

**UNIVERSITY OF WEST-HUNGARY
FACULTY OF AGRICULTURAL AND FOOD SCIENCES
INSTITUTE OF ANIMAL BREEDING
MOSONMAGYARÓVÁR**

**Program: Biological, technological and economic questions of animal
produce production**

Subprogram: Production and processing of cattle products

Program and theme supervisor:

**Dr. Dr. h.c. IVÁNCICS, János
Doctor of the Hungarian Academy of Sciences**

**EXAMINATION OF SOME BIOLOGICAL AND
ENVIRONMENTAL FACTORS INFLUENCING
THE SOMATIC CELL COUNT IN RAW MILK**

THESES OF THE DOCTORAL (PHD) DISSERTATION

**Author:
GULYÁS, LÁSZLÓ**

**MOSONMAGYARÓVÁR
2002**

1. INTRODUCTION

On January 1st 1984 Hungary introduced a new milk inspection system, the principles of which, after various modifications, are still in force . From January 1st 1991 a new evaluating category –the somatic cell count of milk – was included in the standard. Parallel with this the previous qualitative and quantitative characteristics remained valid, on which milk inspection of the preceding years was based. The raw milk evaluating stations already gave the somatic cell count of the analysed milk samples with informatory purpose well in advance. These results gave possibility to the producers to prepare in time for good quality raw milk production.

Both in the countries of the European Union and in Hungary further tightening of regulations can be expected (somatic cell count, germ number), which paves the way for Hungarian research and development.

2. STATEMENT OF PURPOSE

One of the biggest producing, breeding and economic problems of dairy farms is mastitis and the high somatic cell count deriving from it. This leads to the decrease in milk production and the shortening of the lifespan of the animals. On the one hand the high somatic cell count and germ number decreases the inner and the palatability value, the processability, and the amount of product gained from processing milk, on the other hand due to the pathological physiological deviations it endangers both the health of consumers, and the quality of the goods.

The aim of this research is to examine the biological and environmental factors influencing the somatic cell count in raw milk under small and large scale producing conditions.

3. MATTER AND METHOD

The research was carried out on small (n=94) and large (n=54) scale dairy plants of the North-western Transdanubian region between January 1 1991 and June 30 1999. The research was based on 225 Hungarian spotted, 4158 red spotted and 16656 black spotted Holstein-Friesian mixed lactation cows.

The somatic cell count of the bulk milk was examined at stock level with respect to:

- breed,
- milking method,
- keeping technology,
- feeding technology and
- size of plant (number of cows).

The connection between the individual somatic cell count was examined with respect to the following elements:

- number of lactations (age of cow),
- state of lactation,
- morphological characteristics of the udder (shape of udder and its suspension, size and distance of teats),
- length of teat duct (ductus papillaris), and
- pigmentation of teats.

The certain bull progeny groups and the cow families were compared. The general state of hygiene of the dairy plants, the so called “Stall inspection evaluation” result, was evaluated. The connection between the so called “Human factor” as well as the milking technology and the somatic cell count was examined.

The recording of the sizes of the teats (distance, length, diameter) was carried out with a self created measuring instrument, the volume of the teat was measured with the water expelling method with a measuring-tube of 100m³. The length of the teat duct (ductus papillaris) was measured with a special measuring

equipment, created by IVÁNCSICS and co-workers. The accuracy of the measurements was controlled after slaughter.

Udder-morphological examinations were always carried out between the 60th and the 120th day of lactation directly before evening milking.

The “**Stall inspection evaluation**” was compiled using EU animal hygiene norms, with evaluation sheets filled on the spot 4 times a year.

The evaluation sheets were processed using the presence or lack of the used evaluation aspects (yes-no) and a system of evaluating numbers between 1 and 5 (5-excellent, 4-good, 3-sufficient, 2-weak sufficient, 1-insufficient)

The so called “**Human factor**” analysis was carried out using the fractioned milk collection and evaluation method (individually, milker by milker), using the average somatic cell count data of the raw milk samples analysed by the Nyerstejminősítő Laboratórium (Raw-milk Qualifying Laboratory) of Veszprém, and the Állattenyésztési Teljesítményvizsgáló Kft. (Animal Breeding Performance Testing Ltd.) Gödöllő. The tests were carried out with the measuring equipment **FOSSOMATIC 180** and **90**.

For the individual (cow by cow) tests, again the monthly, so called “control milking” somatic cell count data of the Állattenyésztési Teljesítményvizsgáló Kft. (Animal Breeding Performance Testing Ltd.) were used. The daily tests were carried out with the somatic cell count measuring equipment **PISOFT**, the results of which were controlled in comparison with the other results (Veszprém, Gödöllő).

At the site of production so called “quick tests” were applied from time to time (**MASTITEST**, **DOSYL-test**), however, only for checking. The research-series were based on the animals of 54 large scale (stock-farm) and 94 small scale (producer, private entrepreneur) dairy stocks, and the animals (n=10) of the Animal Breeding Farm of the Pannon University of Agricultural Sciences,

Mosonmagyaróvár (PATE Animal Breeding Farm) . The milk samples were taken according to the pace of the examinations:

- At small dairy plants in the milk collecting centre (morning and evening milk) in accordance with the amount and with monthly regularity.
- At large dairy plants during the milking trial with the equipment TRU-TEST introduced by the Állattenyésztési Teljesítményvizsgáló Kft. (Animal Breeding Performance Testing Ltd.).
- At the Animal Breeding Farm of PATE every day (morning + evening) during lactation.
- In case of mixed herd milk test with daily, (morning + evening), weekly, or monthly regularity after homogenising (mixing) from the milk cistern or bulk milk cooler.

The principal data of the tests (somatic cell count, SCC) were analysed according to the aspects of the examinations with the method of one way ANOVA.

The evaluation of the results (average, scattering, CV%, t-test; correlation analysis) were carried out with the help of the programs EXCEL 6.0 and STATISTICA 4.5. For samples with few elements (bull progeny groups, cow families) also the rank correlation tests (r_{rank}) were carried out.

The plants and the stocks where the research series were carried out gave permission to the tests and the examinations by officially signing the “Declaration” and the “Consent” to them. When evaluating the results the stocks (plants, farms) the names of the breeding bulls, and their Central Register Number were substituted by numbers (1-2-3-n), the names of the persons (milkers) were substituted with the letters of the alphabet. The cow families were signed with their initial letter.

4. SUMMARY OF THE RESULTS

It can be stated that in Hungary milk evaluation and inspection, which is connected to the prices and consequent in validity, has had advantageous effect on

milk quality since 1984. When comparing Hungarian quality regulations with those valid in the European Union, it can be seen, that there are no remarkable differences between the criteria. However, both in the EU and in Hungary further tightening of regulations can be expected (somatic cell count, total germ number), which indicates the direction for Hungarian development. In Hungary the rate of EXTRA and 1st class milk exceeds 92%. Good quality milk comes from the large scale producers, while poor quality milk mainly comes from small scale dairy plants. There is still a lot to be done in connection with the quality of the produced and purchased milk.

Summarising the research, it can be determined, that in the programs aiming at lowering the somatic cell count, first a complex farm-analysis, so called “Stall inspection” should be carried out.

Certain biological factors (breed, milk production) have lesser, while others (state of lactation, number of lactations) have more significant effects on the somatic cell count of milk. Udder-morphological characteristics (udder suspension, udder depth, teat-size, length of ductus papillaris), moreover when examining the pigmentation of the teats, it showed that the average somatic cell count of certain bull-progeny groups and cow families was significantly different ($P < 0.1\%$).

From among the environmental factors, in extreme conditions, keeping, feeding, milking technology, and the “human factors” can cause serious problems for milk quality.

5. CONCLUSIONS AND SUGGESTIONS

The results with respect to the **breed** only agree in part with the ones published in scientific literature, therefore further research would be necessary.

As an explanation for the differences in somatic cell count of **milking methods**,

mainly the outdated milking machines and the extensive vacuum fluctuation should be mentioned. Regular checking and control of milking equipment is essential.

From among the **external environmental factors**, under extreme conditions, keeping, feeding and milking technology lowers the milk quality, thus increases the somatic cell count.

From among the **biological factors** some (milk production) to a lesser extent, while others (state of lactation, number of lactations) to a significant extent influence the somatic cell count.

Most of the **udder characteristics** and the **teat pigmentations** are fairly well inheritable characteristics, therefore results can be significantly improved within one or two generations.

The **bull-progeny group** and **cow-families** analyses should be continued in further lactations, until there are sufficient number of offspring.

Carrying out the “**Stall inspections**” regularly and consequently, the factors with disadvantageous effect (increasing the somatic cell count) should be revealed.

The so called “**human factors**” are also of great importance, since they affect the other factors either directly or indirectly, which influence the somatic cell count.

To improve the milk quality various **milk-tests** (stall-trials, quick-tests, instrumental analysis, laboratory tests) are absolutely essential.

6. NEW SCIENTIFIC RESULTS

Summarising the research the following new research results can be established:

- 1. In the research it was proved that the somatic cell count is influenced by numerous factors (biological, environmental, human). Therefore it can be*

decreased using a complex farm analysis, improving the factors inducing the disadvantageous effects.

- 2. During the research the presumption that with the increase of milk yield the quality of milk deteriorates, and the somatic cell count increases did not prove.*
- 3. Certain udder morphological characteristics (udder suspension, udder depth, shape, length and diameter of teat) play an important role in the quality of the produced milk.*
- 4. A very close connection can be found between the length of the teat duct (ductus papillaris), the pigmentation of the teat and the somatic cell count of the milk ($r=-0,59$ - $-0,89$, and $r=0,75$ - $0,80$ resp.)*
- 5. Between the individual bull progeny groups and the cow families there are significant differences with respect to the average somatic cell count. ($P<0.1\%$) Evaluating the sequence/order of the progeny groups and cow families, stocks the following values were shown $r_{rank}=0.60$ and 0.94 , and $r_{rank}=0.82$ resp.*
- 6. The programs aiming at improving the milk quality can hardly achieve any remarkable improvement without regular milk quality testing; such as in case of large dairy plants individual (cow by cow), at small scale plants with milk collecting places (farmer by farmer) evaluation.*

7. SCIENTIFIC PUBLICATIONS AND LECTURES FROM THE TOPICS OF THE THESIS

1. Scientific publications

1.1 Publications in foreign language

1. GULYÁS, L.- IVÁNCSICS, J. (2001): Zusammenhänge der somatischen Zellzahl und einiger eutermorphologischen Eigenschaften. Archiv für Tierzucht. (Connections between the somatic cell count and some udder morphological characteristics.) Vol. 44. No. &. pp. 15-22. (IF: 0.4)

1.2 Publications in Hungarian

1. IVÁNCSICS, J. - GULYÁS, L. – DAMJANOVICS, S. – GÁSPÁR, R. – KRASZNAI, Z. (1996): Biological and technological factors of hygienic milk production. 26th Scientific Days in Óvár: New challenges and strategies in agricultural production. Animal breeding section. Vol. 1. pp. 53-55. Mosonmagyaróvár, 25 September 1996.
2. GULYÁS, L.- BOROSS, P. (1997): The effect of personal factors on the somatic cell count of milk. Acta Ovariensis. 39. 1-2. pp. 101-109.
3. GULYÁS, L. - IVÁNCSICS, J. (1998): Analysis of the milk produced in West Hungarian small dairy plants with respect to the accession to the EU. 6th International Agro-economic Scientific Days. GATE College Faculty of Agricultural Sciences, Gyöngyös, 24-25 March 1998.
4. GULYÁS, L. - IVÁNCSICS, J. (1998): The role and significance of extension in milk production at small dairy plants. 12th Food Quality Control Scientific Conference, Szolnok, 25-30 April 1998.
5. GULYÁS, L. – SZALKA, É. – KOVÁCS, T. – BEDNARIK, R. (1998): Economic analysis of milk production at the “Kisalföld” Agricultural Co-operative in Bogyoszló. Acta Agronomica Ovariensis. Mosonmagyaróvár, 40. 2. pp. 189-199.
6. GULYÁS, L. - IVÁNCSICS, J. (1998): Analysis of the connection between milk quality and stock size. Competitive Hungarian agriculture at the turn of the millennium. 40th Georgikon Days. Vol. 3. pp. 112-115. Keszthely, 24-25 September 1998.

7. GULYÁS, L. - IVÁNCICS, J. (1998): Examination of the quality of the milk produced in small dairy plants in Győr-Moson-Sopron county. 27th Scientific Days in Óvár: New challenges in agriculture with respect to the EU accession. Animal breeding section, Vol. 1. pp. 54-58. Mosonmagyaróvár, 29-30 September 1998.
8. IVÁNCICS, J. - GULYÁS, L. (1998): Improving the hygienic quality of raw milk, with special attention to the somatic cell count. 27th Scientific Days in Óvár: New challenges in agriculture with respect to the EU accession. Animal breeding section, Vol. 1. pp. 78-82. Mosonmagyaróvár, 29-30 September 1998.
9. IVÁNCICS, J. - GULYÁS, L. – PONGRÁCZ, L. (1999): Genetic possibilities of reducing the somatic cell count of milk. 4th Genetic Congress, pp. 92-93. Siófok, 11-14 April 1999.
10. GULYÁS, L. - IVÁNCICS, J. (1999): The challenge of the turn of the millennium and the EU in improving milk quality. The basis of our agriculture's future is quality. 41st Georgicon Days. Vol. 2. pp. 316-320. Keszthely, 23-24 September 1999.
11. GULYÁS, L. - IVÁNCICS, J. (1999): Correlations between the udder morphological characteristics and the somatic cell count. Animal Breeding and Feeding. 48. 6. pp. 643-644.
12. GULYÁS, L. – SZALKA, É. (2000): The effects of milking technology and milk quality on economic production. 7th International Agro-economic Scientific Days, Vol. 2. pp. 54-58. Gyöngyös, 28-29 March 2000.
13. SZALKA, É. - GULYÁS, L. (2000): The effect of keeping and feeding technology on economic milk production . 7th International Agro-economic Scientific Days, Vol. 4. pp. 145-150. Gyöngyös, 28-29 March 2000.
14. GULYÁS, L. - IVÁNCICS, J. (2000): The connection between the somatic cell count and some udder morphological characteristics. Animal Breeding and Feeding. 49. 4. pp. 331-339.

1.3 Texts published full in proceedings

1. GULYÁS, L. (1996): Examination of the factors influencing the somatic cell count of milk. 26th Scientific Days in Óvár: New challenges and strategies in agricultural production. Animal breeding section, Vol. 1. pp. 138-141. Mosonmagyaróvár, 25 September 1996.
2. GULYÁS, L. (1996): The effect of personal factors on the somatic cell count of milk. 26th Scientific Days in Óvár: New challenges and strategies in agricultural production. Animal breeding section, Vol. 1. pp. 142-146. Mosonmagyaróvár, 25 September 1996.
3. GULYÁS, L. – BOROSS, P. (1997): Analysis of somatic cell count in milk produced by small dairy farms. I.C.A. Summer school on “Agricultural Challenges and EU Enlargement”, Pannon University of Agricultural Sciences Faculty of Agricultural sciences, Mosonmagyaróvár, 11-21 August 1997.
4. GULYÁS, L. – KOVÁCS-GAÁL, K. - GULYÁS, T. – BÖJTÖS, J. (1998): Examination of the connection between somatic cell count in milk and some udder morphological characteristics. 27th Scientific Days in Óvár: New challenges in agriculture with respect to the EU accession. Animal breeding section, Vol. 1. pp. 225-230. Mosonmagyaróvár, 29-30 September 1998.
5. GULYÁS, L. - GULYÁS, T. – SZALKA, É. – KOVÁCS, T. (1998): Economic analysis of milk production at the “Kisalföld” Agricultural Co-operative in Bogyoszló. 27th Scientific Days in Óvár: New challenges in agriculture with respect to the EU accession. Economic section, Vol. 3. pp. 666-673. Mosonmagyaróvár, 29-30 September 1998.
6. GULYÁS, L. - GULYÁS, T. (1999) Economic analysis of milk production. The basis of our agriculture’s future is quality. 41st Georgikon Days. Vol. 2. pp. 197-201. Keszthely, 23-24 September 1999.
7. GULYÁS, L. - IVÁNCSICS, J. (1999): Connections between the udder morphological characteristics and the somatic cell count. Breaking points in Hungarian animal breeding. Hungarian Academy of Sciences, Budapest, 24 November 1999.
8. IVÁNCSICS, J. - GULYÁS, L. (2000): Quality milk production in the 21st century. 42nd Georgikon Days. “Agricultural product markets and their environment”, Vol. 1. Sections 1-4. pp. 380-384. Keszthely, 21-22 September 2000.

9. GULYÁS, L. - IVÁNCICS, J. (2000): Correlation between somatic cell count in milk and udder morphology. 42nd Georgikon Days. "Agricultural product markets and their environment", Vol. 1. Sections 1-4. pp. 390-393. Keszthely, 21-22 September 2000.
10. GULYÁS, L. (2000): Analysis of the somatic cell count of bull progeny groups. 28th Scientific Days in Óvár. "Possibilities of improving food industry", Animal Breeding Section, Vol. 1. pp. 214-219. Mosonmagyaróvár, 5-6 October 2000.
11. GULYÁS, L. (2000): Examination of the somatic cell count of cow families. 28th Scientific Days in Óvár. "Possibilities of improving food industry", Animal Breeding Section, Vol. 1. pp. 220-223. Mosonmagyaróvár, 5-6 October 2000.
12. IVÁNCICS, J. – BÁDER, E. - GULYÁS, L. – PONGRÁCZ, L (2001): Improvement of quality of raw milk with selection based on somatic cell count. EAAP – 52nd Annual Meeting, Budapest, Hungary, 26-29 August 2001. Book of Abstracts of the 52nd Annual Meeting of the Association for Animal Production/ Wageningen Pers. Wageningen. p. 82. Poster GC 6.26.

2. Informatory publications

1. GULYÁS, L. (1996): Ungarn braucht Gen-Import. (Hungary needs gene import.) Rindezucht-Fleckvieh, 1. p. 21.
2. GULYÁS, L. (1996): Das ungarische Steppenrind. (The Hungarian grey cattle) Unser Land, 5. pp. 27-28.
3. IVÁNCICS, J. - GULYÁS, L. (1999): Factors influencing the somatic cell count of raw milk. Holstein Magazin. 7. 2. pp. 32-33.
4. GULYÁS, L. (1999): Extension and milk quality. Kistermelők Lapja. (Paper of the small producers). Budapest, 10. p. 14.
5. GULYÁS, L. - GULYÁS, T. (1999): Examination of the correlation between the somatic cell count and the udder morphology. Holstein Magazin. 7. 3. pp. 31-32.
6. GULYÁS, L. - IVÁNCICS, J. (1999): Examination of the correlations between the somatic cell count and the udder morphology. Holstein Magazin. 7. 4. pp. 34-35.

7. GULYÁS, L. - IVÁNCICS, J. (2000): Examination of the correlation between the somatic cell count and the udder morphology. Holstein Magazin. 8. 1. pp. 29-30.
8. GULYÁS, L. (2000): Comparison of the somatic cell count of bull progeny groups. Holstein Magazin. 8. 4. pp. 29-30.
9. GULYÁS, L. (2000): Evaluation of the somatic cell count of cow families. Holstein Magazin. 8. 4. p. 28.
10. GULYÁS, L. (2001): The connection between the keeping technology and the somatic cell count. Holstein Magazin. 9. 3. pp. 19-21.
11. GULYÁS, L. – KOVÁCS-GAÁL, K. (2002): The connection between feeding and the somatic cell count. Holstein Magazin. 10. 3. pp. 38-39.
12. GULYÁS, L. (2002): Connection between the breed and the somatic cell count. Holstein Magazin. 10. 4. p. 31.

3. Lectures

1. GULYÁS, L. (1995): Rindezucht in Ungarn. (Cattle breeding in Hungary) Bayerische Landesanstalt für Tierzucht. Grub, 15 November 1995.
2. GULYÁS, L. (1999): The challenge of the turn of the millennium and the EU in improving milk quality. "Current questions of quality milk production", Regional Conference, Vép, 28 September 1999.
3. GULYÁS, L. (1999): Quality milk production in the 21st century. Conference of Extension Experts, Vásárosfalu, 29 September 1999.