



Bovine Interdigital Necrobacillosis Epizootic Data from Livestock Farms in Almaty Region of Kazakhstan between 2017 and 2019

ZHANARA KENESOVNA TULEMISSOVA¹, ASSEM SERIKOVNA IBAZHANOVA^{1*}, RAYA ZHAKSYGULOVNA MYKTYBAYEVA², DAMIR MIKDATOVICH KHUSSAINOV¹, ASSILBEK MAILBOIEVICH MUSSOYEV¹, ZHULDYZAJ ZHAKABAEVNA KENZHEBEKOVA¹, MEREJ AJBYNOVICH TOREHANOV¹

¹Department of Biological Safety, Kazakh National Agrarian University, Almaty, Kazakhstan; ²Department of Microbiology and Virology, Kazakh National Agrarian University, Almaty, Kazakhstan.

Abstract | This paper discusses the epizootic situation observed in livestock farms located in the Talgar, Ile and Enbekshikazakh districts of the Almaty region for the period from 2017 to 2019. Bacteriological study was carried out on samples taken from 501 cows showing clinical signs of interdigital necrobacillosis. For each farm considered, coefficients were calculated that reflected the intensity of the epizootic process. To ascertain preconditions for morbidity, the households and livestock complexes were inspected by certified veterinarians from Kazakh National Agrarian University. In the vast majority of the farms studied, the incidence of bovine foot rot was quite high, which was presumably determined by inappropriate housing conditions, imbalanced nutrition, and the lack of vaccination. A number of recommendations were indicated, such as reduction of stocking density and adequate nutrition.

Keywords | Cattle, Cow, Foot rot, *Fusobacterium necrophorum*, Pathogen

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***Correspondence** | Assem Serikovna Ibazhanova, Department of Biological Safety, Kazakh National Agrarian University, Almaty, Kazakhstan; **Email:** assemibazhanova@yahoo.com

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INTRODUCTION

Interdigital necrobacillosis (IN) is an infectious disease, which may cause purulent-necrotic lesions of all organs and tissues of animals. Susceptible hosts are domestic and wild ungulates (Ardüser et al., 2020). Countries with intensive livestock production have the incentive to the development of diagnostic as well as prevention and treatment measures for bovine IN due to its quite high prevalence almost worldwide (Osová et al., 2017; Ramanon et al., 2018; Davis-Unger et al., 2019; Dendani-Chadi et al., 2020; Islam et al., 2020; Mishra et al., 2020).

This infection causes huge economic losses, which are associated with the costs of prevention and treatment of sick cows, death or premature culling of animals, loss of pro-

ductivity and other costs associated with measures to eliminate the disease (Gomaa et al., 2014; Saleh et al., 2019).

This challenge has been exacerbated by antibiotic resistance nowadays. In Pakistan, scientists have recently expressed alarm at the excessive and uncontrolled use of antimicrobials, including oxytetracycline, contributing to antibiotic residues in raw and fermented foods and the ensuing antimicrobial resistance in human and animals (Saleem et al., 2018; Rahman and Mohsin, 2019).

The causative agent of IN, *Fusobacterium necrophorum*, is a gram-negative bacillus, which can cause the development of diseases. Biotype A (subsp. *Necrophorum*) is considered more virulent because it causes foot rot, liver abscess, and calf diphtheria. Biotype B (subsp. *Funduliforme*) is isolated from abscesses in a mixed bacterial culture and is consid-

ered less virulent (Nagaraja et al., 2005).

Considering that *Streptococcus pyogenes* can also cause IN (Abdullah et al., 2014), resistance of multiple strains of *S. pyogenes* to β -lactam antibiotics recently documented in China (Yu et al., 2020) should be taken into account as well in light of the enhanced distribution of the Chinese agricultural production.

The agro-industrial complex of a country should be developed based on various types of management for livestock farms, implementing the fundamentals of farming in livestock complexes with independent solution of the main issues concerning production and selling. To solve the food program, radical transformations in economic relations are required, combined with the acceleration of scientific and technological progress in the social reconstruction of the countryside, including improvements in veterinary and sanitary measures.

Unfortunately, IN is not considered within the research plan established by the Ministry of Agriculture of the Republic of Kazakhstan. Meanwhile, the evidence collected from some farms in Kazakhstan indicates the presence of bovine foot rot (Tulemissova et al., 2019; Tulemissova et al., 2020), but the prerequisites of that situation have not been addressed. Therefore, the purpose of our study was to assess the effect of epizootic factors on the extent of necrobacillosis spread in various farms located in Kazakhstan and to propose preventive measures based on the data obtained.

MATERIALS AND METHODS

STUDY AREA

Veterinarians from 15 livestock farms situated in Talgar, Ile and Enbekshikazakh districts of Almaty region (Kazakhstan) during the period from 2017 to 2019 were asked to take samples for bacteriological culture from the cleaned interdigital space of cows showing clinical signs of bovine IN. A total of 501 Aberdeen Angus, Hereford, Holstein-Friesian, Auliekol, and Kazakh whiteheaded cows were included in the study. The samples were brought to the Department of Biological Safety at Kazakh National Agrarian University (Kazakhstan, Almaty), where they were routinely placed in Kitt-Tarozzi medium with 10% sheep serum and incubated for 2 days at 37 °C, then the plating was performed on meat-peptone broth and agar in order to evaluate the growth of *F. necrophorum* by means of Zeiss Axiostar plus microscope (Zeiss Inc., Göttingen, Germany). To determine the intensity of the epizootic process, the following indexes were calculated: incidence rate (the proportion of the total number of IN-affected cows from a farm for a year), comparative index (showing

difference between a given value and previous one), and the focus of infection (number of diseased cows in a single location). To ascertain preconditions for morbidity, the households and livestock complexes were inspected by certified veterinarians from the aforementioned institution.

DATA ANALYSIS

The summary descriptive statistics, including the indices specified above, were calculated using Microsoft Excel.

RESULT AND DISCUSSION

Bovine IN epizootic data from several livestock farms located in Almaty region of Kazakhstan between 2017 and 2019 are provided in Table 1.

As is evident, there was the maximum number of bacteriologically confirmed cases in 2019. *F. necrophorum* was detected in a small number of samples taken from animals with clinical presentation of IN. No data on other disease causative agents were obtained, although mixed infection might be supposed in the vast majority of cases. For instance, bacteriological examination of purulent discharge from cows with interdigital phlegmon conducted by (Kontturi et al., 2020) has revealed the presence of *Dichelobacter nodosus* besides *F. necrophorum*.

At the next stage of our research, the indicators characterizing IN epizootic process were computed. The results are set out in Table 2.

Examination of cattle housing has revealed that there were year-round housed flocks in all the cases investigated. Those conditions have conceivably lead to increased crowding of the animals in a confined space, which could increase the titers of the pathogens. That poses risk of limited mobility, poor sanitation, ventilation problems, elevated moisture and microclimate issues.

Generally, we have identified the following environmental factors that could have a negative impact on the organism of the cows studied: climatic features; housing environment (density of accommodation, indoor microclimate, etc.); type and level of feeding; methods of preparation and distribution of feed; biological value of animal rations; veterinary preventive and zootechnical measures (vaccination, weighing, rearrangement), etc. The noise level is higher in enclosed stalls than on pastures and this can also influence the animal health. Moreover, the studied herds were not vaccinated against *F. necrophorum*, which could contribute to the overall incidence as well. The sharply continental climate of Kazakhstan with large temperature oscillations can serve as an additional factor affecting the health of animals, and it requires additional measures to regulate the

Table 1: Clinical and bacteriological results for bovine interdigital necrobacillosis for 2015-2017 in some livestock farms of Almaty region, Kazakhstan

District, farm	2017			2018			2019		
	N	PD	BC	N	PD	BC	N	PD	BC
Talgar district	1,371	81	8	1,422	73	4	1,526	82	5
'Amiran-Agro'	798	51	4	822	50	3	860	47	4
'Alipov T'	148	8	1	102	5	0	152	9	0
'Plemzavod Almaty'	182	10	1	185	7	1	214	11	1
'Dastur'	86	3	1	103	0	0	124	6	0
'Nurbekov'	157	9	1	210	11	0	176	9	0
Ile district	6,000	320	20	6,468	368	21	6,858	427	27
'Baiserke-agro'	4,535	253	17	4786	287	15	5,052	326	20
'Mezhdurechensky Agro'	1,362	67	3	1,497	76	5	1,548	80	7
'Omarov Tolegen'	103	0	0	185	5	1	258	11	0
Enbekshikazakh district	2,321	100	6	2,617	138	7	2,731	142	7
'Adal'	2,045	91	5	2,235	119	7	2,374	125	6
'Alimzhanov T.S.'	137	7	1	184	13	0	165	10	1
'Battal'	65	2	0	103	5	0	90	4	0
'Khasen'	74	0	0	95	1	0	102	3	0
Total	9,692	501	34	10,507	579	32	11,115	641	39

N: number of cows; PD: preliminary diagnosed with interdigital necrobacillosis; BC: bacteriologically confirmed cases

Table 2: Indices of intensity of the epizootic process for interdigital necrobacillosis in cattle for 2017-2019 in some livestock farms of Almaty region, Kazakhstan

District, name of farm	Incidence rate		Comparative index %	Incidence rate	Comparative index %	The focus of infection		
	2017	2018				2019	2017	2018
Talgar district	5.9	5.1	86.4	5.4	106	54	39.6	29.2
'Amiran-Agro'	6.4	6.1	95	5.5	90	25.5	16.6	11.7
'Alipov T'	5.4	7.8	144.4	6	77	8	5	4.5
'Plemzavod Almaty'	5.5	5.4	98	5.1	94.4	10	7	5.5
'Dastur'	3.5	4	0	4.8	0	1.5	0	3
'Nurbekov'	5.7	5.2	91.2	5.1	98	9	11	4.5
Ile district	5.3	5.7	107.5	6.2	108.8	96.7	98	74.2
'Baiserke-agro'	5.6	6	107	6.4	107	63.25	57.4	65.2
'Mezhdurechensky Agro'	5	5	100	5.2	104	33.5	38	3.5
'Omarov Tolegen'	4	2.7	0	4.3	159	0	2.5	5.5
Enbekshikazakh district	4.3	5.3	123.2	5.2	98	17.2	47.8	43.2
'Adal'	4.4	5.3	120	9	170	30.3	40	31.2
'Alimzhanov T.S.'	5	7	140	6	85.7	7	4.3	5
'Battal'	3	4.6	153.3	4.4	95.6	2	2.5	4
'Khasen'	0	1	0	1	100	0	1	3
Total	5.2	5.5	105.8	5.8	105.5	190	185.3	146.6

temperature in enclosed spaces.

On many farms observed there was no differentiated feeding and preparation of cows and heifers for calving, while the silage and concentrate type has a very adverse effect on

the health of cows and newborn calves (Babintseva et al., 2020). In the dry period (60 days), cattle were fed incorrectly. In some cases they were overfed or fed insufficiently. It is known that *F. necrophorum* inhabits a bovine scar in healthy animals, but can cause the development of panar-

itium. Unfavorable factors of a physical nature include abrupt climatic changes (temperature, pressure, humidity); noise (natural, technical); limited mobility of cows. Adverse chemical factors include; change in the partial pressure of oxygen, carbon dioxide; emissions of toxic gases by industrial facilities; ingestion of toxic substances of synthetic, plant, microbial or fungal origin. Adverse factors of biological nature are non-pathogenic and pathogenic microorganisms, such as viruses, microbes, fungi, protozoa, which under normal conditions constantly colonize the organism and do not cause pathological changes. Otherwise, they cause dysbiosis, and opportunistic microorganisms acquire virulent properties (Rasmussen et al., 2012).

CONCLUSION

Thus, highly recommended measure for livestock farms located in Almaty region of Kazakhstan is reduction of stocking density, which leads to a decrease in the microbial titer of *F. necrophorum* within the herd. In addition, increasing the mobility of cows in pasture conditions and the absence of dependence on regulated conditions in the stall would allow maintaining a high level of immunity in cattle. High-quality feeds with high fiber content (at least 18–20% of the diet) often reduce the cases of limb pathologies before and after the birth isolated cases in view of the increasing maternal organism's need for minerals and vitamins. It is also very important at the beginning and peak of lactation cycle to carry out a gradual transition of cows and heifers to concentrated feed, since changing the proportions of concentrated, coarse and succulent fodder leads to cicatricial digestive disorders (scar acidosis), fatty degeneration of the liver and metabolic immunodeficiency and, as a result, hoof diseases. Thus, ensuring the balance of energy and protein, eliminating the deficiency of Ca, P, I, Co, Cu, Be during the dry period, after calving, as well as at the beginning and peak of lactation cycle, is one of the main principles of prevention of bacterial hoof lesions. Our proposals are much in line with those indicated in (Gelasakis et al., 2019).

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AUTHOR'S CONTRIBUTION

Zhanara Kenesovna Tulemissova conceptualized and designed the study. Assem Serikovna Ibazhanova, Raya Zhaksygulovna Myktybayeva, and Damir Mikdatovich Khussainov participated in acquisition of the experimental data, as well as drafting and revising the paper. Assilbek Mailiboievich Mussoyev, Zhuldyzaj Zhakabaevna Ken-

zhebekova, and Merej Ajbynovich Torehanov were responsible for analysis and interpretation of the data. All authors read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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