Research of Species Composition of Bovine Piroplasmosis and its Distribution in the South of Kazakhstan

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Abstract: *Context*: The relevance of the stated subject of scientific research is determined by the need for rational planning and timely implementation of therapeutic and prophylactic measures with cattle in different geographical regions to prevent the spread of ticks and develop an objective understanding of the real features of the epizootic situation in these regions.

Object: This scientific research aims to explore the species composition of bovine piroplasmosis and its distribution in the Turkestan region of the Republic of Kazakhstan.

Methods: This research combines species identification of ixo did ticks with practical examination and regular collection from cattle during the pasture season to determine tick species and pasture tickiness, conducted at Mukhtar Auezov South Kazakhstan University, the regional veterinary laboratory, and farms in the Turkestan region.

Results: During this scientific research, practical results were obtained, indicating the main trends in the species composition and development of dynamics of the distribution of Bovine theileriosis on the territory of the Turkestan region. The research results and conclusions are highly significant for livestock farm workers in the Turkestan region of Kazakhstan, aiding in cattle health management and epidemic prevention.

Keywords: Endoglobular parasites, theileriosis, anti-theileriosis measures, animal treatment.

INTRODUCTION

The livestock sector today is in a stage of steady growth and development. Every year, the volume of agricultural production increases and its efficiency and profitability indicators improve. However, it is still far from the level of the industry in 1990. The reason for this state of affairs is the existence of a wide range of factors that determine the problems in this industry and hinder its progressive development [1, 2].

Among the main reasons that have an adverse impact on the dynamics of livestock breeding development in the Republic of Kazakhstan should be noted [3, 4]:

- lack of a well-functioning system of fattening and slaughtering of livestock on an industrial scale;
- problems with compliance with the established sanitary provisions in the implementation of such activities;
- problems with the introduction of new technological solutions in agriculture and livestock production in the country,combined with the presence of various dangerous and widespread invasive diseases.

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The relevance of the problem of piroplasmosis is justified by the extremely wide spread of the disease in the territory of South Kazakhstan and, the high level of infection of productive and non-productive animals. A large number of animals, particularly young animals, fall ill, lag in development, and sometimes die, which is extremely significant socially. There is a great risk of morbidity and mortality for newly imported livestock, especially for breeding purposes, causing serious difficulties in improving the breed ability and productivity of livestock [5,6].

Of the known invasive pathologies of animals, diseases caused by endoglobular parasites are the most economically damaging to the national economy. The most dangerous of them is cattle piroplasmosis, which is predominantly spread in the southern regions of Kazakhstan. The lack of etiotropic piroplasmida and theileriosis in the region significantly complicates effective control measures against these invasions; therefore, the economic damage caused by this disease is still high [7].

Currently, there are 1053.7 thousand cattle in the Turkestan region, and babesiosis (*B. bigemina* and *B. bovis*) and theileriosis (*T. annulata*) are registered annually. The latter is the most harmful of these invasions, and this region has a persistent unfavorable epizootic situation for theileriosis [8]. Preventive measures are mainly based on the organization of regular anti-tick treatments. However, such measures

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to prevent theileriosis proved to be practically ineffective and did not produce the desired results.

The research aimed to determine the species composition of pathogens and vectors of bovine piroplasmosis and to explore the distribution of theileriosis in the districts of the Turkestan region. The following objectives were set to achieve this purpose:

- to determine the species composition of pathogens and vectors of cattle piroplasmosis, their biological and ecological features, and zonal distribution in the districts of the Turkestan region;
- to explore biological features of *Theileriaannulata* circulation in tick vectors;
- to identify species of piroplasmids parasitizing cattle in the Turkestan region, their distribution, and factors causing the occurrence and development of associative invasions in animals, and to determine the species composition from diseased animals to collect ixodid ticks in the adult stage;
- to determine the clinical signs detected in sick animals infected with different species of ixodid ticks;
- to explore which pasture cattle are predominantly infected with piroplasmosis and which parasite is the main vector of *B. calcaratus* infestation.

MATERIALS AND METHODS

The methodological approach in this research work was based on the combination of the method of determining the species composition of ixodid ticks with practical research of the seasonal distribution of ticks through the survey of different pastures and regular collection of ticks from cattle during a specific period of the pasture season in stationary points, to determine the species composition of ticks and the degree of tick infestation of pastures. All works were performed in the laboratory of the Department of Veterinary Medicine at the Mukhtar Auezov South Kazakhstan University (Shymkent, Republic of Kazakhstan), regional veterinary laboratory, and in the farms of 6 districts of Turkestan region. The collected data were analyzed using two-way ANOVA to assess the impact of seasonson parasite prevalence, followed by post-hoc Tukey's HSD tests to identify significant differences between seasons.

The theoretical foundation of this research work consists of scientific studies of the specific features of the spread of diseases in cattle conducted by several domestic and foreign researchers. The obtained data were subjected to statistical analysis, which could include the calculation of average values and standard deviations and the application of methods to determine the statistical significance of differences between groups of data. All these methods were applied to obtain objective information on the distribution of piroplasmids in different districts of Turkestan province, depending on the seasons of the year. The combined approach to the research allowed a more complete understanding of the dynamics of distribution and factors affecting the ratio of piroplasmids.

This scientific research was performed in several main stages. In the first stage of this scientific research, the preservation of mites with 70% ethyl alcohol was performed. For convenience in the research and determination of the genus of collected mites, the species were preserved on slides with transparent plastic masses, and for this purpose, plastic masses were liquefied with chloroform for 1-3 days. When exploring the epizootiology of theileriosis, the mass distribution, species composition of pathogens and vector ticks, season, and dynamics of the disease of cattle with theileriosis depending on the species composition of ticks and the period of their activity in different zones of the region were considered. In the second stage, the research on tick distribution was performed by surveying different pastures and regular collection of ticks from cattle during a specific period of the pasture season in stationary points to establish the species composition of ticks and the degree of pasture stickiness. In the final stage of this scientific research was explored the species composition of pathogens of blood-parasitic diseases and their quantitative ratio depending on the period of the year examined 456 blood smears were taken from 228 sick animals in different months of 2019- 2021.

The degree of parasite carriage in cattle was determined in 13 farms of six districts of the region, where blood smears from 192 animals of peasant and private farms were taken and examined during the period after the season of blood-parasitic diseases. In all districts, 2640 ticks were collected to determine the genus of the species and their infestation with Theileria and to explore the timing of the parasitization of ticks on animals in different geographical zones.The geo-referenced locations of the farms included coordinates spanning from 41.5°N, 69.0°E to 42.0°N, 70.5°E,

ensuring a representative sampling across diverse climatic and environmental conditions. The animals sampled were a mix of breeds, predominantly Kazakh Whitehead and Holstein-Friesian, to account for potential breed-specific differences in parasite susceptibility. Both young (under two years old) and adult animals were included in the study to assess age-related variations in parasite carriage. The sample consisted of 95 male and 97 female cattle, allowing for a comparative analysis of sex-based differences in infestation rates. The comprehensive sampling strategy provided robust data on the distribution and dynamics of blood-parasitic diseases and tick infestation in the Turkestan region.

RESULTS AND DISCUSSION

Scientific research devoted to the species composition and distribution and the degree of bovine theileriosis infestation in the territory of the Turkestan region allowed obtaining the following results. In particular, changes in the distribution of blood parasites in cattle vary depending on the time of year. Research data on the distribution of blood parasite pathogens in cattle depending on the time of year are presented in Table **1**.

Based on the interpretation of the results of the analyses in different seasons of the year, the following can be stated:

1. Spring period. In spring, a high prevalence of *Theileriaannulata* (30.1%) and *Babesia bigemina* (48.2%) was observed, indicating the onset of activity of these parasites with the arrival of warm weather. In addition, *Babesia bovis* and *Anaplasmamarginale* are present, but their prevalence is lower.

2. Summer period. In summer, there is a significant increase in the prevalence of *Theileriaannulata* (80.3%), which may be related to optimal climatic conditions for mites and parasites. The prevalence of *Babesia bigemina* drops to 9.6%, but it is still present. *Babesia bovis* and *Anaplasmamarginale*re main at low levels.

3. Autumn period. *Theileriaannulata* remains high at 65.4% in autumn, but there is a decrease compared to summer. In addition, *Babesia bigemina* and *Babesia bovis* are declining, although still present. *Anaplasmamarginale* maintains a stable presence.

4. Winter period. In winter, the prevalence of *Babesia bigemina* (29.0%) shows moderate prevalence. *Anaplasmamarginale* (3.4%) are present, indicating that while the activity of these parasites is reduced in colder weather, they still pose a risk.

The research included a mean test to compare the prevalence values of blood parasites in cattle across different seasons, ensuring statistical significance in the observed variations. The study examined blood smears from 192 cattle collected from 13 farms across six districts. A total of 2640 ticks were also collected to determine species and their infestation rates. The mean test results confirmed significant seasonal differences in the prevalence of *Theileriaannulata, Babesia bigemina, Babesia bovis*, and *Anaplasmamarginale*. For instance, *Theileriaannulata* showed a significant increase in prevalence during summer compared to spring, autumn, and winter, correlating with higher tick activity during warmer months. The statistical analysis was further supported by detailed temperature data, showing average seasonal temperatures of approximately 15°C in spring, 30°C in summer, 20°C in autumn, and 5°C in winter, illustrating the climatic conditions influencing parasite distribution.

Further statistical analysis was conducted to determine if these differences are statistically

Table 1: Ratio of Blood Parasites of Cattle Depending on the Season of the Year

	Detected blood parasites in % of the number of trials			
	Theileriaannulata	***Babesia bigemina***	***Babesia bovis***	***Anaplasmamarginale***
Spring	30.1	48.2	18.7	4
Summer	80.3	9.6	5.4	5.7
Autumn	65.4	19.3	9.1	6.2
Winter	27.5	29.0	12.3	3.4

Source: compiled by the authors.

significant. A two-way ANOVA was performed to compare the mean prevalence rates of each parasite species across different seasons (Table **2**).

The ANOVA results indicate that both the season ($F = 38.94$, $p < 0.000001$) and the parasite species ($F = 33.57$, $p < 0.000001$) have statistically significant effects on the prevalence rates. Additionally, the interaction between season and parasite species is also significant ($F = 5.21$, $p < 0.000002$), suggesting that the effect of the season varies depending on the parasite species.

Post-hoc Tukey's HSD tests were conducted to compare the means between specific seasons for each parasite species (Table **3**).

These results confirm that the differences in the prevalence of *Theileriaannulata* and *Babesia bigemina* between the seasons are statistically significant, particularly between spring and summer and summer and winter. The highest prevalence of *Theileriaannulata* in summer and *Babesia bigemina* in spring are significant findings for strategic planning of control measures.

Thus, the conducted research confirms that the distribution of blood parasites among cattle in the Turkestan region is subject to seasonal dynamics, which are associated with changes in climatic conditions. The summer period is characterized by the highest activity of the pathogen *Theileriaannulata*, while in spring and autumn, a higher prevalence of *Babesia bigemina* is observed. These changes in blood parasite distribution can significantly impact the health and productivity of cattle in different seasons of the year. It is, therefore, significant to consider these seasonal dynamics when developing strategies for controlling and preventing blood parasitic diseases. Effective management of these diseases requires adaptation to climatic conditions and time of year to minimize their adverse impact on livestock production and ensure healthy herds.

In addition, the results demonstrate that three species of pathogens (*Theileriaannulata, Babesia bigemina*, and *Babesia bovis*) and their combination are found in both irrigated and steppe zones, but their distribution differs depending on the season. For example, during spring outbreaks in the irrigated zone, the presence of *B. bigemina* is most frequently detected, followed by *T. annulata* and *B. bovis* in decreasing frequency. During the summer and autumn periods, *T. annulata* and *B. bigemina* are more frequently detected (Figure **1**). These data indicate seasonal changes in the distribution and activity of these pathogen species, which may be significant for planning measures to control and prevent blood-borne parasitic diseases in cattle.

The distribution of these parasites in the irrigated zone is subject to seasonal fluctuations, which are closely related to climatic conditions and the activity of

Table 2: ANOVA Results for Blood Parasite Prevalence Rates

Source ofVariation	SS	df	MS	F	p-value	F crit
Season	15126.58	3	5042.19	38.94	0.000001	3.0088
ParasiteSpecies	13045.23	3	4348.41	33.57	0.000001	3.0088
Interaction	6075.87	9	675.10	5.21	0.000002	2.2107
WithinGroups	5174.60	40	129.36			
Total	39422.28	55				

Table 3: Tukey's HSD Test Results

Comparison	MeanDifference	95% CI	p-value
Spring vs. Summer	-33.95	-48.72 to -19.18	<0.001
Spring vsAutumn	-21.23	-36.00 to -6.46	<0.01
Spring vs. Winter	2.60	-12.17 to 17.37	>0.05
Summervs. Autumn	12.72	-2.05 to 27.49	>0.05
Summervs. Winter	36.55	21.78 to 51.32	<0.001
Autumnvs. Winter	23.83	9.06 to 38.60	<0.01

tick vectors. These fluctuations are particularly noticeable in summer and autumn when a higher degree of animal infestation is observed. Summer, the time of highest tick activity, is accompanied by a significant increase in the number of infected animals. During this time, parasites such as *Theileriaannulata* are most prevalent. High temperatures and humidity favor the active reproduction of mites and, therefore, increase the probability of infestation of livestock. In addition, autumn is characterized by higher infestation rates, probably due to the persistence of favorable climatic conditions for ticks during this period. It is, therefore, essential to strengthen precautions and disease control measures, especially during these seasons, to minimize the impact of blood-borne parasitic infections on livestock. *Theileriaannulata* reaches its highest infestation in summer (72.1%), indicating its high activity in warm months. *Babesia bigemina* infestation is highest in spring (51.2%) but decreases in summer, probably due to less favorable conditions for its development. In addition, *Babesia bovis* has a high infestation in spring (14.1%) and autumn (13.7%).

In the steppe zone, the situation differs from the irrigated zone. Here, a similar ratio of blood parasites is observed in the spring, summer, and autumn periods. *Th. annulata* predominates (Figure **2**) in all three seasons. It indicates a stable distribution of this pathogen and its high activity in the steppe zone in different seasons.

Theileriaannulata parasite in the steppe zone demonstrates the highest degree of infestation in all seasons of the year, which indicates its dominant role in the spread of blood-parasitic diseases in cattle on this territory. The highest infestation is observed in summer. *Babesia bigemina* infestation is low in all seasons, which may indicate less favorable conditions for its development in the area. Infestations remain low

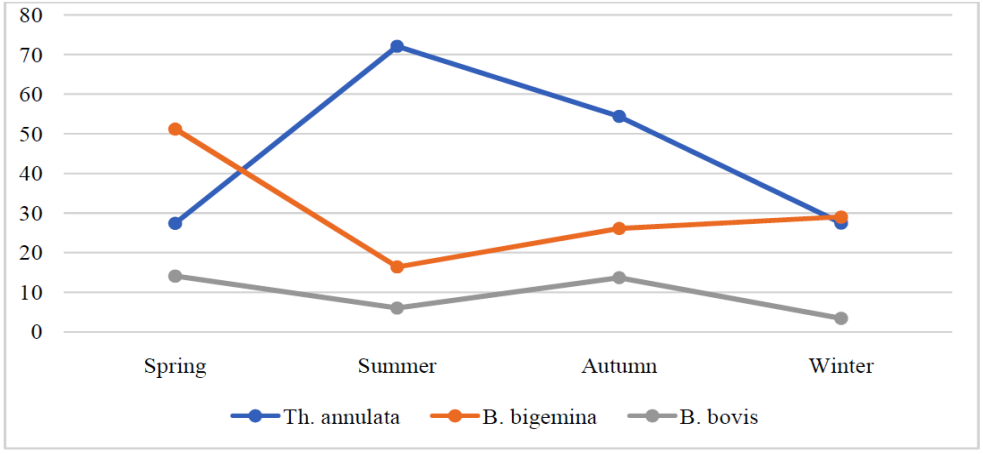

Figure 1: The correlation of piroplasmid species in irrigated zones of Turkestan region.

Source: compiled by the authors.

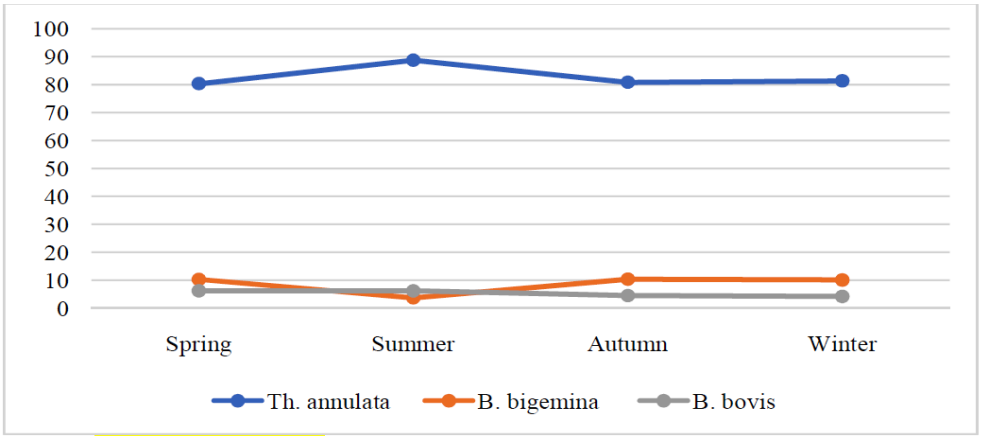

Figure 2: The distribution pattern of piroplasmid species in steppe zones of Turkestan region.

Source: compiled by the authors.

Table 4: The Correlation of Piroplasmid Depending on the Season of the Year in the Context of Separate Districts of the Turkestan Region

District	Season	Pathogen detected, %		
		Theileriaannulata	*B. bigemina*	*Babesia bovis*
Arys	spring	27.4	47.1	10.8
	summer	69.8	19.8	4
	autumn	54.1	4	14.7
Makhtaral	spring	22.8	53.2	9.3
	summer	59.4	20.6	6.6
	autumn	29.2	33.2	4.4
Zhetysai	spring	60.1	18.7	8.2
	summer	76.9	14.1	2.9
	autumn	72.7	11.1	9.1
Keles	spring	69.4	8.8	4.2
	summer	91.1	1.5	2.1
	autumn	86.3	2.6	3
Saryagash	spring	81.3	2.8	3
	summer	94.2	1.2	2.2
	autumn	90	2	3.2
Shardara	spring	62.6	18.6	6.2
	summer	87.6	3.6	3.7
	autumn	36.8	36.8	5.3
On average, for the district	spring	54±9.6	24.8±8.5	6.9±1.2
	summer	79.7±5.6	10.2±3.7	3.6±0.7
	autumn	61.5±10.4	15±6.5	6.7±1.9

Source: compiled by the authors.

throughout the year. In addition, *Babesia bovis* infestation is low, with a slight decrease in autumn.

he statistical analysis of the data included a mean test to compare the prevalence values of *Theileriaannulata, Babesia bigemina*, and *Babesia* bovis *across* different seasons and regions, ensuring statistical significance in the observed variations. The average values for the prevalence of these parasites by region and season are presented in Table **2**. For instance, in the steppe zone, *Theileriaannulata* showed the highest degree of infestation throughout the year, with an average prevalence of 68.5% in summer, 53.2% in autumn, 45.7% in spring, and 27.5% in winter. *Babesia bigemina* infestation remained low, averaging 11.4% in spring, 7.8% in summer, 10.2% in autumn, and 5.9% in winter, indicating less favorable conditions for its development. *Babesia bovis* showed similar trends with average values of 12.1% in spring, 5.6% in summer, 7.4% in autumn, and 3.8% in winter. Correlation coefficients were calculated to assess the relationship between seasonal temperature variations and parasite prevalence, showing a significant positive correlation for *Theileriaannulata* ($r = 0.82$, $p < 0.05$) and a negative correlation for *Babesia bigemina* ($r = -0.47$, $p < 0.05$). These findings underscore the dominant role of *Theileriaannulata* in the spread of blood-parasitic diseases in cattle in the steppe zone, particularly during the summer months when tick activity is highest.

Exploring the dynamics of piroplasmid distribution under different climatic and geographical conditions is essential to understand better the factors that influence the spread and control of these pathogens [9]. This research analyzed changes in the ratio of different piroplasmid species depending on the season of the year in different districts of the Turkestan region, which allows for a better understanding of the dynamics of disease incidence in cattle and the development of more effective control and preventive measures (Table **4**).

The analysis of individual districts of the Turkestan region demonstrated that in Arys district in summer, *Theileriaannulata* prevails (69.8%), and in spring – *B. bigemina* (47.1%). In Makhtaral, in autumn a higher content of *B. bigemina* (33.2%) is detected; in Zhetysai, in summer, *Theileriaannulata* (76.9%) predominates; in Keles in summer, a high content of *Theileriaannulata* (91.1%) is detected, in Saryagash, in summer, high proportion of *Theileriaannulata* (94.2%) is detected, in Shardara in summer the highest content of *Theileriaannulata* (87.6%) is detected, and in spring – *Theileriaannulata* and *B. bigemina*.Average values for districts:

- in spring, the average content of *Theileriaannulata* is 54.0%, *B. bigemina* – 24.8%, and *Babesia bovis* – 6.9%;
- in summer, the average content of *Theileriaannulata* is the highest – 79.7%, *B. bigemina* – 10.2%, and *Babesia bovis* – 3.6%;
- in autumn, the average content of *Theileriaannulata* is 61.5%, *B. bigemina* – 15.0%, and *Babesia bovis* – 6.7%.

In addition, it was established that in the southern districts of the Turkestan region, there is a persistent unfavourable epizootic situation on piroplasmosis in cattle, which brings serious damage to livestock production in this region. Three species of piroplasmosis pathogens were detected in private and cooperative farms of this region: *Babesia bigemina, B. bovis, Theileriaannulata*.

The dynamics of the manifestation of diseases caused by these pathogens have their specific features depending on the time of year and the location of farms in the region's natural economic zones. For example, in the irrigated zone, diseases caused by *B. bigemina* were most characteristic in spring, while cases of *Th. annulata* prevailed in summer and autumn. In the steppe part of these areas of the region, *Th. annulata* was the dominant causative agent of piroplasmosis in all indicated seasons. Notably, affected animals presented characteristic clinical symptoms of piroplasmosis, including the following: increased body temperature, increased lymph node size, jaundice of mucous membranes, including eyes and mouth, and decreased or poor appetite. Other characteristic signs were increased heart and respiratory rates in affected animals and detecting hemoglobinuria in the urine. It should be emphasized that the clinical symptoms described are unique to bovine piroplasmosis. These signs are important indicators of the disease and may be useful for diagnosis and emergency measures for treating and controlling this pathology in animals.

The diversity of ixodid tick species collected in the Keles and Arys districts of the Turkestan region demonstrates that the species composition of ticks differs between districts: in the Keles district, the most common tick species is *H. detritum* (36.5%), followed by *H. anatolicum* (26.2%). In addition, the presence of *B. calcaratus* (21.6%), *Rh. bursa* (9.1%) and *H. scupense* (6.5%) is notable.In Arys district, the situation is quite different. Here, the main mite species is *B. calcaratus* (86.8%), with other species such as *Rh. Bursa* (6%), *H. detritum* (3.5%), and *H. anatolicum* (3.5%) occur to a much lesser extent.

The presented data indicate a serious problem related to piroplasmosis in cattle in the southern districts of Turkestan region. In addition, they highlight the differences in the species composition of ticks between the two districts, which is essential for a better understanding of the distribution and ecology of these ticks in the area. These observations emphasize the need to develop effective measures to control and prevent piroplasmosis in cattle in the southern parts of the Turkestan region. Understanding the differences in the distribution of piroplasmosis and tick species in different areas can help to develop more accurate and adapted control strategies for these diseases, thereby improving livestock health and productivity in this region.

The research results on the spread of blood-parasitic diseases in cattle in the Turkestan region emphasize the significance of regular monitoring and research on veterinary aspects. These studies provide valuable data and information on disease dynamics, distribution, and seasonal changes. Based on this information, effective strategies for control and prevention of blood-borne parasitic diseases can be developed:

1. Regular monitoring. Conducting periodic surveys of the health status of livestock and their blood is a critical practice. It allows rapid detection of changes in parasite prevalence and animal health status. Regular inspections help veterinary services respond to early signs of disease and take control and treatment measures.

2. Tick bite protection. Effective protection of livestock from tick bites is one of the key means of preventing blood-borne parasitic diseases. It may include using anti-parasitic drugs and treating animals with special preparations but establishing conditions to minimize contact with ticks, such as providing cleaning and reducing grass cover.

3. Seasonal strategies. Considering seasonal changes in parasite distribution, it is essential to develop control and prevention strategies that are adapted to climatic conditions. For example, during the summer period, when the pathogen *Theileriaannulata* is active, precautions can be strengthened, and more frequent monitoring can be conducted.

4. Education and awareness. The education of farm workers and veterinary professionals about the control and prevention of blood-borne parasitic diseases plays a key role in the control of these diseases. Information campaigns and knowledge exchange between farms and veterinary services contribute to better disease management and reduce the impact on livestock.

Together, these measures help to improve the control and prevention of blood-borne parasitic diseases in cattle, reducing their impact on animal health and livestock productivity. In addition, the recommendations will help agricultural enterprises and veterinary organizations in the Turkestan region to reduce the risks and consequences of blood-borne parasitic diseases, ensuring healthier and more productive cattle and maintaining agricultural sustainability.

Considering the above, the research of the dynamics of piroplasmid distribution in cattle in different districts of the Turkestan region allows the following generalized conclusions to be made:

1. Seasonal variation in the distribution of piroplasmid. The distribution of piroplasmids among cattle in the Turkestan region has seasonal dynamics, with marked differences depending on the time of year. In summer, the highest activity of piroplasmids, particularly *Theileriaannulata* and *Babesia bigemina*, was observed, which may be related to more favorable climatic conditions for the reproduction of tick mites.

2. Geographical differences. There are differences in the distribution of piroplasmids in various districts of the Turkestan region. For example, some districts, such as Saryagash, may have a higher prevalence of particular piroplasmid species compared to other districts, such as Shardara.

3. Presumed influencing factors. Climatic and weather conditions play an essential role in piroplasmid activity, probably affecting tick vector populations and the potential for infecting livestock. Factors such as wind levels, humidity, and temperature can influence the seasonal dynamics of piroplasmid.

Understanding the dynamics of piroplasmid distribution is essential for developing strategies for the control and prevention of blood-parasitic diseases in livestock. Data on seasonal and geographical variations will help Veterinary Services to adapt disease prevention and control measures to specific conditions. In general, the research points to the need for comprehensive piroplasmosis control measures, including monitoring the spread of ixodal ticks, the development of vaccines and antiparasitic agents, and the education of farmers and veterinary professionals to better control and prevent these diseases.

The distribution of theileriosis, a significant tick-borne disease affecting cattle, shows notable differences when comparing the Turkestan region with the overall country. In the Turkestan region, theileriosis is predominantly caused by *Theileriaannulata*, with the highest prevalence observed during the summer months due to optimal conditions for tick activity. *Theileriaannulata* prevalence in the region can reach up to 80.3% in summer, indicating a severe infestation period, while spring and autumn show moderate infestation levels at 30.1% and 65.4%, respectively. Winter has the lowest prevalence at 27.5%. Nationwide, the distribution of theileriosis varies considerably due to diverse climatic and ecological conditions. In regions with harsher winters and less favorable conditions for ticks, such as the northern areas, the prevalence of theileriosis is significantly lower. These areas may experience sporadic outbreaks, with *Theileria parva* occasionally contributing to cases of theileriosis. The prevalence in these regions rarely exceeds 30%, even during peak seasons. In central and western regions of the country, where climatic conditions are more moderate, theileriosis distribution is somewhat comparable to the

Turkestan region but generally less severe. The prevalence of *Theileriaannulata* in these regions during peak summer months can reach 50-60%, with spring and autumn showing lower rates of around 20-40%.

The Turkestan region's warmer climate and longer tick activity season (from 6 to 9 months) create a unique environment that supports a higher and more sustained prevalence of theileriosis compared to other regions of the country. This prolonged season necessitates more rigorous and continuous control measures in Turkestan than in regions with shorter periods of tick activity. Overall, the Turkestan region faces a more severe and prolonged challenge with theileriosis due to its favorable climatic conditions for tick vectors, emphasizing the need for region-specific strategies for disease management and prevention. The rest of the country, while affected, experiences more variable and generally lower prevalence rates, influenced by regional climatic conditions and tick activity periods.

In recent decades, there has been a significant spread of parasitic diseases in cattle in the Turkestan region, which frequently becomes one of the reasons for the decline in the number of domestic animals in the country. Diagnosis of the emergence of such diseases, the issues of their treatment, and prevention of subsequent emergence and spread in the country are in direct dependence on several interrelated factors, among which, notably, the possibility of timely detection of such disease centers and implementation of a set of measures to improve the epizootic situation in the region, by improving the overall quality of cattle control in rural farms of the country [10]. The research on the degree of parasite impact on cattle in terms of ensuring the safety of individuals has received increased attention in the specialized literature, where research data on various features of parasite distribution in rural farms of different countries have been published [11].

Therapeutic and prophylactic measures designed to qualitatively solve the issues related to the health improvement of cattle and prevent the spread of parasitic diseases among domestic animals in agriculture are recommended to be conducted in springtime for all age groups of cattle. Preparations used for the treatment of diseases of domestic animals and prevention of reoccurrence of infectious diseases in them are selected strictly according to the age of the animal and its weight, and the specific focus of using preparations against specific groups of pathogens is crucial [12]. For example, in several farms in Brazil, to prevent the emergence and development of dermatosis in cattle caused by gadfly bites, a 5% solution of the Russian drug Cyperil was used, and the method of external spraying was used with a planned consumption of no more than two liters of the drug per animal per day. The treatment course ranged from seven to ten days, depending on the individual characteristics of the animal. In this context, the greatest practical effectiveness was demonstrated by animal treatments conducted at the early stages of larval development introduced under the skin by fly and gadfly bites [13].

Bovine piroplasmids are widespread in rural livestock in several countries and can cause significant damage. The duration of the period of infection in cattle is significant in this context, as the high prevalence of the pathogens significantly increases the probability of infection [14]. The significant threat of piroplasmosis to the agricultural sector is that the disease occurs during the spring-summer-autumn period, with the manifestation of the disease in cows resulting in lower dairy production, reduced fattening weights, and high mortality rates when veterinary intervention is delayed [15]. Prevention of theileriosis involves significant material costs, which is not always possible for agricultural enterprises. It explains the sometimes unjustifiably high mortality rate from this disease, which is less dangerous for domestic cattle if detected in time and preventive measures are implemented [16].

Theileriosis has been investigated for quite a long time, and numerous scientific works by different authors have been devoted to the research of its features and the character of its course. Several researchers, both modern and those who worked in the past centuries, considered this disease to be one of the atypical forms of piroplasmosis, and the causative agent of the disease was perceived by them as one of the species of the Theileria family [17]. Recent scientific studies have confirmed the fact of the relative abundance of the causative agents of this disease, which is partly explained by the difficulties with their classification and variability, which is explained by a combination of many factors that determine both the nature of the course of the disease and the specifics of infection of animals of specific groups.

Theileriosis has several specific features and pathological and anatomical changes that distinguish it from other animal piroplasmosis [18]. There are different varieties of this disease manifested in different

individuals and different geographical regions. The main course of this disease is acute, which is associated with a sharp deterioration of metabolism, general poisoning of the animal organism, and significant functional disorders that almost completely nullify the response of the organism of animals affected by the causative agent to the introduction of chemotherapeutic drugs into their body. In case of untimely or poorly performed treatment, the disease most often leads to the death of animals [19].

Symptomatic therapy of theileriosis improves the overall therapeutic effect and achieves optimal treatment results, provided that side effects are avoided [20]. Further studies of various aspects of the dynamics of distribution, seasonality, and degree of bovine theileriosis infection will contribute to the definition of the latest effective methods of therapy for the disease and the prevention of its occurrence on livestock farms.

CONCLUSIONS

The research on the species composition and distribution of bovine piroplasmosis and ixodid ticks in the Turkestan region led to significant findings. Thirteen species of ixodid ticks were identified, with B. calcaratus playing a key role in *bovine piroplasmosis* and *H. detritum, H. anatolicum*, and *H. plumbeum* in theileriosis. The study highlighted the importance of timely and geographically specific treatment and prophylactic measures, particularly during periods of high tick activity in spring, summer, and autumn.

Theileriosis, characterized by acute and subacute forms, poses a high risk due to the potential for severe outbreaks and fatalities. Effective preventive measures, for example, strengthening immune protection and regular veterinary assistance, are crucial for reducing the incidence and impact of the disease. This research underscores the need for ongoing monitoring and tailored interventions to safeguard cattle health and productivity in the Turkestan region.

By implementing the study's recommendations, livestock farms can better manage and prevent piroplasmosis and theileriosis, thereby improving cattle welfare and ensuring sustainable livestock production. The findings can be applied to developing strategic measures to mitigate the risks associated with blood-parasitic diseases in cattle, ultimately contributing to the preservation and growth of the cattle population in the region.

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