumance areas on the lowland plaining in winter, where, in our opinion, contact with infected animals may occur.

Thus, the main reasons for BLV spread in the mountainous areas of the Republic include the following: joint grazing of indigenous animals and animals from the mountainous areas in the plain areas, veterinary manipulations (tagging, blood collection, obstetrics, etc.) at the transhumance veterinary stations, etc. As noted earlier [9], the high level of EBL spread in the plain areas of the Republic is associated with the historical importation of infected animals from the disease-infected farms in the north-western and central regions, as well as from the Baltic Republics and Ukraine during the Soviet period. An important factor in the spread of the infection in the plain areas of the Republic of Dagestan also involves high concentration and intensification of animal reproduction on public farms [17, 18, 19].

In the Republic, in the places of transhumant management of cattle and small ruminants, the transhumance veterinary stations are located in the plain areas, where diagnostic tests of animal blood for various diseases are carried out, including EBL. In 2022, specialists of these veterinary stations serologically tested 20,540 animal blood samples for EBL, of which 170 (0.83%) showed positive results (Table 3). In the laboratories of four out of the eight veterinary stations (Derbent, Kochubeysk, Ulankholsk, Bakres), EBL was not diagnosed by serological method, and in the other four a high level of animal BLV seropositivity was detected (Kizlyar – 14.6%, Babayurt – 3.6%, Tarumovsk – 3.0%, Kizilyurt – 1.06%).

Comparative analysis of EBL epizootological data in municipal okrugs, raions and related transhumance areas



Municipal raions

1. Agulsky
2. Akushinsky
3. Akhvakhsky
4. Akhtynsky
5. Babayurtovsky
6. Botlikhsky
7. Buynaksky
8. Gergebilsky
9. Gumbetovsky
10. Gunibsky
11. Dakhadayevsky
12. Derbentsky
13. Dokuzparinsky
14. Kazbekovsky
15. Kaytagsky
16. Karabudakhkentsky
17. Kayakentsky
18. Kizilyurtovsky
19. Kizlyarsky
20. Kulinsky
21. Kumtorkalinsky
22. Kurakhsky
23. Laksky
24. Levashinsky
25. Magaramkentsky
26. Novolaksky
27. Nogaysky
28. Rutulsky
29. Sergokalinsky
30. Suleyman-Stalsky
31. Tabasaransky
32. Tarumovsky
33. Tlyaratinsky
34. Untsukulsky
35. Khasavyurtovsky
36. Khivsky
37. Khunzakhsky
38. Tsumadinsky
39. Tsuntinsky
40. Charodinsky
41. Shamilsky
42. Bezhtinsky uchastok

Municipal okrugs

43. Makhachkala
44. Buynaksk
45. Dagestanskiye Ogni
46. Derbent
47. Izberbash
48. Kaspiysk
49. Kizilyurt
50. Kizlyar
51. Khasavyurt
52. Yuzhno-Sukhokumsk

Fig. Epizootic map of EBL spread in the Republic of Dagestan in 2022

(Kizlyarsky Raion – 3.0%, Kizlyar Municipal Okrug – 16.9%, Kizlyar Transhumance Veterinary Station – 14.6%, etc.) shows the interdependence (relatedness) of BLV spread indicators in animals. This is due to the fact that the BLV-infected farm animals in the plain area come into contact with healthy cattle in the transhumance areas.

An epizootic map of EBL spread in municipal raions and okrugs of the Republic was compiled on the basis of the official statistical data for 2022, received by the GBI RD "Republican Veterinary Laboratory" (Fig.).

As one can see, EBL is widespread in the middle and northern parts of the Republic, where a large number of public (family-operated) farms are concentrated in the plain areas. The southern part of Dagestan remains EBL-free, with the exception of several raions (Dakhadayevsky, etc.). There are transhumance farms located in the flat parts in the mountainous and high-altitude areas marked in red and green on the map, which explains BLV spread in these climatic zones.

Thus, EBL is reported in all natural and climatic zones of the Republic of Dagestan, but it has received a high degree of spread on the lowland plains.

CONCLUSIONS

As a result of the work carried out to study the EBL epizootic situation in 1988–2022, the following conclusions can be made.

1. The number of serological tests of animal blood samples is annually increasing (from 9,248 in 1988 to 875,312 in 2022), while the proportion of BLV-infected farm animals is decreasing (from 32.2% in 1988 to 0.5% in 2022).

2. The spread of infection is reported in all natural and climatic zones of the Republic, but the highest level is observed in the plain area and in transhumance zones located on lowland plains.

3. The epizootic map compiled on the basis of the official statistical data for 2022 shows high degree of EBL spread in many municipal raions and okrugs of the Republic of Dagestan.

In summing up, a general conclusion can be made: in early 2023 the Republic of Dagestan remained an EBL-infected region of the Russian Federation.

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INFORMATION ABOUT THE AUTHORS / ИНФОРМАЦИЯ ОБ АВТОРАХ

Arkif R. Mustafayev, Cand. Sci. (Veterinary Medicine), Leading Researcher, Laboratory of Infectious Pathology of Farm Animals, Caspian Regional Research Veterinary Institute – Branch of Dagestan Agriculture Science Center, Makhachkala, Republic of Dagestan, Russia; *https://orcid.org/0000-0002-5142-8360, e-mail: mustafaev_arkif@mail.ru.*

Magomed O. Baratov, Dr. Sci. (Veterinary Medicine), Chief Researcher, Head of Laboratory for Infectious Pathology of Livestock, Caspian Regional Research Veterinary Institute – Branch of Dagestan Agriculture Science Center, Makhachkala, Republic of Dagestan, Russia; *https://orcid.org/0000-0002-8261-5038, e-mail: alama500@rambler.ru.*

Мустафаев Аркиф Рамазанович, канд. вет. наук, ведущий научный сотрудник лаборатории инфекционной патологии сельскохозяйственных животных, Прикаспийский зональный НИВИ – филиал ФГБНУ «ФАНЦ РД», г. Махачкала, Республика Дагестан, Россия; *https://orcid.org/0000-0002-5142-8360, e-mail: mustafaev_arkif@mail.ru.*

Баратов Магомед Омарович, д-р вет. наук, главный научный сотрудник, заведующий лабораторией инфекционной патологии сельскохозяйственных животных, Прикаспийский зональный НИВИ – филиал ФГБНУ «ФАНЦ РД», г. Махачкала, Республика Дагестан, Россия; *https://orcid.org/0000-0002-8261-5038, e-mail: alama500@rambler.ru.*