

Name of the project: IRN AR19679977 «Study of species diversity and genetic features of viral and bacterial pathogens of infectious diseases of pets in Astana»

Actuality: diagnosis of infectious diseases in pets in Kazakhstan is not at the proper level. The scheme for diagnosing infectious diseases in pets is based on the observation of clinical signs (with a blood test), the use of immunological diagnostic methods specific to one pathogen (ELISA), and microscopy and histological analyzes. At the same time, a comprehensive analysis of the diversity and prevalence of viral and bacterial infectious pathogens of dogs and cats in the city of Astana is not carried out. Various parasitic organisms cause a large number of infectious diseases associated with pets: viruses, bacteria, fungi, protozoa, helminths and external parasites (fleas, ticks, lice). Due to the wide variety of infectious diseases and their overlapping clinical features, many cases go undiagnosed or misdiagnosed. In this regard, a treatment regimen based on the regular use of antibiotics is often used, which leads to the development of resistance in pathogens and the death of pets from improperly prescribed therapy. The introduction of molecular genetic methods for diagnosing viral and bacterial infectious diseases of dogs and cats into veterinary practice will increase the effectiveness of therapy, reduce the spread of antibiotic-resistant strains and prevent zoonothronous infections. Genotyping of the identified pathogens will allow a better understanding of the epizootic processes in the city of Astana, to track the distribution routes and major circulating genotypes. The proposed project is aimed at developing molecular genetic methods for diagnosing and studying the diversity of viral and bacterial pathogens of infectious diseases in dogs and cats.

Objective: to study the species diversity and genetic features of viral and bacterial pathogens of infectious diseases of dogs and cats in Astana.

Expected results: As a result of the project, new data on the species and genetic diversity of pathogens of viral and bacterial infectious diseases of dogs and cats in the city of Astana will be obtained. PCR screening of sick dogs and cats for viral and bacterial pathogens will be carried out in the period 2023-2025. Sequencing and genotyping of identified pathogens will be carried out. The resulting sequences will be published (deposited) in open access databases, which will allow any scientist to use the data with attribution.

The social, economic, scientific and technical effect lies in the introduction of PCR protocols into clinical practice, which allow identifying a wide range of viral and bacterial pathogens, which will significantly improve the diagnosis and treatment of dogs and cats in the city of Astana, with the possibility of a similar approach in other regions of Kazakhstan. The target consumers of the results are veterinary laboratories engaged in the diagnosis and monitoring of pet infections.

Two articles or reviews will be published in peer-reviewed scientific publications indexed in the Science Citation Index Expanded of the Web of Science database and (or) having a CiteScore percentile in the Scopus database of at least 35 (thirty-five); as well as one article in a peer-reviewed foreign or domestic publication recommended by the KKSON.

Results obtained for the project for 2023: According to the conducted epizootological analysis and primary survey in veterinary clinics of the Republic of Kazakhstan, canine distemper, pan leukopenia, calcivirosis, coronavirus, feline leukemia, and salmonellosis are registered in dogs and cats. A list has been compiled that includes six types of viruses and three types of bacteria. PCR protocols have been developed for the diagnosis of pathogens of bacterial infectious diseases in dogs and cats, using international recommended protocols and literature data. For each bacterial pathogen, primers were selected and the optimal composition of the reaction mixture with an amplification program was optimized. PCR protocols have been developed for the diagnosis of pathogens of viral infectious diseases of dogs and cats, using international recommended protocols. For each viral pathogen, primers were selected and the optimal composition of the reaction mixture with the amplification program was optimized. Algorithms for collecting and delivering samples from infected animals have been developed and a collection of samples has been compiled. The algorithms include the following steps:

selection and collection of anamnesis of animal disease, packaging of biological material and transfer in compliance with the cold chain to a laboratory with a BSL-2 safety standard. Standard operating procedures for the bacterial diagnosis of pathogens in dogs and cats have been developed and describe the steps for isolating and identifying the three major bacterial pathogens in dogs and cats.

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Information about the main publications of the scientific supervisor of the project related to the topic of the project:

1. Abdrakhmanov S.K., Mukhanbetkaliyev Y.Y., Korennoy F.I., Beisembayev K.K., Kadyrov A.S., Kabzhanova A.M., Adamchick J., Yessembekova G.N. Zoning of the Republic of Kazakhstan as to the risk of natural focal diseases in animals: the case of rabies and anthrax // Geography, environment, sustainability. – 2020. – Vol.13. – №1. – P.134-144. <https://doi.org/10.24057/2071-9388-2020-10> (CiteScore – 38 процентиляй; Q3).

2. Abdrakhmanov S.K., Mukhanbetkaliyev Y.Y., Sultanov A.A., Borovikov S.N., Yessembekova G.N., Abdykalyk A.N., Abishov A., Andres M Perez, Korennoy F.I. Mapping the risks of Peste des Petits Ruminants spread in the Republic of Kazakhstan // Transbound Emerg Dis. 2022 Jul; 69(4):2296-2305. doi:10.1111/tbed.14237 (WoS, Q1)

3. Tyulegenov S.B., Zhakupbayev A., Berdikulov M., Yessembekova G.N., Karibayev T., Sultanov A.A., Perez A.M., Abdrakhmanov S.K. Foot-and-mouth disease in Kazakhstan // Transboundary and Emerging Diseases 69(4). 2022. DOI: 10.1111/tbed.14607 (WoS, Q1)

Members of the research group:

Researcher 1: Amirgazin Asylulan Orazgalievich, undergraduate, researcher at the Laboratory of Applied Genetics of the National Center for Biotechnology LLP. <https://orcid.org/0000-0001-9418-7758> . Hirsch index by Scopus/WoS=two.

Researcher 2: Shevtsova Elena Sergeevna, Master, Senior Researcher, Laboratory of Applied Genetics, National Center for Biotechnology LLP. Hirsch index by Scopus/WoS=five. <https://www.scopus.com/authid/detail.uri?authorId=56736321900> ORCID: <https://orcid.org/0000-0002-7221-5866> Scopus Author ID: 56736321900.

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Researcher 5: Abenova Asem Zhandarbekovna, senior lecturer, of the Department "Veterinary medicine" KazATRU named after S. Seifullin.

Information about the main publications of the research group:

1. M. Kuibagarov, A. Amirgazin, G. Vergnaud, A. Shustov, A. Ryskeldina, Y. Ramankulov, A. Shevtsov. Draft Genome Sequence of *Moraxella bovoculi* Strain KZ-1, Isolated from Cattle in North Kazakhstan. Microbiol Resour Announc. 2020 Jul 23; 9(30):e00670-20. <https://journals.asm.org/doi/10.1128/MRA.00670-20> . Web of Science Q4

2. Kuibagarov M., Kairzhanova A., Vergnaud G., Amirgazin A., Lukhnova L., Izbanova U., Ramankulov Y., Shevtsov A. Draft Genome Sequence of the Strain *Francisella tularensis* subsp. *mediasiatica* 240, Isolated in Kazakhstan. Microbiology Resource Announcements 9.35 (2020). <https://doi.org/10.1128/MRA.00766-20> . Web of Science Q4

3. Amirgazin, A., Vergnaud, G., Mukanov, K., Kuibagarov, M., Karibaev, T., Ramankulov, Y., Shevtsova, Y. Draft genome sequences of three *Pasteurella multocida* strains isolated from domestic animals in Kazakhstan. Microbiology Resource Announcements 9.32 (2020). <https://doi.org/10.1128/MRA.00487-20> . Web of Science Q4

4. Amirgazin A., Shevtsov A., Karibayev T., Berdikulov M., Kozhakhmetova T., Syzdykova L., Ramankulov Y., Shustov A.V. Highly pathogenic avian influenza virus of the A/H5N8 subtype, clade 2.3. 4.4 b, caused outbreaks in Kazakhstan in 2020. PeerJ 10 (2022): e13038. <https://doi.org/10.7717/peerj.13038> . PMID: 35256921. Web of Science Q2, Percentile – 63, IF-2.984. citation – 0.

5. Shevtsov, A., Lukhnova, L., Izbanova, U., Vernadet, J. P., Kuibagarov, M., Amirgazin, A., Vergnaud, G. (2021). Bacillus anthracis Phylogeography: New Clues From Kazakhstan, Central Asia. Frontiers in microbiology, 12. PMID: 34956141. <https://doi.org/10.3389/fmicb.2021.778225> . Web of Science Q1. Percentile – 82, IF-2.984. citation – 2.

Information for Potential Users: This project will analyze biological samples taken during the infectious process in dogs and cats by PCR for the purpose of diagnosis and epidemiological screening for various viral and bacterial pathogens. In addition, when pathogens of fundamental, practical or economic interest are identified, genotyping or whole genome sequencing is planned.

The implementation of the project will expand the elements of molecular genetic monitoring of infections in domestic animals used in Kazakhstan. The results will be used by veterinarians to diagnose infections and select therapies for treating animals. The data obtained on the diversity, geographical distribution and genotypes of pathogens will improve surveillance and prevent diseases of citizens. Data on the species and genetic diversity of pet pathogens will be published in articles and open genomic databases, which may contribute to the development of veterinary control of infectious diseases.

Additional information: as a result of the research work, it is planned to develop methodological recommendations for the diagnosis of infectious diseases of dogs and cats in Kazakhstan.