

PROBLEM OF LUMPY SKIN DISEASE OUTBREAK PREVENTION AND ERADICATION

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SUMMARY

The paper presents data on lumpy skin disease spread in the Russian Federation, Middle East, Azerbaijan, Armenia, Georgia, Greece, Bulgaria, Macedonia, Serbia, Albania, and Kosovo. It characterizes epidemic situation in the Republic of Dagestan in 2015. It also gives analysis of the OIE data on lumpy skin disease outbreaks in the Russian Federation in 2016. The paper summarizes experience in LSD outbreak eradication in a large dairy establishment in Tbilisi Rayon of the Krasnodar Krai.

Key words: lumpy skin disease, cattle, outbreak eradication, dairy establishment, economic losses, Krasnodar Krai, vaccination.

Lumpy skin disease (*Dermatitis nodulares*, LSD) is a highly contagious transboundary emerging viral disease characterized by persistent fever, swollen lymph nodes, edema of subcutaneous connective tissue and internal organs, development of skin nodules (lumps), eye lesions, lesions in the mucous membranes of respiratory organs and gastrointestinal tract. Some animals demonstrate symptoms of bronchial pneumonia. Lumpy skin disease is caused by enveloped DNA virus of the Neethling type of the genus *Capripoxvirus*, the family *Poxviridae*. Lumpy skin disease is included in the OIE list of notifiable diseases [6, 13]. In the USA pathogens of the genus *Capripoxvirus* are classified as potential disease agents of agroterrorism [20]. The prototype strain of LSD virus (LSDV) is the Neethling virus. The pathogen is antigenically similar to pox virus of sheep and goats. According to the OIE Terrestrial Animal Health Code (2016) LSDV susceptible animals include cattle (*Bos taurus*, *Bos indicus*) and Asian water

buffalo [2]. LSDV is not transmissible to humans.

The portals of entry for LSDV infection are skin, mucous membranes of respiratory organs and gastrointestinal tract, conjunctiva carrying the virus to lymph nodes through the lymphatic system, where the virus propagates and is carried throughout the organism, causing disease-specific nodular lesions [9, 18]. LSD can result in either acute infection or chronic infection [6]. There are two routes of LSDV transmission outside the outbreak:

1) via infected animals and animals during the incubation period, actively excreting the virus. In this case the source of infection functions not only as an excreter but also as a virus carrier over long distances. The LSDV spread is likely to be related to cattle drive [1, 6, 13]. No carrier state in animals for LSD has been reported [1].

2) via passive (mechanical) intermediate virus vectors – contaminated livestock products, feeds, personnel, transport vehicles, animals and animal care products. It has been proved that LSDV can be mechanically

Table 1
LSD epidemic situation in Tlyaratinsky Raion, Republic of Dagestan, July 2015

Settlements	Cattle number	Diseased animals	
		Number (animals)	Percent
1	162	8	4.94
2	87	5	5.75
3	96	5	5.21
4	471	10	2.12
5	149	6	4.03
6	210	9	4.29
7	19	1	5.26
8	128	5	3.91
Total	1322	49	3.71

Table 2
LSD epidemic situation in the Republic of Dagestan, 2015 [14]

No	Raions	Date	Transhumance zones	Outbreak number	Diseased	
					гол.	%
1	Kumtorkalisky	04.10.15	-	3	19	0.7
2	Khasavyurtovsky	11.11.15	-	29	323	1.1
3	Babayurtovsky	30.09.15	-	8	90	0.9
4	Kizlyarsky	09.11.15	-	4	242	2.2
5	Kizilyurtovsky	07.10.15	-	10	19	0.3
6	Tarumovsky	28.10.15	-	3	3	0.3
7	Khuzakhsy	07.09.15	Kizilyurtovsky	1	91	0.7
8	Gergebilsy	26.09.15	Kizilyurtovsky	3	78	3.2
9	Gunibsky	04.10.15	Kizilyurtovsky	16	73	1.6
10	Tsumadinsky	04.10.15	Babayurtovsky	9	172	3.0
11	Botlikhsy	10.11.15	Babayurtovsky	3	10	0.6
12	Kazbekovsky	12.11.15	Babayurtovsky	2	6	0.3
13	Akushkinsy	16.09.15	Babayurtovsky	7	7	0.5
14	Laksky	01.10.15	Babayurtovsky	11	409	3.7
15	Gumbetovsky	02.10.15	Babayurtovsky	1	10	5.2
16	Rutulsky	14.10.15	-	1	1	0.04
	Total			111	1597	1.5

transmitted through air and by bloodsucking insects, including flies and ticks [1, 21, 22]. Data on virus growth in cells of respiratory organs demonstrate that aerogenic (air-borne) virus transmission mechanism plays a significant role. The possibility of transmission mechanism by air and dust, as well as by contact with blood can't be excluded. Some authors consider that lumpy skin disease is an obligate transmissible disease [3, 13, 15]. However, references given in the paper lack data on the most important transmission components: vector competence and vector ability of insects being the LSDV transmission vectors [5]. That confirms reports of some authors that bloodsucking insects, including flies and ticks, play the role of mechanical transmission vectors [1, 16, 21, 22].

Infectious animal diseases with the pathological process registered in different organs of the respiratory system are considered aerogenic infections. These diseases are characterized by high contagiousity and aerogenic virus transmission [12]. During breathing, coughing, sneezing animals with infected respiratory tract excrete large amounts of the virus that may retain in the suspended state and spread over long distances. Among other portals of entry, respiratory organs are extremely vulnerable due to their physiological characteristics. Air passages are involuntarily exposed to external factors and lungs have a large surface area.

Lumpy skin disease results in significant economic losses as it causes decrease in milk production, abortions

in cows and heifers, mastitis, temporary or permanent sterility in servicing bulls, mass loss, skin lesions, lameness due to inflammation and edema of limbs, as well as death of infected animals caused by secondary bacterial infection [1, 19]. For instance, in case of LSD introduction in the territory of Ukraine and negative development of the epidemic situation, the approximate losses in productive herds are estimated as follows: death of productive cattle — 40-70%; lifelong production decrease — 30-40%; death of calves — up to 90%; complete disposal of milk from quarantined herds — 28 days [8]. Other authors consider that lumpy skin disease causes 45-65% decrease in economic effectiveness of livestock production [20].

For many years LSD occurrence was limited to Central and North Africa. Subsequently the multi-year trend was LSDV spreading mainly in the Middle East region from south to north-east. This can be explained by implementation of the 'Livestock Revolution' programme. Under this programme, the so called 'Eurasian ruminant street' was established in the relative proximity to the RF and the EC, covering the territory from the Eastern Mediterranean Region to Central Asia, including Turkey, Iran, Pakistan, Afghanistan, the Arabian Peninsula. In this regard it is inevitable that livestock population increases and conditions are created for occurrence of different pathogens [4]. In 2013 the disease was registered in Israel, Lebanon, Jordan, Palestine, Iraq and Egypt. In 2014 LSD was detected in Turkey, Lebanon, Azerbaijan, Iraq, Egypt,

Table 3
 LSD outbreaks in the RF in 2016

No	RF Subjects	First outbreak date	Total number of raions	Number of affected	
				raions	settlements/areas
1	Astrakhan Oblast	15.06.16	11	7 (63.3%)	10
2	Volgograd Oblast	03.07.16	33	4 (12.1%)	9
3	Voronezh Oblast	10.08.16	31	1 (3.2%)	1
4	Rostov Oblast	17.07.16	43	2 (4.7%)	5
5	Ryazan Oblast	24.09.16	25	2 (8%)	2
6	Tambov Oblast	27.08.16	23	1 (4.3%)	6
7	Samara Oblast	02.10.16	26	1 (3.7%)	5
8	Krasnodar Oblast	25.05.16	38	4 (10.5%)	5
9	Stavropolsky Krai	19.06.16	26	10 (38.5%)	30
10	Kabardino-Balkar Republic	10.08.16	9	1 (11.1%)	1
11	Karachai-Cherkess Republic	22.07.16	8	4 (50%)	10
12	Republic of Adygeya	22.07.16	7	1 (14.3%)	1
13	Republic of Dagestan	07.07.16	41	10 (24.4%)	39
14	the Republic of Ingushetia	01.07.16	4	3 (75%)	35
15	Republic of Kalmykia	07.06.16	13	7 (53.3%)	57
16	Chechen Republic	25.08.16	15	14 (93.3%)	112
	Total: 16		353	72 (22.0%)	328

Iran. In 2014-2015 the disease was diagnosed in Cyprus and Greece. In 2013-2015 LSD spread in 12 countries in the Middle East. The data indicate that LSD is endemic in Africa and the Middle East and lately it has been reported in Syria, Turkey, Israel, Jordan, Iraq, Iran, Azerbaijan and Kuwait [24]. According to OIE there were 16 LSD outbreaks in 4 regions on the River Kura in Azerbaijan in 2014. Veterinary experts of Azerbaijan assume that LSD virus entered the territory through cattle grazing pastures in the neutral zone of the Iran-Azerbaijan boarder. According to media sources, LSD was diagnosed in cattle in 12 regions of Azerbaijan. LSD cases were reported in cattle grazing in pastures near the border with Armenia and Georgia [19]. According to the OIE, the LSD outbreaks in Turkey were possibly caused by illegal cattle movement [27].

Lack of infection control in the country led to LSD introduction in continental Europe. In 2015 LSD was first registered in Greece. 117 LSD outbreaks were reported throughout the year. The outbreaks were eliminated by stamping-out measures, i.e. immediate slaughter of all susceptible animals. LSD was also reported in the country in 2016 despite all the measures taken. Besides Greece, LSD outbreaks were also registered in Bulgaria and Macedonia [11]. In Bulgaria first LSD cases were registered in central regions. That served a basis for Bulgarian experts to make a supposition that LSD was introduced intentionally [25]. Subsequently LSD outbreaks were registered in other South-Eastern countries (Serbia, Macedonia, Albania,

Kosovo etc.). All these facts indicate low effectiveness of LSD control and prevention measures. In early December, 2015 LSD cases occurred in Syuniksk Oblast (Armenia) that borders with East Azerbaijan Province in the Islamic Republic of Iran [11]. In early November, 2016 LSD was diagnosed in cattle owned by two residents of two settlements Racha-Lechkhumi and Kvemo-Svaneti located in Georgia near the RF border [26].

OIE data on LSD spread in the Middle East, Turkey, Iran and Azerbaijan served a basis for predicting high probability of LSDV introduction in the Russian Federation [7, 13, 17].

In July 2015 LSD was diagnosed in free-ranging herds grazing in mountain pastures and belonging to residents of the settlements in the Tlyaratinsky Raion of the Republic of Dagestan near the border with Azerbaijan and Georgia [10, 13]. In September-October 2015 LSD was diagnosed in mature cattle owned by residents of settlements from other regions of Dagestan. The data on LSD epidemic situation in the Tlyaratinsky Raion, the Republic of Dagestan [23] is given in Table 1.

The data given in Table 1 demonstrate that 3.71 (2.12-5.26)% of animals of free-ranging herds and herds belonging to Tlyaratinsky Raion residents got diseased. In August-October 2015 lumpy skin disease was reported in cattle belonging to residents of Naursky, Nadterechny and Grozny Raions of the Chechen Republic. In September-October 2015 the disease was reported in cattle

Table 4
LSD diseased cattle prevalence, 2016

No	Property ownership type	Number	Average number (%)
1	APC	71	13,8 (1,0-100)
2	BF	87	7,0 (0,2-100)

BF – backyard farm;
APC – Agricultural production cooperative

belonging to residents of settlements of the Republic of North Ossetia-Alania [10, 14]. Later LSD outbreaks were reported in other raions of the Republic of Dagestan [14]. Table 2 characterizes LSD epidemic situation in cattle.

Analyzing the LSD epidemic situation veterinary specialists from Dagestan state that 110 (92.4%) outbreaks of the infection were reported in the flatland part of the northern territory of the Subject while in the mountainous part 9 disease cases were reported (7.6%). Epidemic processes were most intensive in Khasavyurtovsky Raion (29 outbreaks), Gunibsky Raion (16), Laksky Raion (11), and Kizilyurtovsky Raion (10). Severe disease with high mortality level (7.7%) was observed in animals of the Khuzakhsky Raion of the Kizilyurtovsky transhumance zone [14].

The data given in table 3 demonstrate that in 2016 LSD was reported in 328 areas/settlements of 72 (22.0%) raions, 16 subjects, four federal districts (Southern, North-Caucasia, Central, and Privolzhsky) of the RF. Table 4 demonstrates data on the number of LSD diseased cattle on farms of different property ownership types.

These data demonstrate that the number of diseased animals on backyard farms was 7.0 (0.2-100)%, and in APC (ZAO, farm holdings, OAO, etc.) – 13.8 (1.0-100)%. Macedonia, Bulgaria, and Serbia informed about low LSD morbidity level of (5-10%) [26]. The differences in the morbidity level on different farms can probably be explained by the difference in the animal density in their habitat.

Apparently, one of the reasons for LSD wide spread in the Russian Federation is lack of regulations on the infection control and prevention. The FGBI «ARRIAH» specialists developed Draft veterinary rules on lumpy skin disease control and prevention, which were submitted to the Ministry of Agriculture in October, 2015.

Today there are several basic methods of LSD control. One method provides modified stamping out i.e. destruction of diseased and infected animals as well as ring vaccination in the containment zone. The other one suggests stamping out, i.e. destruction of all animals and performing veterinary and sanitary measures. Veterinary and sanitary measures as well as ring vaccination are frequently performed.

Vaccination is the only effective way to control lumpy skin disease in the countries (subjects) where the disease is endemic. All commercially available vaccines for LSD prevention are based on the live attenuated virus strains. Application of such vaccines leads to restrictions on international trade in live animals and animal products [16].

In the second half of May, 2016, abortions in 16 cows were reported on the dairy farm named after T.G. Shevchenko, Tbilissky Raion, Krasnodarsky Krai.

The investigation of the abortion causes revealed skin lesions similar to those characteristic of lumpy skin disease. Specialists of the GBI «Kropotkinsky Regional Veterinary Laboratory» sampled pathological material from diseased cows on May 25, 2016. Tests of pathological material samples performed in the GBI «Kropotkinsky Regional Veterinary Laboratory» and FGBI «ARRIAH» using PCR detected LSD virus genome. Clinical examination of 1,066 cows kept in three barns revealed 478 (45,1%) animals demonstrating LSD clinical signs. Large proportion of LSD diseased animals can be explained by high density of animals and air-borne virus transmission. Due to the lack of approved veterinary rules (instruction) on the infection control and prevention it is impossible to take restrictive measures (quarantine). To carry out measures aimed at lumpy skin disease eradication the State Veterinary Department of the Krasnodarsky Krai issued an Act on approving the plan of administrative, zootechnic, veterinary and sanitary measures in the LSD outbreak on ZAO after T.G. Shevchenko and measures for the disease spread and prevention in the territory of the Tbilisski Raion municipal entity. The plan of anti-epidemic measures included all major steps of the Draft veterinary rules on lumpy skin disease control. The veterinary specialists performed the following health improvement measures:

- 1) cattle skin with nodules was treated with ASD (fraction 3);
- 2) all animals on the farm were intramuscularly injected with Bicillin-5 at a dose of 10000 U/kg of the body weight;
- 3) all animals were administered with Trivitamin A, D, E;
- 4) after the quarantine lifting all 2,579 animals kept on the farm were immunized with the vaccine based on the ARRIAH attenuated sheep pox virus strain, produced by the FGBI «ARRIAH» at a recommended dose of 3,5 lg TCD₅₀/cm³;
- 5) all animals were treated with the following insecticides: «Provetrin 100» – 0.0125%, «Butox 50» – 0.005%;
- 6) animal facilities were disinfected using 2% sodium hydroxide solution;
- 7) the territory of the farm and facilities were subject to desinsection using «Cifox» 0.04%, «Provetrin 100» 0.0125%, «Butox 50» 0.005%;
- 8) the milk was daily disinfected with 1% formaldehyde solution within 60 minutes;
- 9) calves and young animals were fed with pasteurized milk.

During clinical examination of the entire animal population performed on June 30, 2016 on the dairy farm no diseased animals were detected.

Direct losses of the LSD outbreak on ZAO after Shevchenko exceeded 10.6 million rubles. Major damage (92.93%) was due to the milk disposed.

CONCLUSION

Within the last decade lumpy skin disease has widely spread in the Middle East. In 2014 LSD outbreaks were reported in Azerbaijan. In July 2015 the disease was detected in cattle belonging to raions of the Republic of Dagestan neighboring Azerbaijan. In August-November 2015 LSD was reported in the Chechen Republic and the Republic of North Ossetia-Alania. For the first time LSD outbreaks were reported to the north of 43 degrees north latitude.

At the beginning of December 2015 LSD was reported in Syunik Oblast, Armenia bordering East Azerbaijan Province of Iran. At the beginning of 2016 the disease was reported in cattle belonging to residents of two settlements of Racha-Lechkhumi province and Kvemo-Svanetti province, Georgia, bordering Russia. In 2016 the first LSD disease case was reported in the dairy farm ZAO after T.G. Shevchenko, Tbilissky Raion, Krasnodarsky Krai, RF. Direct losses associated with the disease eradication exceeded 10.5 million rubles.

All in all in 2016 LSD was diagnosed in 328 settlements/ areas, 72 raions, 16 subjects of the four federal districts (Southern, North-Caucasia, Central, and Privolzhsky). The LSD outbreaks in Tambov and Ryazan Oblasts are located to the north of 53 degrees north latitude. Such rapid disease spread can be explained by high pathogenicity of the virus, multiple routes of the infection agent transmission, illegal import of cattle to the RF Subjects. The situation is aggravated due to the lack of regulatory documents governing rules of the infection control and prevention.

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