

# Evaluation of Selected Effects on Milk Production and Fertility in Holstein Dairy Cattle

Tomáš Frejlach, Miloslav Šoch, Jan Frelich, Luboš Záborský, Anna Švarcová, Zuzana Křížová, Iveta Novotná, Kateřina Švejdová, Anna Šimková, Robert Kala

University of South Bohemia in České Budějovice, Faculty of Agriculture, Department of Zootechnical Sciences, Studentská 13, 370 05, České Budějovice, Czech Republic

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## Abstract

The breeding of dairy cattle, in terms of investment and operating costs, is the most demanding sector of livestock production. In terms of importance for agricultural enterprises and all of society, in most EU Member States and the Czech Republic it is one of the major agrarian sectors. Milk production in the Czech Republic has been an important source of income for farmers. For this reason, it is important to ensure an adequate level of milk production in dairy cattle herds and the resulting profit of the enterprise. At the present time in the Czech Republic, it is difficult to ensure profitability in dairy farming because input costs have a continuously rising trend, as compared to the price of milk, which is very unstable. The evaluation of selected indicators of milk yield and fertility in dairy herds is an important tool for evaluating the economics and the level of the breeding. The highest milk yield in kilograms during the first lactation was attained by dairy cows that calved at the age of 27 to 29 months (9,335 kg of milk). When utilizing the DOUBLE OVSYNCH synchronization protocol, the average calving interval was 412 days, and a higher conception rate after first insemination (43%) was found as compared to the nationwide average in the Czech Republic (34.2%).

**Keywords:** age at first calving, fertility, Holstein cattle, milk yield.

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## 1. Introduction

The objective of this article was to assess and evaluate the effects of selected indicators on milk yield and fertility of Holstein dairy cattle.

Currently, primary emphasis is placed on increasing milk yield year-on-year. As a result of rising operating costs, there is a continuous decline in the state of dairy cows, the replacement rate of herds is increasing and the reproductive abilities of breeding cows are worsening. For this reason, every breeder should keep in mind that breeding cows achieve maximum milk production during the 3<sup>rd</sup> to 4<sup>th</sup> lactation, i.e. during skeletal maturity [1]. As mentioned above, it is precisely the worsening reproductive traits of breeding cows

that can be a significant problem in the future. The optimal age at first calving in Holstein heifers is 23 - 24 months, both in terms of milk yield during the first lactation and in terms of the health of the breeding cow and subsequent production. This is confirmed by research, where it was found that the highest number of completed lactations (2.67) was attained by heifers that first calved at the age of 26.3 months and older [2]. Heifers may calve at the age of 19 - 20 months, however, this system is not recommended due to an increased risk of difficult delivery and postpartum metabolic disorders, such as postpartum paresis, ketosis and others [3]. Decreasing the age at first calving negatively affects the milk yield during the first lactation and milk fat content in milk [4]. Due to the increasing worldwide consumption of milk, it makes sense to continue cattle breeding with milk production for the market and to continue to develop and improve this sector. The worldwide

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\* Corresponding author: Tomáš Frejlach, Phone: + 420 728 653 811; e-mail: [tfrejlach@seznam.cz](mailto:tfrejlach@seznam.cz)

consumption of milk and dairy products is steadily growing, in the last 7 years consumption increased by 7.6 kg/person/year (8%). In 2012, the consumption of milk and dairy products in the world was 109 kg per person/year, and in the EU it was 288.5 kg per person/year [5]. In the Czech Republic, consumption of milk and dairy products was 234.1 kg/person/year (in milk equivalent), of which 62.2 kg was cow's milk [6].

## 2. Materials and methods

Data from the milk yield and zootechnical records of the monitored enterprise were obtained using the website Milk Profit Data. In the monitored breeding enterprise, data were evaluated from a total of 202 dairy cows, which had completed at least their first lactation. Only oestrus synchronization was used during the reproduction process of dairy cows. Natural oestrus detection was used during the reproduction of heifers.

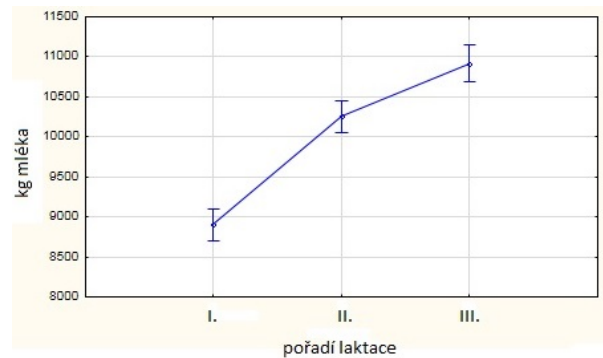
The data on milk yield in kilograms of milk and fertility according to the length of the calving interval, age at first calving and the number of inseminations were sorted according to the amount of milk yield, the lactation number and age at first calving. In thus sorted groups, there were found basic statistical characteristics and the differences between groups were evaluated in the Statistica 12 program using a one-way ANOVA. The Tukey HSD test was used for the evaluation of the levels of significance.

## 3. Results and discussion

### *The effect of the lactation number on milk yield in kilograms of milk*

A statistically significant difference ( $p > 0.05$ ) was shown between the lactation number and level of milk yield at individual lactations. The average milk yield of a dairy cow was 8,902 kg of milk during the first lactation. The greatest milk yield according to lactation number was attained by dairy cows during the third lactation (10,920 kg of milk). This milk yield was significantly higher as compared to the average milk yield of Holstein cows in the Czech Republic in 2012, as stated by [7], which was 9,228 kg. The national average in the Czech Republic during the first lactation amounted to 8,383 kg of milk and during the

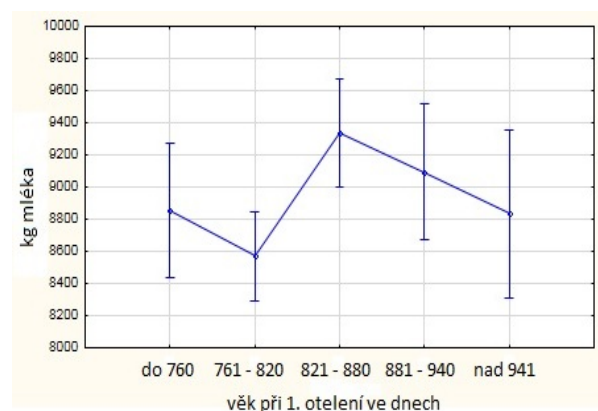
second and subsequent lactation was 9,484 kg of milk. For 2013, the average milk yield of Holstein cows in the Czech Republic was 9,426 kg [8]. The national average in the Czech Republic during the first lactation was 8,568 kg and during the second and subsequent lactation was 9,721 kg of milk. The average milk yield during the first lactation, according to the breeding goal, should reach 8,000 to 8,500 kg of milk and for subsequent lactations 9,000 to 10,000 kg of milk [9].



**Figure 1.** The effect of lactation number on milk yield in kg of milk

### *The effect of age at first calving on milk yield in kg of milk during the first lactation*

The relation between age at first calving and milk yield during the first lactation showed that the highest milk yield during the first lactation was attained by dairy cows that calved for the first time at the age of 821 to 880 days (27 to 29 months, 9,335 kg of milk). In the study [2], dairy cows attained the highest milk yield ( $\geq 8,500$  kg) that first calved no sooner than at the age of 780 days (25.65 months).



**Figure 2.** The effect of age at first calving on milk yield during the first lactation

The highest number of dairy cows first calved at the age of 25 to 27 months. Agreeing with this statement are the results of [10], who states that the average age at first calving of Holstein cattle is 25 months and 22 days. A statistically significant difference ( $p < 0.05$ ) was demonstrated between the groups.

*The effect of the level of milk yield during the first lactation in kg of milk on the calving interval in days*

The shortest average length of the calving interval (386 days) was attained by dairy cows with a milk yield during the first lactation of up to 8,000 kg of milk. With an increasing milk yield during the first lactation, the length of the calving interval also increased (8,001 to 10,000 kg of milk at 422 days and over 10,001 kg of milk at 428 days). This calving interval exceeds the length stated by [7], according to whom it is possible to tolerate 400 days during a milk yield over 7,000 kg of milk. The length of the calving interval of Holstein cattle should be, according to the breeding goal, up to 400 days [9]. A statistically significant difference ( $p < 0.05$ ) was demonstrated between the level of milk yield during the first lactation and the length of the calving interval.

*A summary of pregnancy after the first and all inseminations in %*

The percentage of pregnancy after the first insemination (43%) is nearly 10% above the national average in the Czech Republic (34.2 %, [7]) meaning that 34.2 % of Holstein dairy cows became pregnant after the first insemination in 2012. According to [11], pregnancy after first insemination was in 2009 41.5%, in 2010 41.1% and in 2011 40.3%. After the second insemination 24% became pregnant and 14% after the third. Overall, it can be said that the level of fertility is at a good level.

**Table 1.** Summary of pregnancy after the first and all inseminations in %

Number of inseminations	n	%
1	83	43%
2	47	24%
3	27	14%
4	16	8%
5 and more	20	10%

#### 4. Conclusions

We can draw the following conclusions from the ascertained results:

- Milk yield increases with the number of lactations.
- The age at first calving has a significant effect on subsequent milk yield – the best results were attained by heifers that calved at the age of 27 to 29 months.
- When utilizing the DOUBLE OVSYNCH synchronization protocol, 43% of dairy cows became pregnant after the first insemination.

The level of milk yield is primarily affected by the age at first calving and the lactation number. Holstein dairy cattle attained above average values in milk yield as compared to the average in the Czech Republic in 2012 and attained the values of the breeding goal. Selected indicators of fertility showed above average reproductive results. Thus, it is evident that during high milk yields it is possible to maintain reproduction at a high level. For this reason, great importance is given to the management of reproduction and nutrition at the enterprise level.

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