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Effects of lactation month and season on test-day milk yield and milk components in Holstein cows

Özden Çobanoglu[1], Eser Kemal Gurcan[2], Soner Çankaya[3], Ertugrul Kul[4*], Samet Hasan Abaci[5] and Mehmet Ülker[5]

Department of Animal Science,
Faculty of Agriculture, Ahi Evran University, Kirsehir, Turkey.
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ABSTRACT

This study aims to determine the correlations between the test-day milk yield (TDMY) and the fat and protein content as well as the fat and protein yields in Holstein dairy cows and to investigate the effects of lactation period and sampling season on these parameters. The study material consists of 1.380 records of a total of 151 head of Holstein dairy cows raised on a private farm in Samsun province. In the study, the mean TDMY, fat content, protein content, fat yield and protein yield were recorded as 20.6±5.10 kg, 3.97±0.734%, 3.23±0.276%, 0.81±0.210 kg and 0.66±0.160 kg, respectively. The effects of lactation period and sampling season on the TDMY, fat content, protein content, fat yield and protein yield were found statistically significant (P<0.01). Statistically significant negative correlations were determined between the TDMY and the fat and protein content, but positive and statistically significant (P<0.01) correlations between the TDMY and the fat and protein yields. In conclusion, it might be stated that the effects of lactation period and sampling season should also be taken into account to improve milk yield and milk components.

Key words: Fat content, Holstein, Lactation period, Protein content, Test-day milk yield.

INTRODUCTION

In dairy cows, significant changes in milk yield and milk components occur throughout the lactation period. In the studies performed, it was reported that although the milk yield increased in the early period of lactation, when the milk yield was at the maximum level or peaked (Stanton *et al*., 1992), the fat and protein content decreased (Yoon *et al*., 2004). The negative correlations between milk yield and the fat and protein content throughout the whole lactation period were emphasized in many studies as well (Tsuruta *et al*., 2004; Dechow *et al*., 2007). However, there are also results of studies which report that milk yield (Sudhakar *et al*., 2013) and components (Bhoite and Padekar, 2002) are unaffected by lactation months. Season is another most important factors which affect milk yield and composition, and the milk composition in particular is considerably affected by seasonal factors (Khazaei and Nikosiar, 2008). In the studies on the subject, it was reported that milk yield (Yoon *et al*., 2004; Sarkar *et al*., 2006) and components (Filik *et al*., 2011; Bahashwan, 2014) were negatively affected in hot seasons.

In present study, it was intended to determine the correlations between the TDMY and the fat and protein content as well as the fat and protein yields in Holstein dairy cows and the effects of lactation period and sampling season on these parameters were investigated.

MATERIALS AND METHODS

The material of this research consisted of 1.380 TDMY records and milk samples of some 151 head of Holstein dairy cows in the first lactation on a private dairy cow raising farm operating in Samsun province. Milk samples from the evening milking were collected from the animals included in the research for 10 lactation months at the dates coinciding with ±15th days of their lactation.

The milk samples collected were placed between ice molds, brought to the laboratory by means of carriers with lids and preserved at +4°C; furthermore, the milk analyses were made within 12 hours. In the milk samples, the fat and protein analyses were performed by means of a LactoFlash (Funke Gerber) ultrasonic milk analyzer. The milk fat yield (TDMY * Fat%) and the milk protein yield (TDMY * Protein%) were calculated by the help of the values obtained as a result of the analyses. The animals included in the experiment were grouped according to four different sampling seasons (Autumn: *September, October and November*; Winter: *December, January and February*; Spring: *March, April and May*; and Summer: *June, July and August*).

*Corresponding author's e-mail: ertugrul.kul@ahievran.edu.tr.
[1]Department of Genetics, Faculty of Veterinary Medicine, Uludag University, Bursa, Turkey.
[2]Department of Animal Science, Faculty of Agriculture, Namik Kemal University, Tekirdag, Turkey.
[3]Department of Biostatistics, Faculty of Medicine, Ordu University, Ordu, Turkey.
[4]Department of Animal Science, Faculty of Agriculture, Ahi Evran University, Kirsehir, Turkey.
[5]Department of Animal Science, Faculty of Agriculture, Ondokuz Mayis University, Samsun, Turkey.

An analysis of variance was made to analyze the effects of lactation month and season on the TDMY, fat content, protein content, fat yield, and protein yield, and statistical model consisting of these two effects was applied on data.

The means of the TDMY and milk components were determined and the analyses of variance were made. The TUKEY's multiple comparison test was utilized to determine the differences among the subgroup means (Büyüköztürk, 2011). In addition, Pearson's Correlation method was employed to compute the correlations between the TDMY and milk components. The relevant statistical analyses were made with SPSS 13.00 package program (SPSS, 2004).

RESULTS AND DISCUSSION

The effect of lactation months on the TDMY is provided in Table 1. The highest TDMY was recorded in the second month of lactation, also known as the peak period and decreased with the progress of lactation (P<0.01). The effect of lactation months on the TDMY was also found significant in the studies on the subject (Gurmessa and Melaku, 2012; Jónás *et al*., 2016). Stanton *et al*. (1992) reported that the TDMY was at the maximum level on the 45th day of lactation, which is similar to the result of this study. Although Khazaei and Nikosiar (2008) determined a negative and statistically significant correlation between lactation persistence and milk yield, Sudhakar *et al*. (2013) reported that milk yield was unaffected by lactation periods in Holstein cows.

In this study, the fat content was found to be the lowest in the second and fourth lactation months increased with the progress of lactation (P<0.01). Likewise, Yoon *et al*. (2004) and Jónás *et al*. (2016) reported that the effect of lactation period on the milk fat content was significant and that the fat content increased with the progress of the lactation period.

The effect of lactation periods on the protein content was found statistically significant (P<0.01). The highest protein content was recorded in the first three months of lactation, and this content was found to have decreased with the progress of lactation. In the other studies on the subject, it was also reported that the effect of lactation months on the protein content was significant (Gurmessa and Melaku, 2012; Jónás *et al*., 2016). The results of present study differ from Stanton *et al*. (1992), who reported that the protein content was the lowest in the peak period. Results which reported that the protein content in milk remained unchanged throughout lactation are also available besides the findings of the present study (Cejna and Chládek, 2005; Sudhakar *et al*., 2013).

The fat and protein yields were also significantly affected by the lactation periods (P<0.01). The highest fat yield was observed in the first and fourth months of lactation. On the other hand, the protein yield was the highest in the second month of lactation but linearly decreased with the progress of lactation. In another study by Stanton *et al*. (1992), it was seen that the fat and protein yields found to be the highest in the early lactation period decreased with the progress of lactation, whereas the protein yield was reported to be the highest on the 72nd day of lactation.

The change in the TDMY and its components in the early lactation period is a result of the physiological change in cows (Domecq *et al*., 1997). Cows undergo a period of negative energy balance (NEB) in this period (Llewellyn *et al*., 2007) and require extra energy (Cejna and Chládek, 2005). Therefore, the milk yields of dairy cows

Table 1: The means of the test-day milk yield and milk components (± Standard deviation)

	N	TDMY (kg/day)	Fat (%)	Protein (%)	Fat Yield (kg/day)	Protein Yield (kg/day)
Lactation Period *						
1 (30±15)	146	19.7±4.79^{C}	3.91±0.863^{BC}	3.34±0.196^{A}	0.76±0.229^{BC}	0.66±0.157^{BCD}
2 (60±15)	145	23.2±4.53^{A}	3.70±0.614^{C}	3.32±0.188^{A}	0.85±0.200^{A}	0.77±0.144^{A}
3 (90±15)	146	21.2±4.99^{B}	3.90±0.627^{BC}	3.36±0.217^{A}	0.82±0.213^{ABC}	0.71±0.159^{B}
4 (120±15)	145	20.5±5.23^{B}	3.71±0.608^{C}	3.26±0.208^{AB}	0.75±0.215^{C}	0.67±0.158^{BCD}
5 (150±15)	144	21.1±4.83^{B}	4.07±0.697^{AB}	3.26±0.278^{AB}	0.85±0.196^{A}	0.68±0.145^{BC}
6 (180±15)	141	21.1±4.65^{B}	4.02±0.720^{AB}	3.13±0.358^{C}	0.83±0.187^{AB}	0.65±0.135^{BCD}
7 (210±15)	141	20.3±5.12^{B}	4.04±0.633^{AB}	3.21±0.302^{BC}	0.81±0.213^{ABC}	0.65±0.150^{CD}
8 (240±15)	133	19.9±4.95^{C}	4.01±0.748^{AB}	3.12±0.316^{C}	0.79±0.198^{ABC}	0.62±0.162^{DE}
9 (270±15)	126	19.9±5.16^{C}	4.13±0.785^{AB}	3.11±0.244^{C}	0.81±0.213^{ABC}	0.61±0.152^{DE}
10 (300±15)	113	18.4±5.55^{C}	4.27±0.876^{A}	3.17±0.257^{BC}	0.76±0.210^{BC}	0.58±0.161^{E}
Sampling Season *						
Autumn	192	18.5±5.46^{B}	4.22±1.044^{A}	3.29±0.182^{A}	0.76±0.242^{B}	0.61±0.180^{C}
Winter	421	21.0±5.10^{A}	3.72±0.605^{C}	3.34±0.165^{A}	0.78±0.203^{B}	0.70±0.168^{A}
Spring	484	21.0±4.72^{A}	4.03±0.668^{B}	3.20±0.330^{B}	0.84±0.200^{A}	0.67±0.139^{B}
Summer	283	20.6±5.15^{A}	4.06±0.664^{B}	3.08±0.276^{C}	0.82±0.203^{A}	0.63±0.149^{C}
Overall	1,380	20.6±5.10	3.97±0.734	3.23±0.276	0.81±0.210	0.66±0.160

^{ABCDE}: The differences between the group means with different letters in the same column are significant **(*:P<0.01)**

are expected to increase in the peak period, when they enter a period of NEB (Ruegg and Milton, 1995). Likewise, Pryce *et al*. (2004) reported that 50% of the milk produced was obtained in the first 120 days of lactation.

The TDMY, fat content, protein content, fat yield and protein yields were found different from each other depending on the sampling seasons (P<0.01). The lowest TDMY was recorded in autumn. Unlike this, the highest fat content was found in autumn, while the highest protein content was again determined in autumn and spring. Whilst the difference in the TDMY among the other sampling seasons was not found significant, the fat content was found to be the lowest in the milk collected in winter and the protein content was found to be the lowest in the milk collected in summer. As seen, the fat content and the protein content tend to increase in those seasons when the milk yield is low (Table 1). Khazaei and Nikosiar (2008) reported that both the fat content and the protein content were significantly affected by seasonal change, which resembles the result of the present study. This may probably due to the fact that the nutrient uptake decreases, the water metabolism changes, and cows are physiologically affected depending on the temperature stress; consequently, decreases in milk yields are experienced (Sarkar *et al*., 2006). Furthermore, the inadequate feed consumption and severe NEB in hot summer months lead to serious fat mobilization from the body.

Statistically significant negative correlations were determined between the TDMY and the fat and protein content, but positive and statistically significant (P<0.01) correlations were found between fat yield and protein yield (Table 2). The correlations between the fat and protein content and the fat and protein yields are positive (P<0.01). Additionally, both positive and statistically significant correlations were determined between the fat content and the fat yield as well as between the protein content and the protein yield (P<0.01).

Table 2: The correlations between the test-day milk yield and milk components

	Fat content	Protein content	Fat yield	Protein yield
TDMY	-0.302*	-0.245*	0.772*	0.938*
Fat content		0.277*	0.339*	-0.230*
Protein content			-0.072*	0.088*
Fat yield				0.761*

*: P<0.01

Also in the studies on the subject, negative and statistically significant correlations were determined between milk yield and the fat and protein content (Silvestre *et al*., 2009), but positive (Dechow *et al*., 2007) and statistically significant correlations were found between milk yield and the fat and protein yields.

CONCLUSION

As a result of this research, it was established that the TDMY increased in the early months of lactation, also known as the peak period but decreased with the progress of lactation. Nevertheless, the fat content decreased in the early lactation months, however, it tended to increase with the progress of lactation. Nonetheless, the protein content, like the TDMY, was found higher in the early lactation months. Moreover, it was observed that hot seasons negatively affected milk yield and its composition. When the correlations among the parameters are examined, it is possible to state that with an increase in the TDMY, the fat and protein content decreased, whereas the fat and protein yields increased. In conclusion, in this study, it can be stated that the effects of the lactation period and season may also be taken into consideration to improve milk yield and milk components.

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