Summary of PhD thesis

Relationships between herd health management,
milk production indicators and udder health in
Holstein-Friesian dairy herds

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1. Introduction and aims of the study

Milk and dairy products are consumed by billions of people worldwide and global demand for milk continues to grow. The decline in the number of dairy farms has coincided with an increase in the average number of cows and milk production worldwide, with a significant impact on the health and well-being of dairy cows. Today, sustainable and climate-friendly production is increasingly central to our daily lives. Improved productivity - be it milk or meat - and efficient use of feed reduces environmental pressures. Future livestock production systems need to be more efficient and exploit available and emerging technologies. A newer issue is human health concerns such as antibiotic residues in milk, antimicrobial resistance and the transmission of pathogens through milk or dairy products.

In dairy farms, the primary objective is to increase the size of the economic profit. In recent years, market fluctuations in milk and feed costs have made profitability even more important. Profitability can be achieved by increasing the quantity and quality of products sold and paid for by the market, and by reducing unit costs.

Increased productivity and the growing need to reduce the use of antibiotics and environmental pressures, as well as a growing awareness of animal welfare issues, will have a major impact on the future of dairy cattle farms.

Mastitis is one of the most common and economically damaging diseases of dairy cattle worldwide. Due to the multifactorial nature of the disease, the problem of mastitis can be approached from many angles. The aim of my PhD thesis is to investigate the problems of mastitis from a management perspective and to obtain results that will help to improve the prevention of the disease in line with the increasing focus on reducing the use of antibiotics and the need for profitability and sustainability.

Research objectives:

1. To survey milking technology and to study the relationship between milking technology, herd size and certain milk production indicators based on data from performance-tested dairy farms in Hungary.

2. To survey farm management factors influencing udder health in Hungarian dairy farms and to identify the factors influencing average herd somatic cell count in Hungarian dairy herds.

3. To study the implementation of an automatic sensor-based animal monitoring system in a dairy farm, in terms of key production indicators and economic efficiency.

4. To study the impact of home-grown protein feeds on milk production indicators and economics in a dairy farm.

2. Summary of the results

My thesis summarises the results of four studies. The first study aimed to assess milking technology and to investigate the correlation of milking technology with herd size and certain production indicators based on data from 417 Hungarian dairy farms. In Hungary, the dairy herd size varies widely. Not only in herd size, but also in milking technology (milking parlour, number of milking stalls, number of daily milkings) and milk production (daily milk yield, daily milk production per cow, somatic cell count [SCC]), large differences can be observed. While the most common type of milking parlour is the herringbone parlour, in dairy herds with more than 600 cows, parallel and rotary parlours are also predominant. Our results show that herd size has a greater influence on milk production (daily milk yield, daily milk production per cow and SCC) than the used milking technology. Furthermore, we found that the average SCC is high in domestic dairy herds, suggesting that improving milk quality in Hungarian dairy herds could further increase the quantity of milk produced.

The second study aimed to assess the specific farm management factors affecting udder health in Hungarian

farms and to identify the factors influencing farm SCC in Hungary. It was found that dairy farms in Hungary are in a wide range of management factors influencing udder health. Our findings are very similar with the results of other European and US surveys, and no significant inconsistencies were found when examining any of the management factors. Our survey showed that dry cow therapy has a significant impact on SCC in the Hungarian dairy herds. SCC was lowest when frequent (min. weekly) drying off was included in the farm udder health protocol, and teat sealants were used. Farm average SCC tended to be lower by one-phase dry cow feeding strategy (no different diet in far-off and close-up) and when on-farm diagnostic tools were used.

The third study aimed to assess how the introduction of a sensor-based automatic animal monitoring system in 2019 changed the main production indicators and their economic impact on a dairy farm with 1500 Holstein-Friesian cows compared to 2017-2018. Based on our economic analysis, the annual income per cow increased by more than 44,000 HUF (120.5 EUR, 1 EUR = 365 HUF) in 2019 following the introduction of the sensor-based automatic animal monitoring system.

In the fourth study, we replaced imported soybean in the diet of a group of milking cows on a Hungarian dairy farm with home-grown protein feed (canola meal and alfalfa hay and alfalfa senage). The hypothesis was that such a diet could be used to develop a more environmentally friendly management model with lower environmental impact and better production indicators. The results of the study showed that milk quality indicators (milk fat%, milk protein%, lactose%) were significantly higher in the trial group. However, in terms of farm profitability, the replacement of imported soybean in this diet resulted in a decreased milk production, causing a total of 2,885 HUF (7.9 EUR, 1 EUR = 365 HUF) monthly decrease in income over feed cost per cow in the trial group.

Increased productivity and the need to reduce antibiotic use and environmental pressures, as well as growing awareness of animal welfare issues, will have a major impact on the future of dairy farms. Dry cow management together with good housing and milking technology, adapted to the farm conditions, has been shown to further improve farm SCC. Sensor-based automatic animal monitoring systems facilitate the monitoring of animals on large-scale farms and provide data to support decision making, thus facilitating the timely implementation of

effective treatments, which further improves farm profitability. Thus, although the investment cost of these systems is high, the invested money into a properly selected and used system can be recovered within a few years. The use of precision faming technologies and economic analyses will support the decisions (e.g., diet change) that will help to achieve profitable dairy production while meeting the various needs that are nowadays at the forefront (reduction of antibiotic use, environmental management, animal welfare).

3. New and novel scientific results

1.   In Hungary, the average SCC of farms with a larger number of cows is significantly lower than that of farms with a smaller number of cows. The SCC of the herringbone milking parlours is the highest, although no significant differences were found between the different types of milking parlours. Overall, herd size has a greater influence on milk production than the used milking technology.

2.   Among the farm management factors influencing udder health, dry cow therapy significantly influences SCC in dairy cows in Hungary. In farms where frequently (e.g. weekly) adapted dry-off therapy was included in the farm udder health protocol ($p < 0.038$), and where teat sealants were used ($p = 0.0228$) SCC is significantly lower. SCC tends to be lower ($p = 0.063$) on farms where dry cow period was one-phase (no different diet) and in herds where on-farm diagnostic tools (e.g., rapid tests) were used ($p = 0.076$).

3.   Following the introduction of a sensor-based automated individual animal monitoring system, the annual income per cow in a Hungarian large-scale dairy farm increased by more than 44,000 HUF (120.5 EUR, 1 EUR = 365 HUF) in the year following the introduction of the system, due to improvements in milk production and reproductive indicators. Although the investment costs of introducing these technologies are high, they have already generated significant additional income in the first year of operation, so the investment into these precision systems could be paid back within a few years.

4.   For circularity and sustainability, replacing imported soybean with home-grown protein feed (canola meal, alfalfa hay and alfalfa senage) in a large-scale Hungarian dairy farm significantly improved milk quality indicators (milk fat%, milk protein%, lactose%), but reduced the quantity of milk produced in the trial group. Thus, the use of home-grown canola meal and alfalfa to replace imported soybean with the tested diet resulted in an overall loss of income and was not economically beneficial for the farm.

4. Publications related to the topic of the dissertation

4.1. Full text papers in peer-reviewed journals with impact factor

Ivanyos D., Monostori A., Németh Cs., Fodor I., Ózsvári L. (2020) **Associations between milking technology, herd size and milk production parameters on commercial dairy cattle farms.** *Mljekarstvo* 70:2 pp. 103-111.

Ózsvári L., Ivanyos D. (2021) **Milking practices on commercial Holstein-Friesian farms.** *Revista Brasileira de Zootecnia – Brazilian Journal of Animal Science* 50 Paper: e20200280

Ivanyos D., Fogarassy Cs., Szádvári J., Ózsvári L. (2020) **Certain economic aspects of the installation of a sensor-based automatic animal monitoring system in an intensive dairy herd** (in Hungarian). *Magyar Állatorvosok Lapja* 142:12 pp. 707-716.

Ivanyos D., Ózsvári L. (2021) **Relationship between certain aspects of farm management and mastitis on**

dairy farms Literature review (in Hungarian). *Magyar Állatorvosok Lapja* 143:9 pp. 515-528.

4.2. Full text papers in peer-reviewed journals without impact factor

Ivanyos D., Monostori A., Németh Cs., Fodor I., Ózsvári L. (2019) **Relationship between herd size, milking technology and milk production parameters on large-scale Hungarian dairy farms.** *Biologiya Tvaryn/Animal Biology* 21:2 pp. 32-34.

Pfützner M., Ivanyos D., Ózsvári L. (2019) **Wirtschaftliche Verluste in deutschen Milchviehbetrieben durch subklinische Mastitiden.** *Klauentierpraxis – Die Zeitschrift der Östereichischen Buiatrischen Gesellschaft* 27 pp. 9-15.

Ivanyos D., Monostori A., Németh Cs., Fodor I., Ózsvári L. (2020) **Udder health and milking technology on the Hungarian large-scale dairy farms.** *Gradus* 7:2 pp. 110-113.

Ivanyos D. (2019) **A szárazonállás tartáshigiéniai és tőgyegészségügyi összefüggései.** *Értékálló Aranykorona* 19:1 pp. 26-27.

Ivanyos D., Monostori A., Németh Cs., Fodor I., Ózsvári L. (2020) **Magyarországi tejelő tehenészetek fejéstechnológiája.** *Partnertájékoztató Hírlevél*, 20. (3) pp. 10-12.

4.3. Presentations at international conferences

Pfüztner M., Ivanyos D., Ózsvári, L. (2017) **Economic loss due to subclinical mastitis in large German dairy herds.** In: Szenci Ottó; Brydl Endre (Ed.) *27th International Congress of the Hungarian Association for Buiatrics:* Proceedings Budapest, Hungary: Magyar Buiatrikusok Társasága pp. 138-145.

Ivanyos D., Ózsvári L. (2019) **Management practices influencing somatic cell count on dairy farms.** In: Szenci Ottó; Brydl Endre (Ed.) *29th International Congress of the Hungarian Association for Buiatrics*: Proceedings Hévíz, Hungary: Magyar Buiatrikusok Társasága pp. 213-216.

Ivanyos D., Monostori A., Németh Cs., Fodor I., Ózsvári L. (2019) **Survey of milking technology on the Hungarian dairy farms.** In: Szenci Ottó; Brydl Endre (Ed.) *29th International Congress of the Hungarian Association for Buiatrics*: Proceedings Hévíz, Hungary: Magyar Buiatrikusok Társasága pp. 65-69.

Ivanyos D., Monostori A., Németh Cs., Fodor I., Ózsvári L. (2019) **Milking technology on the Hungarian dairy farms.** In: Illés, Bálint Csaba (Ed.) *Proceedings of the International Conference on Management: "People, Planet and Profit: Sustainable business and society"*: Volume I Gödöllő, Hungary: Szent István Egyetemi Kiadó Nonprofit Ltd. 385 p. pp. 134-139.

Ivanyos D., A. Monostori A., Németh Cs., Fodor I., Ózsvári L. (2022) **The impact of herd size and milking technology on milk production in dairy cattle units.** In: *31st World Buiatrics Congress* Abstract Book Volume I Madrid, Spanyolország: The National Association of Spanish Specialists in Bovine Medicine (ANEMBE) and The World Association for Buiatrics (WAB) 448 p. pp. 437.

4.4. Presentations at Hungarian conferences

Ivanyos D., Monostori A., Németh Cs., Fodor I. Ózsvári L. (2019) **Fejési rendszerek és termelési mutatók alakulása magyar nagylétszámú tejelő tehenészetekben.** In: Hoyk Edit (Ed.) *Környezettudományi és Analitikai Műhelykonferencia*: Absztraktkötet Kecskemét, Hungary: Neumann János Egyetem Kertészeti és Vidékfejlesztési Kar pp. 5-6.

Ivanyos D., Monostori A., Németh Cs., Ózsvári L. (2019) **A fejőállás típusa és a tejtermelés főbb jellemzői közötti összefüggések magyarországi tejelő tehenészetekben.** In: Sótonyi, P.; Gálfi, P.; Vörös, K.; Magyar, T. (Ed.) *Akadémiai beszámolók* Budapest, Hungary: University of Veterinary Medicine Budapest p. 32

Ivanyos D. (2022) **Hazai fehérjetakarmány hatása a tejtermelésre.** *Precíziós rendszerek a körkörös gazdálkodás támogatására tejtermelő gazdaságokban* c. konferencia és kerekasztal-beszélgetés, Budapest, Hungary: University of Veterinary Medicine Budapest 3rd March 2022