



# Concept Development to Optimize the Reindeer Brucellosis Prevention

KASIM LAISHEV<sup>1\*</sup>, EVGENIY SLEPTSOV<sup>2</sup>, LEONID FOGEL<sup>3</sup>, ALEVTINA KISIL<sup>3</sup>, VLADISLAV VERETENNIKOV<sup>3</sup>

<sup>1</sup>The Northwestern Center for Interdisciplinary Research on Food Supply Problems, Russia, St. Petersburg; <sup>2</sup>The Yakut Scientific Centre of the Siberian Branch of the Russian Academy of Sciences, Russia, Yakutsk; <sup>3</sup>St. Petersburg State University of Veterinary Medicine, Russia, St. Petersburg.

**Abstract** | In the reindeer husbandry of the Asian North reporting many cases of brucellosis, this contagion causes significant economic damage and complicates the epidemiological tension in the regions. Scientific data have received during fieldwork in the Yamalo-Nenets and Chukotka Autonomous Districts, Magadan Region, the Taimyr, and Evenki Municipal Regions of the Krasnoyarsk Territory. We are determining distribution brucellosis among domestic reindeer analyzed by veterinary reporting of the State Veterinary Network and conducting clinical and serological examinations. There has established optimal doses of vaccines from strains of *Brucella abortus* 19 and *B. abortus* 82 in controlled experiments based on the study of reactogenicity, agglutinogenicity, and immunogenicity of biological products. Developed the concept to optimize the specific prevention of reindeer brucellosis. This idea based on modern theories of the epizootic process, self-regulation of parasitic systems, and natural foci, taking into account the characteristics of the technology of the industry. There has established that when choosing anti-brucellosis immunotherapy (especially in the natural foci of brucellosis), ground immunity and permanent immunity should be provided by highly immunogenic vaccines by the S-immune background. Subsequent reimmunization can also be with the help of others, including killed vaccines. The diagnosis of reindeer brucellosis can be only for epizootological control purposes. Promising, in this regard, is the use of an immunodiffusion reaction (RID with O-PS antigen). The results of the studies revealed that for the specific prevention of brucellosis in reindeer, the optimal dose of the vaccine from *B. abortus* strain 19 is 2.5 billion mt. For the immunization from *B. abortus* 82 strain, the treatment is 10 billion mt. It is proven the antiepidemiological efficacy of the optimal doses of vaccines from *B. abortus* 19 and 82 strains for the specific prevention of reindeer brucellosis in experimental and production conditions.

**Keywords** | Arctic zone of the Russian Federation, Reindeer herding, Anti-brucellosis measures, Vaccination

**Received** | July 30, 2020; **Accepted** | August 28, 2020; **Published** | September 20, 2020

\***Correspondence** | Kasim Laishev, The Northwestern Center for Interdisciplinary Research on Food Supply Problems, Russia, St. Petersburg; **Email:** solzeworot@gmail.com

**Citation** | Laishev K, Sleptsov E, Fogel L, Kisil A, Veretennikov V (2020). Concept development to optimize the reindeer brucellosis prevention. *Adv. Anim. Vet. Sci.* 8(s2): 18-23.

**DOI** | <http://dx.doi.org/10.17582/journal.aavs/2020/8.s2.18.23>

**ISSN (Online)** | 2307-8316; **ISSN (Print)** | 2309-3331

**Copyright** © 2020 Laishev et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## INTRODUCTION

Currently, in the Arctic zone of the Russian Federation, much attention is paid to the rational use of natural resources and the creation of their food base. Therefore, the region is actively developing the branches of traditional nature management (domestic reindeer farming, hunting, and fishing, gathering wild plants), which can become an integral part of the food security of the territory (Laishev

et al., 2015).

Under natural conditions, reindeer brucellosis in Taimyr diagnosed by serological and allergic methods by I.M. Golosov in 1948, and in 1955 V.A. Zabrodin was the first to isolate *Brucella* strains from deer. Subsequently, the presence of brucellosis infection in reindeer diagnosed in all regions of the north of the Asian part of Russia, from the Yamal-Nenets, Dolgan-Nenets, and Evenki autonomous

okrugs to the Republic of Sakha Yakutia, Chukotka Autonomous Okrug and Kamchatka Oblast (Gordiyenko, 2013; Listishenko et al., 2012; Sleptsov et al., 2017).

The fight against reindeer brucellosis is quite active. General business and veterinary-sanitary measures are applied (culling of clinically ill and positively responsive animals), diagnostic methods, and specific prevention of brucellosis in reindeer herding are developed and implemented. However, the problem of brucellosis in reindeer herding experience has not finally resolved, and in some areas, it has even worsened. First of all, this is due to the restructuring that took place in reindeer husbandry. As a result of redistribution ownership on animals formed numerous community-based clan and private farms, agricultural production cooperatives formed. The result of which was separation, association, or movement deer without proper veterinary control. That increased the possibility of introducing brucellosis infection into reindeer herds (Gordiyenko et al., 2011; Laishev et al., 2012; Sleptsov et al., 2015; Desforges, 2018; McCann et al., 2017).

Currently, reindeer brucellosis still registered in all of the above regions. In 2018, in the Russian Federation as a whole, 49 points of reindeer-insecure for brucellosis were recorded, including 37 points in the Republic of Sakha Yakutia in the Yamal-Nenets Autonomous District, 2 in the Taimyr Municipal District and 1 in the Chukotka Autonomous Region. In our opinion, this information is not entirely reliable, since in many regions brucellosis studies in reindeer herds not carried out regularly and insufficiently. It confirms the need to update knowledge on the specific prevention of brucellosis in reindeer herds (Vinokurov et al., 2017).

## MATERIALS AND METHODS

Obtaining scientific results based on analytical, statistical, expert methods, and authors' research during fieldwork in the Yamalo-Nenets and Chukotka Autonomous Districts, Magadan Region, the Taimyr, and Evenki Municipal Regions of the Krasnoyarsk Territory. The generally accepted methods of epizootological examination and epizootic surveillance used a detailed description of which given in previously published works of the authors.

The distribution of brucellosis among domestic reindeer was determined by analyzing the veterinary reporting of the State Veterinary Network and conducting clinical and serological examinations.

The analysis of the epizootic situation in the population of wild reindeer carried out using our research and generalization of available literature and archival materials, the aero-visual examination of the placement of animals.

304 deer included in scientific controlled experiments on the study of optimal doses of vaccines from strain 19, and 520 deer on the vaccine 82.

Immunization carried out by infection of animals to test immunity, selection of biomaterial for bacteriological studies, culture on culture media, typification of isolated cultures carried out according to generally accepted methods.

Based on the analysis of the results of studying the reactogenicity, agglutinogenicity, and immunogenicity of various doses of vaccines from *B. abortus* 19 and *B. abortus* 82 strains, the optimal doses of biological preparations for reindeer established.

The experimental data were processed statistically using correlation, regression, and factor analysis in XP / 2003 software packages. All values calculated at a confidence level of  $P = 0.05$ .

## RESULTS AND DISCUSSION

To analyze the effectiveness of anti-brucellosis measures without the use of specific prophylactic agents, we previously conducted production testing of a "vaccine-free regimen" for combating reindeer brucellosis in farms of the Magadan Region.

In the Magadan Region, 26 state farms with the primary livestock of 543.6 thousand deer (out of 39 deer-raising) were declared dysfunctional for brucellosis. Brucellosis recorded in 11 districts of the region (out of 15 in which there are reindeer herding farms).

To monitor changes in the epizootic situation of brucellosis in reindeer husbandry, veterinary specialists of the region systematically (quarterly) conducted a clinical examination of all animals, and from 15-20% of deer took blood for serological studies. Deer with clinical signs of the disease and aborted female deer were isolated from production teams in feeding herds for subsequent slaughter.

Despite the gigantic work done, only 8 (30.2%) farms that were outside the natural focus of deer brucellosis fully recovered. In 18 reindeer husbandry farms, despite the improvement work carried out, well-being could not be achieved. In some cases, the number of animals positively responding to brucellosis increased markedly.

In this regard, we developed a concept for optimizing the specific prevention of reindeer brucellosis from the perspective of theories of the epizootic process, self-regulation of parasitic systems, natural foci, technological

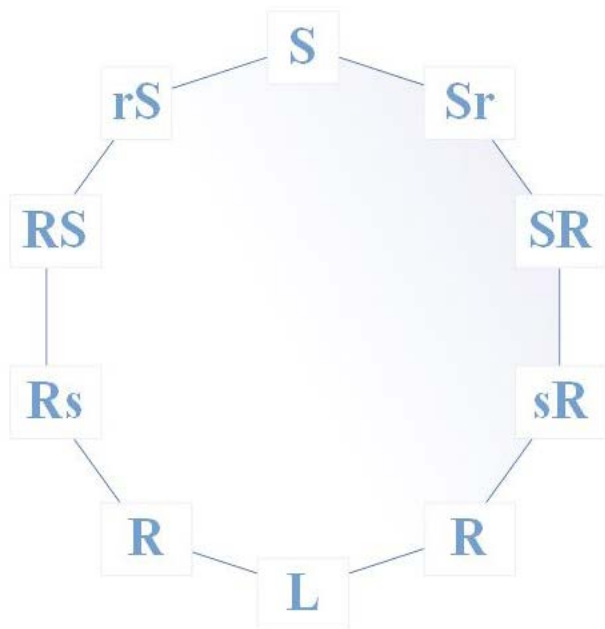
features of the industry, and new socio-economic and epidemic conditions.

Initially, we tried to present possible variants of the development of the epizootic process in the absence of permanent immunity in the populations of domestic reindeer and wild animals, while focusing on the results of both our research and literature data.

The possibility of the presence of both reserve and epizootic strains in individual herds is a priori definite. Reservation strains, in our opinion, should include dissociates, as well as S-strains with reduced virulence.

The formation of epizootic strains occurs in the process of reversal of the pathogen into the S-form and the acquisition of increased virulence during passage through susceptible organisms. The materials of our production experiments and practical observations on the rehabilitation of reindeer husbandry from brucellosis without vaccines confirm this since it was not possible to obtain stable results according to the “vaccine-free regimen” in most herds.

Based on the above, a conceptual model for controlling the epizootic process of brucellosis in animal populations in the presence and absence of permanent immunity has proposed (Figure 1).



**S → Sr → RS → Rs → R → L → Elimination**

**Figure 1:** A conceptual model of development the epizootic process of brucellosis in animal populations with and without immunity. A: The population of non-immune animals with brucellosis circulating in them at different stages; B: Immune reindeer populations (permanent immunity), with flowing brucellosis.

According to the presented scheme, the formation of epizootic strains with 100% coverage of animals with immunization and reimmunization should not practically occur since, under the influence of immunity, an irreversible process of dissociation of pathogens occurs with their subsequent elimination. In populations of non-immune animals, the reservation phases replaced by aspects of the formation of epizootic strains with a certain periodicity.

From the above diagram, the role of permanent immunity in controlling the epizootic process of reindeer brucellosis is unambiguously clear. However, to positively answer the most fundamental question in our concept - is it necessary to create permanent immunity in populations of domestic reindeer, we faced the following issue: how to ensure this lifelong immunity with minimal costs in all herds of local reindeer since in each explicit or potential contacts with sources of the pathogen of brucellosis are not excluded from them, both inside the pack (re-generation of animals during periods of rutting, calving, etc.) and because of the widespread occurrence of natural foci (infection of wild reindeer populations, carnivores, rodents).

The widespread use of specific prophylactic prophylaxis in reindeer, especially in the adult population, has been restrained and continues to be controlled, in our opinion, due to the massive manifestation of the provocative properties of vaccines.

The fact is that in deer herds, where the re-fermentation process never seemed to stop, the pathogen reservation stage, as a rule, is not accompanied by any manifestation, primarily clinical.

Introduction vaccine makes it possible to provoke the transition of the pathogen from the reservation stage to the stage of formation of the epizootic strain and, thereby, to manifest the disease in many animals.

Most scientists and practitioners attributed this phenomenon to either high reactogenicity at a given dose of the vaccine, or increased sensitivity of deer to the vaccine. Without completely denying this, it should be noted that manifestation of the provocative properties of any vaccine, including anti-brucellosis, largely depends on the features of strain, and dose, and method of administration.

Therefore, it is possible to reduce the external manifestation of the “reactogenic” properties of the vaccine by optimizing the dose. As well as by administering the immunopreparation to lowering the level of herd infection before vaccination. Using general veterinary and sanitary measures (aimed at neutralizing the transmission mechanism), diagnostics (identification of brucellosis carriers), and body sanitation deer. These issues have been studied in other animal species.

**Table 1:** The control system for the epizootic process of brucellosis in domestic reindeer (conceptual model).

Domestic reindeer populations	
Epizootological monitoring	Epizootic process management
Purpose: control of an epizootic situation with an assessment of its tension level and identification of epizootically dangerous animals	Purpose: providing in dysfunctional and threatened populations, permanent immunity, preventing the formation and circulation of epizootic strains
Lead Link: Rational Diagnostics	Lead Link: Rational Specific Prevention Schemes
Express method of screening studies: Expert differential method, RBP RID with O-PS antigen Additional methods: According to indications	Means: For the primary vaccination of young animals to create a strong ground immunity: Necessarily live vaccines from agglutigen strains of brucella in optimal doses for subsequent annual immunization of adult animals to maintain permanent immunity. It is possible to use vaccines of various types that maximally provide an objective epizootic assessment of populations using rational diagnostic schemes
<b>Final result:</b> Epizootic well-being of animal populations (in them the causative agent may be present in some hosts, but only at the maximum in the reservation stage: dissociated or typical forms with reduced virulence)	

When choosing anti-brucellosis immunotherapy (especially in the natural foci of brucellosis), it should emphasize that highly immunogenic vaccines should provide gross immunity and permanent immunity.

Grundimmunity is essential only due to the S-immune background. Subsequent reimmunization can also be with the help of others, including killed vaccines. However, in reindeer herding, these are distant prospects.

Diagnosis of reindeer brucellosis can be used only for epizootological control, and the use of an immunodiffusion reaction (RID with O-PS antigen) is promising in this regard.

When introducing specific prophylaxis means in reindeer herding, it is necessary to take into account the technological features of the industry: Year-round deer grazing, constant herds movement (roaming) to search new grazing areas, severe climatic conditions in the region sharply limits the possibilities and organization of mass diagnostic and therapeutic, preventive measures in reindeer husbandry.

Based on the conceptual model, we developed a system for controlling the epizootic process of brucellosis in domestic reindeer and methodological recommendations for monitoring the epizootic process of brucellosis in reindeer (from the standpoint of theories of the epizootic process, self-regulation of parasitic systems, natural foci, technological features of the industry, and new socio-economic and epidemic conditions (Table 1).

We believe that in the practical implementation of the concept of optimizing the control system for the epizootic process of reindeer brucellosis, the following sections should distinguished:

- Control of an epizootic situation: The decisive link in the assessment of the epizootic state of farms (teams)

is the clinical examination and serological testing of adult deer blood for brucellosis.

Mandatory conditions for clinical and serological studies: Quarterly clinical examination of the entire herd of deer in coral; annual serological monitoring of blood serum according to a set of serological studies (RBP, RA, RSK, RID with O PS antigen) from at least 15-20% of deer of each reindeer herding team.

- Protection of prosperous farms from the introduction of brucellosis infection: To avoid the introduction of brucellosis infection into prosperous farms (herds), it is necessary: to have information about the epizootic situation for brucellosis in neighboring reindeer husbandry farms and adjacent territories of grazing herds; receive systematic data on the ways of seasonal migration of wild reindeer in the region (district, okrug); organize strictly isolated deer grazing of brucellosis-free farms (brigades), excluding possible contacts with animals of dysfunctional squads (state farms), wild reindeer or visits to pastures located on the paths of seasonal migration of wild reindeer; to prohibit transport (on reindeer sledding) communications between employees of prosperous farms and brigades disadvantaged for brucellosis; to prevent the entry of deer (purchase, exchange of choirs) from unsuccessful farms (brigades) into safe farms (squads).
- Improvement of reindeer husbandry dysfunctional for brucellosis: The methods for improving the health of brucellosis-deprived households (teams) are selected depending on the course of brucellosis infection in the family (group), taking into account the epizootic state of the district (district) in which this dysfunctional point located. If, during a mass serological examination for brucellosis, more than 30% of seropositive deer found in the herd, it recommended that all animals killed. In reindeer husbandry, where there are no clinically sick

animals, and the number of seropositive is up to 3-5%, the use of anti-brucellosis vaccines recommended. We have studied vaccines from *B. abortus* strains 19 and 82 and the doses of their administration for the specific prevention of reindeer brucellosis. It found that the optimal dose of the vaccine from the *B. abortus* 19 strain is 2.5 billion mt. After its introduction, not a single case of post-vaccination complications revealed. The grafted deer recorded pronounced immunological response with appearance specific agglutinins and the complement of binding antibodies in the blood serum. During 360 days, all vaccinated animals responded negatively or doubtfully to RA. Revaccination of animals causes a secondary immune response, but the rate of decline of specific antibodies is higher. Immunity during six months after vaccination of all experimental deer was 91.6%, while in the control group, the introduction of a virulent strain caused 100% infection. For the vaccine from strain *B. abortus* 82, it found that a dose of 10 billion mt is optimal for use on reindeer. It did not cause post-vaccination complications in vaccinated deer after 180 days. Only doubtfully reacting animals registered in the RA. Immunity during 3 and 6 months after vaccination was 75%. Comparative tests of vaccines from *B. abortus* 19, 82 strains under production conditions indicate a high level of antiepidemiologic efficacy of the scheme for the use of vaccines from strain 19 and 82 in reindeer herding for both primary immunization and reimmunization: no clinically ill animals found. The number is positive reacting animals in herd No. 2 (pcs. 19) decreased by more than 6.5 times, and in herd No. 3 (pcs. 82) - 3 times.

## CONCLUSIONS AND RECOMMENDATIONS

The results of the studies showed that in the reindeer husbandry of the Asian North, brucellosis is registered, which causes not only significant economic damage but also complicates the epidemiological tension in the regions.

In the Yenisei North, the Republic of Sakha (Yakutia), the Chukchi and Evenki Autonomous Okrugs, natural foci of brucellosis infection formed. The epizootic chain of the disease includes domestic, wild reindeer and carnivores, whose regular seasonal migrations and constant pasture contacts create favorable conditions for the spread of brucellosis infection.

The research results showed that the use of anti-brucellosis measures in reindeer husbandry without the use of specific prevention does not have the proper anti-epizootic effect, especially if there is a natural focus of brucellosis infection.

A concept has developed to optimize specific prevention of reindeer brucellosis based on modern theories of the epizootic process, self-regulation of parasitic systems, and natural foci, taking into account the characteristics of industry technology.

It established that for the specific prevention of brucellosis in reindeer, the optimal dose of the vaccine from *B. abortus* strain 19 is 2.5 billion metric tons, and for the vaccine from *B. abortus*, 82 strain the treatment is 10 billion metric tons.

The efficacy of optimal doses of vaccines from *B. abortus* 19 and 82 strains for specific prophylaxis of reindeer brucellosis in experimental and industrial conditions has proven.

## AUTHOR'S CONTRIBUTION

Kasim Laishev is a leader and developer of this research. Evgeniy Sleptsov was conducting fieldwork research in the Yamalo-Nenets and Chukotka Autonomous Districts, Magadan Region, the Taimyr, and Evenki Municipal Regions of the Krasnoyarsk Territory. Leonid Fogel was analyzing the veterinary reporting of the State Veterinary Network. Alevtina Kisil was responsible for selection of biomaterial for bacteriological studies, and its culture on culture media. Vladislav Veretennikov was responsible for conducting clinical and serological examinations.

## CONFLICT OF INTEREST

The authors have declared no conflict of interest.

## REFERENCES

- Desforges JP (2018). Immune function in arctic mammals: Natural killer (NK) cell-like activity in polar bear, muskox and reindeer. *Vet. Immunol. Immunopathol.*, 195: 72-75. <https://doi.org/10.1016/j.vetimm.2017.11.010>
- Gordiyenko LN (2013). Modern problems of a brucellosis of animals in the Russian Federation. *Mater. Int. Sci. Conf. Curr. Trends Agric.*, 1: 38-39.
- Gordiyenko LN, Kulikova EV, Listishenko AA (2011). System the protivobrutselleznykh of actions in northern reindeer breeding. *Achiev. Sci. Technol. Agrarian Ind. Complex*, 9: 70-72.
- Laishev KA, Samandas AM, Prokudin AV (2012). Conceptual models of protection of reindeers against the main infectious diseases of reindeers on Far North. *Materials of a scientific and practical conference Northern reindeer breeding: current state, prospects of development, new concept of veterinary service*, SPb Pushkin. pp. 108-115.
- Laishev KA, Zabrodin VA, Dubovik IK (2015). The main directions of food supply of the population living in the Arctic zone of the Russian Federation. In the collection: *Modern problems and the strategy of development of*

- agrarian science of the European North of Russia Materials of the International scientific conference devoted to the 80 anniversary from the date of foundation of the Karelian state agricultural experimental station. Editor-in-chief ZP Kotova. pp. 161-169.
- Listishenko AA, Kulikova EV, Shtelle DV, Gordiyenko LN (2012). Stepen of spread of a brucellosis among reindeers at a sharp current in the infection centers. Current state of natural and technical science. Mater. VI Int. Sci. Pract. Conf., pp. 120-124.
  - McCann JC, Elolimy AA, Loor JJ (2017). Rumen microbiome, probiotics, and fermentation additives. *Vet. Clin. North Am. Food Anim. Pract.*, 33(3): 539-553. <https://doi.org/10.1016/j.cvfa.2017.06.009>
  - Sleptsov ES, Evgrafov GG, Reshetnikov AD, Evgrafova AV, Barashkova AI (2015). Use of live slaboagglyutinogenny vaccine from B.abortus 82 strain at immunoprevention of a brucellosis of reindeers. *Agrarian Bull. Urals*, 2(132): 26-27.
  - Sleptsov ES, Evgrafov GG, Vinokurov NV, Laishev KA, Fedorov VI, Iskandarov MI, Zakharova OI (2017). A brucellosis of reindeers and a measure of fight against them in the conditions of Far North of the Russian Federation. Novosibirsk. pp. 126.
  - Vinokurov NV, Gulkin AM, Laishev KA, Sleptsov ES, Fedorov VI, Iskandarov MI, Fedorov AI (2017). Diagnosis of a brucellosis of reindeers in the conditions of Far North of the Russian Federation. Novosibirsk. pp. 184.