
Machine milking research in Slovakia

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As in other countries, machine milking research and development in Slovakia have been influenced by dairy cow industry developments. The beginning of machine milking in Slovakia is associated with the establishment of agricultural cooperatives and the nationalisation of former large estates after 1950. Larger herds were created at that time. In the fifties, cowsheds were built for approximately 100 dairy cows. There were usually two or more on any one dairy farm. Later, mainly in the seventies, specialised farms, already equipped with modern milking parlours, were built. At the beginning of the milking parlour era, there were tandem and herringbone parlours. Later on, rotary milking parlours emerged. All of these types, with various modifications, continue to be used today. In the past, and also at present, herringbone milking parlours were the most widespread ones among breeders in Slovakia because of simplicity, and particularly of reliability of operation. At the turn of the sixties and seventies, rotary milking parlours were already being imported, and later on they were being manufactured in the former Czechoslovakia. More recently, parallel parlours have found their place on Slovak farms.

The size of dairy cow herds on Slovak farms points to milking parlours as being the only possible option at present. The most common capacity is 300 - 800 dairy cows in one location.

Generally, the level of machine milking research depends on

- genetic progress in the biological material,
- increasingly strict demands for quality in milk and milk products for consumption,
- the need to raise the living standards of breeders,
- new possibilities resulting from general technological advances (in materials, hardware, software, etc.).

In Slovakia, three basic breeds are kept at present: the Slovak Pied (Simmental), Slovak Pinzgau, and Holstein breeds and their crosses. Changes in breed structure were affected by fashion and political changes as well as by the import of milking equipment. To improve milking efficiency and productivity, there was successive use of the Danish Red,

Introduction

Machine milking research framework

Ayrshire, Lowland Black, and Black or Red Holstein breeds. A significant change in the proportion of Holsteins occurred over the past 15 years. In 1989, there were 121,000 dairy cows of the Slovak Pied breed, 40,000 of the Pinzgau breed, and 26,000 Holsteins. The number of Slovak Pied cows has decreased to 36,000 and of Pinzgau cows to 4,000 at present. There are 124,000 Holstein cows, including crosses with a high proportion of Holstein blood. The milking efficiency and productivity of cows rose as a result. However, the demands for quality in milking technology also rose.

The pressure for innovation in milking technology in Slovakia is caused mainly by demands for higher milk quality. During the past 15 years, the criteria for milk quality evaluation have changed several times. The outdated evaluation criteria (Resasurin test) were changed first. Then the criteria used in EU countries were gradually made more strict. Somatic cell counts (SCC) and total bacterial counts (TBC) are at present the main criteria for milk quality evaluation. Maximum counts are 300,000 SCC and 50,000 TBC for Q class milk, and 400,000 SCC and 100,000 TBC for 1st class milk. In addition, the milk must not contain inhibitory substances. In the year 2004, milk of Q or 1st quality was produced in 94 % of herds. During the past 10 years, considerable modernisation has taken place on Slovak dairy farms. In 1989, only 12% of dairy cows were kept in loose housing and milked in milking parlours. At present, this figure is approximately 50 %.

**Machine milking
research subjects
in Slovakia**

For more than 50 years, machine milking research in Slovakia has been targeted on both biological and technical subjects.

The main objective of the introduction of machine milking is first of all to save working time. Therefore quite a lot of effort was devoted to research into increasing labour productivity. The work routines that were studied varied according to the type and equipment of milking plants. Other decisive factors were the number, qualifications and skills of the milkers and, not least, the traits of the dairy breeds used for milk production at the time. The work routines of milkers were evaluated not only in relation to labour productivity but also in relation to hygiene standards achieved at milking and acceptable ways of handling cows. The evaluation of work routines was aimed mostly at preparation of the udder before milking. Optimum work routines for practice were recommended on the basis of ergonomic studies.

Milking equipment is one of the largest investment costs on a dairy farm. Therefore, economic research was also applied to milking. Optimum numbers of stands in milking parlours, optimum numbers of stands operated by one milker, and optimum layouts of milking parlours were determined. First of all, methods of calculating economic efficiency of capital were looked for.

Because of the size of dairy farms in Slovakia, it was also necessary to consider the rationalisation of energy consumption. Milking could not be omitted from the technological processes evaluated. On the basis of measurements, recommendations were made on optimum configurations for technological processes, and components with lower electrical power consumption were proposed. With regard to milking, most studies were on combinations of vacuum pumps, compressors and milking pumps. Efficiency of utilisation of vacuum pump capacity was the main object of research.

Since the sixties, quite extensive research had already been done on the behaviour of animals. The welfare of dairy cows was evaluated at times of change in milking conditions, e.g. at the changeover from milking in tied stalls to milking in a milking parlour, at the introduction of rotary milking parlours, and also later when using rapid exit facilities for dairy cows on large capacity farms. Very useful study results were obtained of social behaviour in waiting pens before milking, and of behaviour in cows subjected to changed milking methods during their lactation, e.g. from individual tandem boxes into herringbone milking parlours in which the cows got a new feeling of close contact with each other, and from herringbone to rotary milking parlours.

At one time on Slovak farms, a system dairy cows were milked in tied stalls at the beginning of their lactations and then transferred into a milking parlour. With such a system of husbandry, a whole range of new knowledge about the behaviour of dairy cows in relation to milking letdown was obtained.

Variety in the afore-mentioned breed composition of dairy herds also manifested itself in the milking letdown of the cows; in other words, in the response of different breeds to new milking conditions. Very important results were obtained on amounts of machine strippings and complete milking while using the automatic end-off milking system that came into use in Slovakia at the beginning of the seventies. In addition to biological problems, aspects of technical improvement in the automatic end-off milking devices were studied. Recent research is aimed at increasing the critical milk flow in end-off milking equipment.

As in other countries, much time was devoted to looking for optimum settings for pulsation and vacuum. The effects of various levels of pulsation and vacuum, and of various combinations of these levels, on the normal course of milking were evaluated. Experiments were done in which the possibilities of adjusting pulsation parameters in relation to the milkability of the cows were investigated. Also, measures of vacuums and pressures in the teat cups and other parts of the milking cluster and unit were analysed in detail. Results of this research into the parameters of milking cluster operation were used directly in the manufacture of milking equipment produced in the former Czechoslovakia.

A separate part of the research effort focussed on the hygiene of milk production, not only in the milking parlour but also on the whole farm. Research in the design of housing was undertaken to facilitate minimum cleaning of dairy cows before milking. Parameters of cubicle design were established for the reconstruction and modernisation of old cowsheds. The studies of work routines mentioned earlier also paid attention to hygienic factors. Those routines that were not very labour demanding but provided a high level of hygiene were recommended to the breeders. A large section of research was aimed at circulation cleaning and disinfecting of equipment of both classic and automated types. Also, non-traditional methods, such as ultrasound, were looked at.

The evaluation of milk quality measured the effects of machine milking, milk composition, microbial purity and wholesomeness. At one time in Slovakia, milking systems were constructed with over-long and articulated pipelines for milk transport using powerful milk pumps. This resulted in the so-called 'induced lipolysis' that had a considerable effect on the content of free fatty acids, i.e. the quality of milk fat. More gentle methods were proposed on the basis of research measurements.

Research also paid attention to the feeding of concentrates in the milking parlour, from the viewpoint of both economy and dairy cow stimulation. During the seventies and eighties, observation of milk flow from individual quarters of the udder was done mainly to support selection programmes aimed at providing equal distribution of milk in all quarters of the udder. At present, the research is more detailed; knowledge about the patterns of milk flow in individual quarters is obtained and, based upon these patterns, traits indicating the state of health of the udder are looked for. For a short period of time, research was devoted to damage of teat tips in relation to vacuum level, speed of milking, age, stage of lactation and breed.

State of health was evaluated under various methods of milking. Ways of rapid detection of health problems were looked for. The research was mostly aimed at utilisation of the electrical conductivity of milk.

For the present, there are no automatic milking systems in Slovakia. However, we have at our disposal knowledge from studies performed abroad, and we did take part in a study of aspects of milk letdown physiology in robotised systems in Western Europe.

High quality, extensive research on the physiology of milk recovery is undertaken in Slovakia. The overall focus is first of all on the physiological reaction to machine milking. The main topics are:

- the effect of milking and breeding environments and the handling [?] of cows on their milk letdown efficiency during machine milking or suckling. ("Release of oxytocin, milk flow parameters, residual milk volume")
- aetiology of milk letdown disturbances

- the importance of opioid and noradrenergic systems in milk letdown path physiology
- the response of the hypothalamic-pituitary-adrenal axis to milking. (“Release of cortisol, ACTH and prolactin”)

Research into the machine milking of sheep in Slovakia is also important. We should point out that the Slovaks were pioneers in this sphere. During the sixties, machines already milked quite a high number of sheep. Milking equipment of good quality was developed and produced here. Later, research in this sphere and in the milking of sheep ceased because of lack of interest of the breeders and society. In recent years, research was resumed in biological and technical aspects.

Technical research was aimed first of all at the improvement of technical reliability in milking equipment, and at systems of reliability testing and service. Surface damage to teat-cup liners was measured, and measuring instruments to evaluate the vacuum, pulsation and milk flow were developed. So-called ‘rapid control methods’ of technical parameters were developed. A separate part of technical research was aimed at preventive maintenance.

The above summary shows that research in milking was always directed mainly at fulfilment of the breeders’ needs. One consequence was the fact that, apart from milking equipment for sheep, no other milking equipment was produced in Slovakia. Before 1990, there was quite broad co-operation between Slovak research institutions, mainly the Research Institute for Animal Production in Nitra and the Slovak Agricultural University in Nitra, with Agrostroj Pelhřimov, which was the only producer of milking equipment in the former Czechoslovakia.

International co-operation had, and still has, an important role in the fulfilment of research objectives. In the past, it took place not only in Czech institutes and universities but also in Hungary and Eastern Germany, where research co-operation was also undertaken with the milking equipment manufacturer Impulsa. At present, the largest co-operation is with TU Munich Freising Weihenstephan, Germany, especially in the milk letdown research mentioned earlier. With Agrotechnology and Food Innovations BV, Wageningen, we have co-operation in quarter milk flow research. Currently UMR INRA/AGROCAMPUS, France, is our new partner for co-operation in research into sheep and goat milking.