

Analysis of Relationship between Production and Reproduction Traits of Holstein Cattle Population in the Slovak Republic

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Abstract

Is generally known there is antagonistic relationship between production and reproduction traits. We observed this relationship in dataset of 1 197 478 daily milk records of Holstein cows on the first lactation only, first time calved during years 2003-2009. We found increased milk production and prolonged calving interval during this period. We observed highest milk production (7604 kg) on standardized 1st lactation for cows with longest calving interval in compare to cows with shortest calving interval (7079 kg). Positive significant correlation (0.56775, $P < 0.0001$) was found between standardized milk production and calving interval. It means that cows with higher milk production have a prolonged calving interval, which confirms antagonist relationship between production and reproduction traits. Significant negative correlation (-0.27695, $P < 0.0001$) observed between percent of protein production on standardized lactation and calving interval suggests that prolonged calving interval has negative effect on daily protein production (%) in milk. Coefficient of determination between breeding values for milk production and length of calving interval was 0.6434. Following these results we should accept relationship between production and reproduction and include it in process of genetic evaluation of cattle.

Keywords: calving interval, production traits.

1. Introduction

Is generally known there is antagonistic relationship between production and reproduction traits. In most countries and for many years, the primary selection objective in dairy cattle breeding was oriented towards yield traits [1]. Due to negative genetic correlation between female fertility and milk production the selection for increased milk yield resulted in genetic decline in female fertility [2]. A possible way to increase total yields without increasing the occurrence reproduction failure is to select for increased lactation persistency in addition to total production. This selection strategy could cause flattening and extending of the lactation curve [3].

According several authors we also should not forget on effect of fertility on production performance. Pregnancy has a negative impact on milk production [4]. The effect of pregnancy depends on stage of gestation and becomes larger at later stages due to growth and nutrient requirement of conceptus increase. Higher decline in milk yield as a result of pregnancy begins after 4 or 5 months of pregnancy [5, 4]. The aim of this study was to analyse milk and fertility traits and to observe relationship between these antagonistic economically important traits.

2. Materials and methods

We received the data from test day milk yield records of Holstein cows on first lactation performed by Breeding services of Slovak republic. We observed relationship between production and reproduction traits in dataset of

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1 197 478 daily milk records of cows first time calved during period 2003-2009. Heifers had to fulfil subsequent requirements: age at first calving between 600 and 1200 days, calving interval from 300 to 720 days, interval from calving to first service from 28 to 200 days, days open from 28 to 365 days. We have divided dataset according two parameters. First parameter was calving interval (CI). According to frequencies analysis we have divided dataset on three numerous similar groups: CI1 – calving interval from 300 to 403 days
CI2 – calving interval from 404 to 486 days
CI3 – calving interval from 487 to 720 days
Second parameter was age at first calving (AFC): AFC1 – age from 600 to 773 days
AFC2 – age from 774 to 860 days
AFC3 – age from 861 to 1200 days
Basic statistic analysis was performed using program SAS 9.1 Enterprise Guide 3.0.

3. Results and discussion

We found following mean values in dataset of 1 197 478 Holstein heifers in 1st lactation: AFC 837.52 days (27.92 months), CI 451.57 days, CTFS 83.36 days, DO 170.69 days (Table 1). Average daily production of milk, fat a protein was 24.3 kg, 4.06 % and 3.25 %, respectively. Muir et al. [3] found in Canadian Holstein population average age at first calving 27.27 months, average calving interval 395.41 days, and average milk production on 305 days 1st lactation 7689.99 kg. Ulutaş and Sezer [6] reported in their study higher AFC (29.4 days) and shorter DO (88 days) and CI (373 days) after first lactation in compare with our results. Bohmanova et al., [5] found for Holstein cows on first lactation average DO 133 days and average daily milk production 25.3kg. Lower daily milk production 18.7 kg,

lower milk production on lactation 5558 kg, and shorter CI published Haile-Mariam et al., [7]. Average calving interval 408.52 days observed Bujko et al., [8].

In figure 1 we can observe different milk production for cows divided by age at first calving. Cows from group AFC1 (AFC from 600 to 773 days) had highest average milk production (7838.58 kg) on standardized 1st lactation in compare to cows from group AFC3 which were first time calved between 861 to 1200 days (6851.81 kg). We found statistically significant ($P<0.0001$) higher daily milk production for AFC1 compared with AFC2 and AFC3. The statistically significant difference ($P<0.0001$) was also found between AFC2 and AFC3 in favour of AFC2.

Similarly results from Ruiz-Sánchez et al., [9] study indicated that heifers maturing at younger ages are better milk producers. According Muir et al. [3] heifers with earlier oestrus than average, inseminated first time early had greater total 305-d yields and greater persistency in first lactation. On the other hand Moussavi and Mesgaran [10] demonstrated that the milk yields increased by increase in AFC (average AFC 27.23 \pm 3.37 month). They found no impact of AFC on days open. Bayram et al. [11] observed effect of early first calving on milk production of Brown Swiss and Holstein Friesian cattle. Authors published significant ($P<0.05$) reduction in the 305 days milk yield in the first parity in both breeds. Average age at first calving was higher for both breeds in compare with AFC observed in our dataset. Gara, et al. [12] reported that age at first calving less than 24 months and greater than 26 months were associated with low 305 days and lifetime yields.

Table 1. Average values of selected traits in dataset

Trait	Mean	Std. Deviation	Min	Max	N
AFC (days) ¹	837.52	111.56	600	1200	1197478
CTFS (days) ²	83.36	35.01	28	200	1197478
DO (days) ³	170.69	82.08	28	365	1197478
CI (days) ⁴	451.57	82.12	300	666	1197478
Milk (kg) ⁵	7367.25	1831.79	2500	15567	1197478
Fat (%) ⁶	4.02	0.63	2.16	6	1197478
Protein (%) ⁷	3.22	0.21	2.44	4.29	1197478

¹ age at first calving, ² interval from calving to first service, ³ days open, ⁴ calving interval, ⁵ average milk production on standardized 1st lactation, ⁶ average fat production on standardized 1st lactation, ⁷ average protein production on standardized 1st lactation

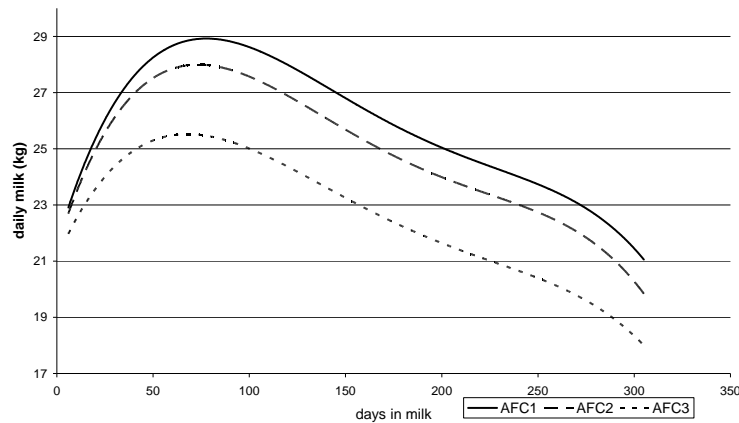


Figure 1. Different lactation curves between groups divided by age at first calving

We observed different lactation curves between groups divided by length of calving interval (figure 2). There were found statistically significant lower daily milk production for CI1 (23.76 kg) compared with CI2 (24.3 kg; $P < 0.0005$) and with CI3 (24.84 kg; $P < 0.0001$). The difference between CI2 and CI3 in daily milk production was also significant ($P < 0.0012$) in favour of CI3. Loker et al. [4] reported that cows with longer days open had proportionally higher milk yield throughout lactation. The results suggest that more highly productive cows tend to have longer days open likely due to physiological competition between high milk production and reproduction cycle of the cow [5]. Van der Linde et al., [13] included days in gestation into the estimation of yield persistency. They found differences in 305 days production of 180 kg milk,

7.2 kg of fat and 7.6 kg of protein between cows getting pregnant at day 85 or day 305 of lactation. Uğur [14] divided dataset of cows according calving interval on six groups. Highest average daily milk yield (22.3kg) was observed in groups with longest CI (450 days and longer) and lowest average daily milk yield (19.2kg) was in group with shorter CI (325 days and below). Effect of pregnancy on lactation yield in dairy Buffaloes observed Khan et al., [15]. Authors presented significant increase in lactation yield in animals conceiving in early lactation, than those conceiving at the end of lactation. They results are in contrary to our results. Roche [16] found no difference in milk yield, the yield of fat, protein, or lactose between pregnant and non-pregnant dairy cows over the entire lactation.

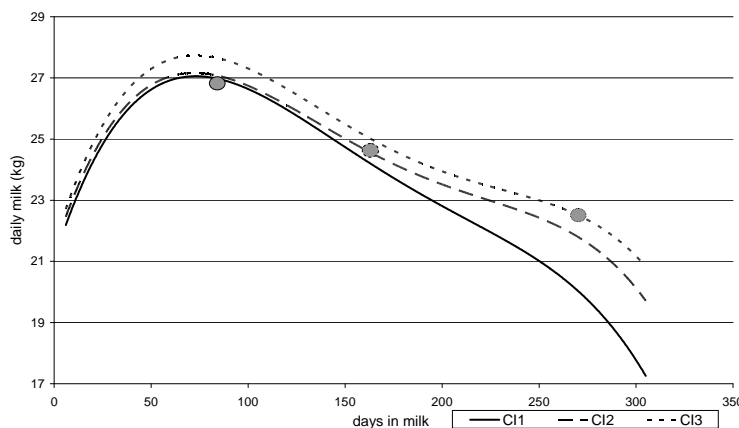


Figure 2. Different lactation curves between groups divided by length of calving interval

A positive phenotypic correlation between milk yield on standardized 1st lactation and calving

interval (0.56775, $P < 0.0001$) was observed, indicating that animals that produce more milk

have longer calving intervals (figure 3). When we used breeding values for milk production for illustration of relationship between milk production and length of calving interval different linear trends were observed (figure 4). Cows with higher breeding value for milk production have longer calving interval due to antagonistic relationship between production and reproduction. The figure 4 suggesting, cows with breeding values for milk production fewer than zero and together with prolonged calving interval have naturally worse reproductive performance. Gonzáles-Recio et al., [17] reported that high

yielding cows tend to be less fertile, have extended calving interval and decreased longevity and lower total lifetime production. They observed high genetic correlation between days open and production traits (0.63 to 0.76). The negative effect of pregnancy on milk yield, milk lactose yield became apparent after 33 weeks and lower milk fat yield after 36 weeks of lactation in pregnant cows. Bohmanova et al., [18] published that the effect of pregnancy on daily milk yield was lower in primiparous than in multiparous cows.

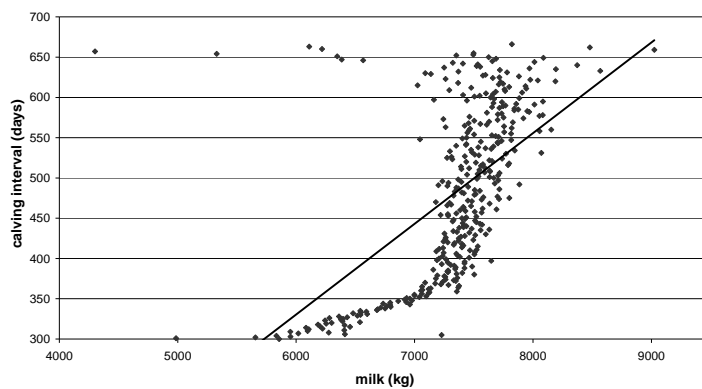


Figure 3. Calving interval by level of milk production

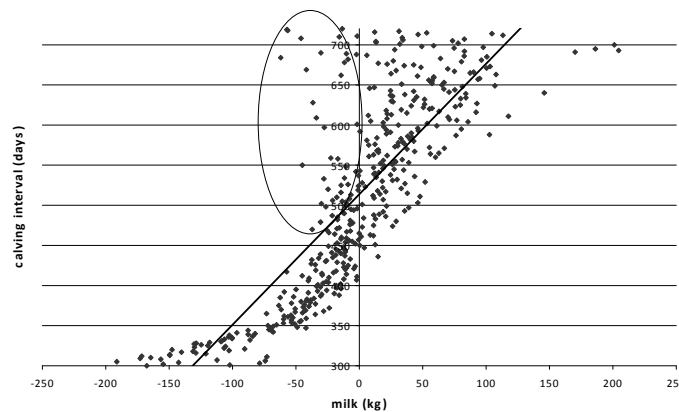


Figure 4. Calving interval by breeding values for milk production

4. Conclusions

The aim of this study was to observe relationship between production and reproductive performance in Holstein cattle population in the Slovak republic on 1st lactation during period 2003-2009. We observed increased milk production and prolonged calving interval during these years. Following our results we can conclude there are

antagonistic relationships between observed traits. Cow with higher milk production had significantly prolonged calving interval. The results suggest that including breeding values for production instead phenotypic value of milk production in fertility evaluation are more sustainable for better and more accurately illustration of relationship between traits.

Acknowledgements

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