ANNOTATION

Dissertation by Zhanaidar Zhagparovich Bermukhametov
on the topic: *"The spread of bovine sarcocystosis in Kostanay Region"*
submitted for the degree of Doctor of Philosophy (PhD) under the educational program 8D09101 – Veterinary Medicine

1. General Characteristics of the Work. This research falls within the field of veterinary parasitology and zoonotic safety and is dedicated to studying the prevalence of sarcocystosis in cattle in the Kostanay Region.

2. Relevance of the Research Topic. Sarcocystosis is a widespread yet poorly studied parasitic disease that causes significant economic damage to livestock farming and remains a pressing issue in veterinary medicine due to its zoonotic nature, chronic course, and lack of sufficient scientific understanding. According to researchers, the infestation rate in cattle ranges from 71.1% to 98.0%, with the chronic form posing the greatest threat as it leads to abortions and reduced productivity. The spread of the disease is further exacerbated by the absence of effective diagnostic tools. Despite its global prevalence, sarcocystosis is not diagnosed in Kazakhstan and therefore remains insufficiently studied. The available literature offers only a few outdated data, except for a 2008 study conducted in Western Kazakhstan, where sarcocystosis in sheep was recorded for the first time.

Keywords: sarcocystosis, invasion intensity, invasion extensiveness, cattle.

3. Research Aim and Objectives

Research Aim: To study the prevalence and level of sarcocystosis infection in cattle in the Kostanay Region, including species identification of the causative agent.

Research Objectives:

1. To examine the epizootic situation and the prevalence of sarcocystosis in cattle across the natural and geographical zones of the region, with determination of infection levels in affected muscle tissues;
2. To investigate morphological and histological changes in muscles infected with sarcocysts;
3. To study the impact of sarcocystosis invasion on hematological and biochemical parameters in cattle blood;
4. To perform species identification of sarcocysts parasitizing in cattle using molecular genetic methods;
5. To conduct coprological examinations and antiparasitic treatment of dogs in a farm affected by sarcocystosis, and, based on the obtained data, to justify the effectiveness of the complex of therapeutic and preventive measures.

4. Object and Subject of the Research

Research Object: Cattle and dogs spontaneously infected with sarcocysts.

Research Subject: Muscle tissue and blood samples from cattle, as well as fecal samples from domestic carnivores.

5. Research Methodology.

The study was conducted from 2018 to 2024 in the laboratory of clinical-diagnostic, microbiological studies and biological material safety, as well as the

molecular genetic research laboratory of the Research Institute of Applied Biotechnology at the Non-Profit Joint-Stock Company «Akhmet Baitursynuly Kostanay Regional University». The research involved epizootiological, compression-microscopic, hematological, histological, molecular-genetic, parasitological, and statistical methods. A total of 976 cattle carcasses and 2,928 muscle tissue samples were examined, including 870 samples from neck muscles, 745 from the diaphragm, 361 from the heart, and 952 from skeletal muscles. Additionally, 247 canine fecal samples were analyzed.

6. Scientific Novelty. For the first time, the epizootic situation and the extent of sarcocystosis infestation among cattle in the Kostanay region have been studied. The species of Sarcocystis parasitizing cattle in the Kostanay region have been identified. The impact of antiparasitic treatment of dogs on the infestation rate in cattle has been evaluated.

7. Key Provisions Submitted for Defense.

- The epizootiological situation regarding sarcocystosis in cattle in the Kostanay Region, including its prevalence, extensiveness, and intensity of infection.
- Infection rates in different muscle groups and morphohistological changes in muscle tissue caused by sarcocystis.
- The species composition of sarcocysts parasitizing cattle in the studied area.
- The role of dogs as definitive hosts and the effectiveness of their antiparasitic treatment in the prevention of sarcocystosis in cattle.

8. Practical Significance. For the first time, the epizootiological situation of sarcocystosis in cattle has been studied in farms of the Kostanay Region. The results obtained have practical value for the diagnosis and prevention of the infection and can also be used in scientific research and educational activities.

The main research results have been implemented in veterinary practice:

1. Act of implementation of research results on sarcocystosis in cattle at *Kolos-Firma LLP*, Denisovsky District, Kostanay Region.

2. Act of implementation of research results on sarcocystosis in cattle, applied and used in the practice of the Large Animal Veterinary Clinic of the Lithuanian University of Health Sciences (Kaunas, Lithuania).

In Educational and Scientific Activities:

3. Act of implementation into the educational process for delivering lectures and conducting laboratory-practical classes in the relevant section of veterinary parasitology for veterinary students at A. Baitursynuly Kostanay Regional University.

4. Act of implementation of research results on sarcocystosis in cattle used in the educational process at the Department of Parasitology and Veterinary Pathobiology of the Lithuanian University of Health Sciences (Kaunas, Lithuania).

5. Act of implementation of results into the scientific laboratory of applied genetics at the National Center for Biotechnology in Astana for the purpose of species identification of the pathogens.

6. Act of implementation of results into the scientific research activities of the Department of Parasitology at Uludağ State University (Bursa, Turkey).

Based on the research results, the following materials have been developed and published:

- Practical guidelines: *"Sarcocystosis in Cattle in the Kostanay Region (Prevalence, Diagnosis, and Prevention)"* (approved by the Methodological Council of the Faculty of Natural Sciences, A. Baitursynuly Kostanay Regional University, Extract No. 1 dated 23.01.2025);

- Monograph: *"Sarcocystosis in Cattle in the Kostanay Region"*, ISBN 978-601-356-445-6. Recommended by the Academic Council of A. Baitursynuly Kostanay Regional University, Protocol No. 13 dated 27.09.2024. Kostanay: KRU Publishing House, 2024. – 164 pages;

- The identified sarcocyst species have been registered in GenBank.

9. Main Research Findings in the Form of Conclusions

1. Analysis of the epizootiological situation based on the results of sarcocystosis monitoring in cattle across various natural and geographical zones of the Kostanay Region during the period from 2018 to 2024 revealed a high prevalence of infection, with an extensiveness rate ranging from 61.9% to 81.3%. The highest levels of infection were recorded in the southern (81.3%) and eastern (77%) districts of the region, while the northern and western districts showed lower rates of 61.9% and 70.4%, respectively. The intensity of infection ranged from 5 to 25 cysts per gram of muscle tissue, with most frequent values observed in the range of 15–25 cysts.

2. The highest degree of infestation by *Sarcocystis* spp. cysts was detected in the neck and diaphragm muscles, while the lowest was observed in skeletal muscles. The size of the cysts ranged from 0.5 to 0.7 mm in length and 0.2 to 0.3 mm in width. The cysts exhibited elongated, spindle-shaped, and oval forms with both pointed and rounded ends. Diaphragm muscles predominantly contained elongated forms with sharp pointed ends.

3. Histological studies of cattle muscle tissue revealed 100% infection with sarcocysts, whose morphological characteristics corresponded to *Sarcocystis bovicanis* (*S. cruzi*). Pronounced degenerative changes in muscle tissue were identified, manifesting as chronic focal myositis (53.3%), focal serous myositis (36.7%), purulent reactive myositis (6.7%), and subacute diffuse myositis (3.3%). Van Gieson histochemical staining indicated the formation of fibrosis while preserving the structure and function of muscle fibers, which suggests a potential decline in meat quality and necessitates further veterinary and sanitary assessment.

4. In animals infected with sarcocystosis, characteristic changes in hematological parameters were observed: a slight decrease in erythrocyte count and hemoglobin level. A mild leukocytosis (by 1.26×10^9/L) and eosinophilia (by 0.81%) were recorded compared to non-infected animals, and by 2.64% and 1.71%, respectively, compared to standard reference values. Significant differences were identified in the biochemical parameters of blood: infected animals showed markedly elevated levels of transaminases AST, ALT, and alkaline phosphatase, indicating the development of pathological processes caused by parasitic burden.

5. For the first time in the Kostanay Region, molecular genetic methods were used to identify three major species of sarcocystosis pathogens in cattle: *Sarcocystis*

cruzi, *Sarcocystis bovifelis*, and *Sarcocystis dehongensis*. The most prevalent species was the pathogenic *Sarcocystis cruzi*, detected in 66.7% of the animals. *Sarcocystis bovifelis* was found in 26.32%, and *Sarcocystis dehongensis* in 7.01% of the examined cattle.

6. In the sarcocystosis-affected farm LLP "Kolos-Firma", a high infection rate among dogs was established (26.1%). The highest level of infestation extensiveness was recorded in adult dogs aged 3 years and older (37.5%), while the lowest was observed in young dogs aged 1.5–2 years (14.3%), indicating an increased risk of infection with age. Pronounced seasonal fluctuations were identified: the lowest infection rate was observed in winter (3.7%), and the highest in autumn (27.9%). Regular quarterly antiparasitic treatment of dogs over a three-year period made it possible to establish a direct correlation between the reduction in their infection rate and the decrease in the prevalence of sarcocystosis in cattle.

7. The conducted scientific and production trials confirmed the high effectiveness of antiparasitic treatment of dogs in preventing sarcocystosis in cattle. Studies carried out from 2019 to 2024 at the LLP "Kolos-Firma" demonstrated a decrease in infestation extensiveness in cattle from 67.8% to 24.2%. Breaking the biological transmission chain of the pathogen from the definitive host (dogs) to the intermediate host (cattle) significantly reduced the prevalence of sarcocystosis in cattle.

8. For effective control of sarcocystosis, it is necessary to introduce amendments to the current regulatory framework at the legislative level, ensuring the inclusion of this disease in the plan of anti-epizootic measures for productive livestock and securing appropriate attention from authorized veterinary authorities.

10. Relation to Research Projects and Government Programs.

The dissertation research was carried out within the framework of the following projects:

- Grant-funded scientific project for 2022–2024, IRN AP14869992: *" Monitoring the spread of Sarcocystosis in domestic animals in the context of food safety "*.

- Scientific and technical program BR249927852: *"Conducting research on the development of the agro-industrial complex of the Kostanay region with the creation of a research center"*, for the period 2024–2026.

11. Reliability and Validity of the Obtained Results.

The reliability and validity of the obtained results were confirmed through the use of precise and modern analytical methods, as well as the application of the scientific method. To ensure accuracy and reproducibility, all experiments were conducted in multiple parallel trials, and the findings were corroborated by publications in high-impact journals and in journals recommended by the Committee for Quality Assurance in the Sphere of Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan, as well as in the proceedings of international scientific conferences both in Kazakhstan and abroad. Additionally, practical guidelines were developed, and the identified sarcocyst species were registered in the international GenBank database.

12. Publications Based on the Main Research Results.

The results of the dissertation research are presented in 8 published works, including: 1 article in a foreign peer-reviewed journal indexed in the Scopus database, with a percentile of 65 in the field of veterinary science and a Q2 quartile ranking; 3 articles in journals recommended by the Committee for Quality Assurance in the Sphere of Science and Higher Education of the Ministry of Science and Higher Education of the Republic of Kazakhstan; and 4 publications in the proceedings of international conferences. In addition, practical guidelines and a monograph have been published.

13. Description of the Doctoral Candidate's Contribution.

The author carried out a significant volume of work: conducted a comprehensive review of the literature and participated in all stages of the experiments – from sample collection to molecular identification of sarcocysts and implementation of preventive measures in dogs. Practical recommendations were developed, the research results were summarized, and the dissertation was compiled and structured by the author.

14. Volume and Structure of the Dissertation.

The dissertation consists of 130 pages of computer-typed text and includes an introduction, main body, and conclusion. The text is illustrated with 48 figures, 20 tables, and 10 appendices. The list of references contains 189 sources.