Summary Study

The Occurrence and Significance of *Prototheca* Species in the Central European Dairy Sector

1. Introduction and Pathogen Overview

Microalgae of the genus **Prototheca** are microscopic, achlorophyllic, unicellular, yeast-like organisms that are ubiquitous in nature, particularly in humid and wet environments. While they primarily cause infections in immunocompromised humans, in farm animals—especially dairy cows—they induce both clinical and subclinical mastitis.

The most common pathogen in dairy herds is **Prototheca bovis** (formerly *P. zopfii* genotype 2), although *P. blaschkeae* and *P. wickerhamii* are also responsible for infections. The incidence of these infections is showing a permanent global increase and represents a serious economic challenge because these pathogens are **resistant to most conventional antimicrobials**.

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2. National Legislation and Regulatory Framework

A consistent finding across the sources is that *Prototheca* mastitis is currently **not subject to specific legislation** in the examined countries:

- **Hungary:** There are no existing specific rules or provisions for the examination of *Prototheca* algae. Infections are primarily managed under general dairy hygiene and animal health regulations. It is not classified as a notifiable disease, and there is no mandatory national eradication program.
- **Czech Republic:** The occurrence of *Prototheca* mastitis is not regulated by law. There are no legal limits for the number of *Prototheca* cells in milk, and it is not part of routine official milk quality assessments.
- **Slovakia:** No legal regulations exist regarding the monitoring of *Prototheca* in the milk of dairy cows or small ruminants.

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3. Authorities Involved in Legislation and Investigation

Various organizations are involved in research, diagnostics, and oversight, although their roles are often not specifically tied to *Prototheca* by law:

Hungary:

- **Hungarian Dairy Research Institute Ltd. (MTKI Kft.):** The central body for raw milk classification and certification.
- **University of Veterinary Medicine Budapest (UVMB):** Conducts screening of raw milk samples and research activities.

- **National Food Chain Safety Office (Nébih):** Monitors compliance with food chain safety regulations.
- **Milk Interprofessional Organization and Product Board:** A forum for sectoral interest conciliation that contributes to professional and legislative activities.
- **Animal Production Performance Testing Ltd. (ÁT Kft.):** Plays a role in raw milk certification and informs partners monthly about the presence of the pathogen.

Czech Republic:

- **State Veterinary Institute (SVI, Jihlava):** Plays a key role in diagnostics and the examination of milk samples.
- **Research Institute of Veterinary Medicine (VRI, Brno):** Cooperates on the identification and quantification of pathogens and research.
- **Dairy Research Institute (DRI, Prague):** Involved in applied research and has developed a certified methodology for eradication.
- **State Veterinary Administration (SVA):** Approves methodological procedures for the industry.

Slovakia:

- **Ministry of Agriculture and Rural Development (MARD SR):** Drafts legislation and sets policy on milk hygiene.
- **State Veterinary and Food Administration (SVFA SR):** The main authority for official control of food of animal origin.
- **National Reference Laboratory for Milk (NRLM):** Provides supervisory and reference laboratory analyses.

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4. Country Statistics and Trends

Available data indicates that the prevalence of the infection is significant or increasing in the region:

- **Hungary:** The pathogen first appeared around 1998–1999. Data from ÁT Kft. shows that **1.77% to 2.20%** of tested raw milk samples were positive in recent years. University research (2013–2019) identified it as the 4th or 5th most common udder pathogen, with prevalence ranging from **3.3% to 7.8%**.
- **Czech Republic:** Between 2019 and 2022, **4.37%** of bulk tank milk samples were found to contain *Prototheca*. More recent screenings (2023–2025) show capture rates between **4% and 7%**. In individual milk samples from problem herds, positive findings can range from **7% to 45%**.
- **Slovakia:** Data is very limited as it is not part of standard testing. In 2024, one out of two tested samples was positive; in 2025, 14 samples were negative. A study detected the genus in **0.8%** of positive goat milk samples.

5. Former Research and Key Findings

Economic Impact and Milk Quality

Research confirms that *Prototheca* infection causes significant losses:

- **Milk Yield Reduction:** Hungarian data shows a decrease of **2.44 kg/day** per cow. In the Czech Republic, a **7.1%** decrease in yield was determined in positive animals.
- **Somatic Cell Count (SCC):** The infection drastically increases SCC, often exceeding **1.5 million cells/ml**.
- **Composition:** The infection reduces fat, calcium, and potassium content. Interestingly, some Hungarian results showed **higher lactose (sugar) content** in infected milk, while Czech studies noted lower titratable acidity.

Environmental Resistance and Transmission

- The pathogen survives in manure, watering troughs, technological biofilms, and bedding.
- **Heat Resistance:** Standard pasteurization (75°C for 20 seconds) does not fully destroy the algae; **12-23% can remain viable**. Only heat treatment at **100°C** is 100% effective.
- Transmission is often linked to poor hygiene during milking and contaminated barn environments.

Diagnostic Methods

Traditional culturing on selective media (PIM agar) is accurate but slow, requiring up to a week for results. Research highlights **real-time PCR** as a faster (3-hour), more accurate method for species-level identification (e.g., distinguishing *P. bovis* from *P. blaschkeae*).

6. Recommendations at Country and V4 Level

National Level Recommendations

1. System-level and Legislative Recommendations:

- **Monitoring and Standards:** Include *Prototheca* spp. among the **officially monitored pathogens** within milk quality assessment frameworks.
- **Alarm Levels:** Establish national "alarm levels" for somatic cell counts (SCC) in raw milk samples. It is suggested that if the **SCC exceeds 400,000 cells/mL**, the sample should be immediately tested for *Prototheca* algae.
- **Food Safety:** Include *Prototheca* spp. among key indicators in terms of food safety (e.g., FAO).
- **Methodological Guidelines:** Develop national "best practices" and use already developed methodologies that have been proven in practice, such as the certified Czech methodology for eradication.

2. Diagnostic and Oversight Recommendations:

- **Prevalence Surveys:** Conduct national surveys to assess the current situation and prevalence of *Prototheca* in dairy cows, particularly in Slovakia where it is not part of standard testing.
- **Implementation of Modern Methods:** Move toward the routine use of **rapid and accurate real-time PCR** diagnostic tools, which can provide results within 3 hours and differentiate between species, as an alternative to slow culturing methods that can take up to a week.
- **Accreditation:** Aim to obtain **accredited status** for *Prototheca* detection methods in laboratories to ensure official control and reliability.
- **Raising Awareness:** Increase information sharing among breeders and veterinarians regarding the importance of the pathogen and the recognition of non-bacterial mastitis.

3. Farm-level (Preventive) Recommendations:

- **Strict Hygiene:** Implement consistent hygiene during milking, specifically the **disinfection of teats before and after milking**.
- **Environmental Management:** Ensure a **dry and clean environment** for housing animals and regularly check the hygiene and technical condition of milking equipment to eliminate technological biofilms.
- **Culling:** Since there is currently no effective antibiotic treatment, positive animals must be detected early, isolated, and **culled from the herd** to prevent further spread of the infection.

V4 Level Recommendations

- **Coordination and Harmonization:** Strengthen professional **coordination among V4 countries** (Hungary, Czech Republic, Slovakia, and Poland) to harmonize approaches to control and eradication.
- **Joint Data Collection:** Develop unified diagnostic methods and eradication protocols across the region to allow for international monitoring of trends.
- **Knowledge Sharing:** Adapt and share certified national methodologies (such as the Czech eradication protocol approved in 2023) across the member states.

Research Recommendations

- **Long-term Data Collection:** Continue research activities aimed at collecting long-term data to monitor trends in the occurrence and spread of the pathogen.
- **Therapeutic Development:** Since conventional antibiotics are ineffective, research should focus on developing **effective veterinary pharmaceuticals** or alternative solutions for treating protothecosis.
- **Environmental Sources:** Conduct further studies on the behavior of these pathogens in technological biofilms and their various routes of spread within the farm environment.