Summary of PhD thesis

Herd health implications of paratuberculosis in large-scale dairy farms

dr. Barbara Vass-Bognár

Supervisor: Dr. Viktor Jurkovich

UNIVERSITY OF VETERINARY MEDICINE

Doctoral School for Veterinary Science

Budapest, 2023

Supervisor:

………………………………………………………

Dr. Viktor Jurkovich, dipl. ECAWBM

senior research fellow

University of Veterinary Medicine

Centre for Animal Welfare

……………………………

dr. Barbara Vass-Bognár

1 Background and objectives of the doctoral thesis

1.1 Introduction

Paratuberculosis is a severe, chronic infectious disease of ruminants with diarrhoea. The causative agent is *Mycobacterium avium* subspecies *paratuberculosis* (MAP), an acid- and alcohol-resistant bacterium highly resistant to environmental influences. The disease is present worldwide, and nowadays, it is considered one of the diseases affecting dairy farms with significant economic damage. Due to the development of the disease, the incubation period can be extremely long, on average 2-10 years. The currently available diagnostic tests do not provide complete detection of infected and bacterium-spreading individuals. The husbandry technology of large-scale dairy farms creates favourable conditions for the spread of the disease. The primary source of infection is the faeces of animals excreting the bacteria or oral intake of bacteria appearing in colostrum or milk.

Animals are most susceptible to infection in calf age, and intensive group housing significantly promotes the spread of the disease. In dairy herds, mainly the subclinical form is typical. Due to the immunosuppression resulting from the disease, the animals are culled for other reasons before the appearance of clinical symptoms. However, they can shed bacteria even during this time and cause a significant loss of production in farms.

The connection between paratuberculosis and human Crohn's disease is still unclear. Still, its possible human health implications setting up control programs to suppress the disease is even more critical. Effective eradication programs are being attempted worldwide with more or less success; the most significant limitation is that there currently needs to be a diagnostic method available to detect infected individuals even before bacterial eradication begins. In many cases, control programs are hindered by both veterinarians and animal keepers due to the costs, the energy required, and the long duration. My doctoral thesis

aimed to assess the level of infection in domestic dairy farms, the effectiveness of the applied control programs, and to identify those possibilities, both from the diagnostic and management side, that provide an opportunity to suppress the disease.

1.2   Aims, methods

1.2.1   *The effect of subclinical paratuberculosis infection on the health and some physiological parameters of dairy cows*

The first study aimed to determine the effect of the subclinical form of paratuberculosis on the production and health of dairy cows.

In the study, we compared the milk production, health and metabolic parameters of 20 faecal qPCR positive but in the subclinical stage of the disease and 10 MAP-negative Holstein Friesian cows. We continued data collection and sampling from the 10th day before the expected parturition to the 120th day of lactation. Body condition, rumen fullness and faecal sludge scores were lower throughout the infected group. No differences were

found in the metabolic parameters between the two groups. Milk production tended to be lower, and somatic cell count tended to be higher in the MAP+ group. All other health and reproductive parameters showed significant differences between the two groups. The number of mammary health treatments was 4.8 times higher in the MAP+ group than in the control group, and all reproductive indicators were lower than in the control group. We found that MAP infection, even in a subclinical form, significantly impacts production, some reproductive parameters and udder health.

1.2.2 *Correlations between calving and calf rearing technology and the level of paratuberculosis infection in Hungarian dairy farms*

The study aimed to identify points in the husbandry technology in dairy farms that promote the spread of the disease to the greatest extent and to identify management options to prevent them.

The survey was conducted during personal site visits based on a ten-question questionnaire. The

questions mainly examined the possibilities of the spread of MAP from cows to calves. We conducted our visits on 26 farms where any management measures to suppress paratuberculosis have been carried out for two years. To assess the success of the management measures, we used the apparent seroprevalence of the farms as a basis. Based on our results, the most critical points in farm management are, on the one hand, whether the newborn calf can be immediately removed from its mother, thereby preventing oral intake of infected faeces, and, on the other hand, drinking colostrum and milk exclusively from MAP-negative animals. The practice of group calving and the proximity of the sick barn to the farrowing barn proved risky. We found that calf management is an essential element of paratuberculosis control programs. If the farms successfully set up the correct management practices, the infection rate will be lower.

1.2.3 Examination of the prevalence of paratuberculosis in domestic large-scale dairy herds and analysis of the success of eradication programs over four years

The study aimed to assess the prevalence of paratuberculosis in domestic large-scale dairy herds and evaluate the eradication programs or the lack thereof depending on the apparent changes in seroprevalence over the years.

During the investigation, we processed the data of 42 farms between 2018 and 2021 and monitored the effectiveness of the control programs applied at the farm. We considered the annual blood sampling data in all cases to calculate the apparent seroprevalence. Based on our data, the apparent seroprevalence increased from 5.1% to 5.6% in the examined period. If no measures are taken on the farm to eliminate the disease, a significant increase in seroprevalence will occur within four years, unaffected by the initial seroprevalence. In the case of farms following only the testing-culling strategy, it was only possible to maintain the disease level or

achieve a slight improvement. The seroprevalence reduction was significant during the study if the critical infection management measures were followed in addition to the testing and culling, and in the case of additional diagnostic tests aimed at facilitating the culling decision, measuring faeces by qPCR proved the most effective.

1.2.4 Examination of the sensitivity of diagnostic tests for the detection of paratuberculosis infection in different stages of lactation

During our fourth study, we examined the applicability of the available diagnostic tests for practice, milk and serum ELISA and faeces qPCR, during lactation.

We selected 52 known PTB+ pregnant cows from 4 large-scale dairy farms in Hungary. Six times, 1-5, 10-14, 40-60, 90-120, 180-200 and 280-300 days after calving (DIM), individual faeces, blood and milk samples were collected from the cows in the study. During the study, 16 animals were culled due to clinical PTB around 40-DIM. The analysis was performed both with the animals that were culled

and with the exclusion of the culled animals. In both cases, the highest proportion of positive diagnostic tests occurred on DIM 40-60. We also examined the repeatability of individual diagnostic tests. The most agreement was observed at sampling intervals at the beginning of lactation. In the case of a positive result obtained on a 40-60 DIM sample, the affected cow may be removed from the animals intended for insemination during the voluntary waiting period. She may be culled at the end of lactation, thus preventing it from becoming a source of infection for the newborn calves at the next calving.

2 New scientific results of the thesis

1.   Under Hungarian conditions, no significant results could be achieved in the eradication of paratuberculosis in the examined 4-year period with only a testing-culling strategy. There was no significant difference in the annual seroprevalence change in the farms where only the testing-culling program was followed. On the farms where, in

addition to culling, the management steps were followed, the apparent seroprevalence decreased proportionally by 20% per year.

2.   If the colonies do not carry out exemptions against paratuberculosis, a significant apparent seroprevalence increase of 13% per year can be observed on average over four years, regardless of the initial apparent seroprevalence. We found that between 2018 and 2021, the apparent seroprevalence in the studied farms increased from 5.1% to 5.6%.

3.   Among the management measures taken to suppress paratuberculosis in domestic large-scale dairy farms, removing the calf from its mother decreased the chance of seropositivity by 55%, while the destruction of the colostrum of PTB+ cows by 48%, so these two factors proved to be the most important in preventing the spread of paratuberculosis within the herd.

4.   To detect paratuberculosis, qPCR proved the most reliable method among the currently available diagnostic tests. However, the ELISA

S/P values of milk and serum correlate well with the qPCR Ct values of faecal sludge. The serum ELISA proved to be more sensitive than the milk ELISA during the first five days of lactation.

5. The best chance of diagnosing paratuberculosis is 40-60 days after calving. Between days 40 and 60 of lactation, the milk and serum ELISA values of animals culled due to paratuberculosis are significantly higher, and their faecal PCR Ct values are significantly lower than those of infected animals showing no clinical symptoms. Based on our studies, the methods may be suitable for predicting clinical paratuberculosis at the beginning of lactation.

3 Publications related to the thesis

3.1 Papers published in peer-reviewed scientific journals

1. Vass-Bognár B., Bakony M., Baumgartner W., Khol J. L., Jurkovich V.: **Association between calf rearing technology and farm-level**

paratuberculosis infection in Hungarian dairy farms. Prev. Vet. Med., 207. 105719, 2022.

2. <u>Vass-Bognár B.</u>, Jánosi Sz., Baumgartner W., Khol J. L., Jurkovich V.: **A paratuberculosis diagnosztizálásának lehetőségei szarvasmarhában** Magy. Állatorv. Lapja, 142. 579-592, 2020.

3. <u>Bognár B.</u>, Farkas K., Fornyos K., Zrufkó R., Baumgartner W., Khol J.L., Jurkovich V.: **A szarvasmarhák paratuberculosisa és az ember Crohn-betegsége közötti lehetséges kapcsolat.** Magy. Állatorv. Lapja, 141. 659-675, 2019.

4. Jurkovich V., <u>Bognár B</u>., Balogh Krisztián, Kovács-Weber M., Fornyos K., Szabó R., Kovács P., Könyves L., Mézes M.: **Effects of subclinical Mycobacterium avium ssp. paratuberculosis infection on some physiological parameters, health status and production in dairy cows.** Acta Vet. Hung., 64. 301-312, 2016.

3.2 Dissemination of the results in international scientific conferences

1. <u>Vass-Bognár B.,</u> Baumgartner W., Fornyos K., Jurkovich V.: **Prediction of clinical paratuberculosis with RT-qPCR.** In: Abstract book of the 15th Congress of International Association for Paratuberculosis, 12-16 June 2022, Dublin, Ireland, p. 224

2. Jurkovich V., Bakony M., <u>Vass-Bognár B.</u>: **Factors associated with the spread of paratuberculosis in Hungarian dairy cattle herds.** In: Abstract book of the 15th Congress of International Association for Paratuberculosis, 12-16 June 2022, Dublin, Ireland, p. 225

3. <u>Vass-Bognár B.</u>, Fornyos K., Jurkovich V.: **Measuring environmental faecal samples on dairy farms infected with paratuberculosis**. In: Abstract book of the 31st World Buiatrics Congress, Vol. 2., 4-8 Sept 2022, Madrid, Spain, p. 136.

4. <u>Bognár, B.</u>, Fornyos, K., Jurkovich, V.: **A klinikai paratuberculosis előrejelzése bélsár Rt-PCR**

vizsgálattal - előzetes eredmények In: Szenci, Ottó; Brydl, Endre (szerk.) A Magyar Buiatrikus Társaság 29. nemzetközi kongresszusa: Proceedings Hévíz, Magyar Buiatrikusok Társasága pp. 57-60, 2019.

5. Bognár B., Jurkovich V.: **Major risk factors for environmental and farming technology involved in the spread of paratuberculosis in Hungarian dairy herds.** In: Sebastian Opaliński (szerk.) Proceedings of the XIXth International Congress of International Society for Animal Hygiene, Wrocław, Poland, 2019.09.08-2019.09.12. pp 56-57.

6. Bognár B., Fornyos K., Jurkovich V.: **A kérődzők paratuberculosisának kimutatására szolgáló újabb diagnosztikai módszerek.** In: A Magyar Buiatrikus Társaság 29. nemzetközi Kongresszusa, Proceedings, 2019. 11. 13-16., Hévíz, pp. 210-213, 2019.

7. Bognár B., Fornyos K., Jurkovich V.: **Paratuberculosis, mint lehetséges közegészségügyi veszélyforrás.** In: 18. Közép-

Európai Buiatrikus Kongresszus, 2018. 05. 30 - 06. 02., Eger, Magyar Állatorvosok Lapja, 140 (Suppl. 1.), 259-262, 2018.

8. Bognár B., Jurkovich V.: **A paratuberculosis terjedésében szerepet játszó fontosabb környezeti és tartástechnológiai kockázati tényezők hazai tehenészetekben– előzetes eredmények.** In: 18. Közép-Európai Buiatrikus Kongresszus, 2018. 05. 30 - 06. 02., Eger, Magyar Állatorvosok Lapja, 140 (Suppl. 1.), 36-40, 2018.

9. Bognár B, Jurkovich V.: **A paratuberculosis diagnosztikai lehetőségei**. In: A Magyar Buiatrikus Társaság 27. nemzetközi Kongresszusa, Proceedings, 2017. 11. 15-18., Hévíz, pp. 194-197, 2017.

10. Jurkovich V., Bognár B., Balogh K., Kovacs-Weber M., Szabo R.T., Kovacs P., Könyves L., Fornyos K., Mézes M.: **The effects of subclinical M. avium ssp. paratuberculosis infection on the health and production parameters of dairy cows.** In Proceedings of the

29th World Buiatrics Congress, Dublin, Ireland, 3-8 July 2016. pp 529.

11.   Bognár B., Balogh K., Mézes M., Kovács-Weber M., Szabó Rubina T., Könyves L, Jurkovich V.: **Szubklinikai Mycobacterium avium ssp. paratuberculosis fertőzöttség hatása tejelő tehenek egészségére és teljesítményére – előzetes eredmények**. In: A magyar Buiatrikus Társaság 25. Jubileumi Nemzetközi Kongresszusa, 2015. 09. 13-16., Budapest. Magyar Állatorvosok Lapja, 137 (Suppl. 1) 21-25., 2015