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The Influence of Calving Year on Milk Yield and Milk Components in Dairy Cattle

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Abstract

The aim of this study was to identify the effect of calving year on milk yield and milk composition traits in Holstein and Jersey cattle raised in the Marmara and Black Sea Regions of Turkey, respectively. The data set consisted of 582 dairy cows, which were 306 Holstein raised and 276 Jersey cows calving from 2011 to 2013. Except for fat yield, test day milk yield (TDMY), 305-day milk yield (305 DMY), fat percentage, protein percentage and protein yield of Jersey cows were affected by calving season. The effect of calving year on TDMY, 305 DMY, fat percentage, fat yield, protein percentage and protein yield of Holstein cows were found to be statically significant. In conclusion, in 2011 to 2013, milk yield and its composition in both Holstein and Jersey cows were significantly related to calving year.

Key words: Calving year, DGAT1, milk yield, fat yield, protein yield

Introduction

Dairy cow breeding is the forefront of milk production under the conditions of our country. Milk is one of the important animal-based nutriment sources in terms of content and most milk and dairy products are produced from cattle. According to data from Turkish Statistical Institute for 2018, the total number of cattle was 17.042.506 head in Turkey. 90.65% of these animals are culture and crossbred. In addition, a total of 22.120.716 tons of milk produced annually in Turkey and 90.58% of these productions are obtained from cattle.[1] The highest milk production rate in our country is obtained from Holstein cows grown in the west part of country and Jersey cows raised especially in the Black Sea Region.

The increasing milk yield in terms of quantity and quality has always been the desired target for producers. To increase dairy productivity of animals, it is important to work with all the parameters affecting milk yield and all its components. Those factors are genetic and non-genetic factors which affect directly or indirectly to milk production of cows. All the genetic factors are in quantitative nature, thus many genes also influence reproductive performance of animals directly or by the manner of interacting with each other. Although some of the genes has a major effect, most of them has a very small effect on milk yield. Those types of genes are cumulatively affecting the level of production.

Even if genetic capacity of animal determined the utmost limit of quantitative traits like milk yield, the observation of genetic capability depends entirely on environmental factors. Thus, many non-genetic factors including calving year, calving interval, season, parity, age of cows, feeding, housing, climate change, disease, days from parturition to

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first service, days open, number of services per conception, and management conditions are crucial for this type of traits. There are many studies conducted to search not only the effect of genetic factors but also all possible environmental parameters which somehow influence on the milk yield and its component. One of the studies was conducted to search milk yield and reproductive performance of crossbred cows and it was reported that the significant effect of calving year on lactation duration.[2] Some studies were also showed that calving year significantly influenced on all milk yield traits such as 305 DMY, dry period, and lactation period.[3-5] Inci et al[6] also found that calving year were important on 305 DMY and lactation period but not significantly affecting on dry period. In another study, it was reported that various environmental factors including calving year significantly affected on 100, 200, 305 DMY in Holstein cows raised in different regions of Turkey.[7] As optimizing all the environmental effects will help to increase milk yield, the levels of milk fat, milk protein, and all other composition traits.[8] Overall this process will be possible by selecting animals through the breeding programs, improving of genetic structures of animals, and besides adapting of all environmental factors that affect the yield of animals. Therefore, the aim of this study was to determine the effect of non-genetic factor which is calving year on milk yield and milk composition traits of animals genotyped for DGAT1 (K232A) gene polymorphism in Jersey and Holstein cows raised in Marmara and Black Sea regions, respectively.

Materials and Methods

Animals Sources and Phenotypic Data

The study involved a total of 582 dairy cows, which were 306 Holstein raised in Marmara region and 276 Jersey raised in Black Sea region of Turkey. The number of Holstein and Jersey cows according to five parity (from 1 to ≥5) in this study were 128, 127, 29, 15 and 7, and 29, 54, 47, 51 and 95, respectively. Holstein cow is raised especially the west part of country. On the other hand, Jersey breed is raised mostly in Black Sea region due to well adaptation to environmental condition. Within the scope of this study, animals were identified and selected based on farm records. Milk yield records were obtained monthly basis during the lactation periods from 2011 to 2013. Collected milk samples at monthly milk test days were used to detect milk fat and protein percentage by ultrasonic milk analyzer (Foss MilkoScan FT1, Hillerod, Denmark). Moreover, milk fat and protein yields were calculated based on the milk yield levels for each cow. Milk fat yield (TDMY*Fat%) and milk protein yield (TDMY*Protein%) were calculated by the use of the values obtained as a result of the analyses.

The following model was used to examine the influence of calving year on TDMY, 305 DMY, fat percentage, fat yield, protein percentage and protein yield;

$Yij = \mu + Ai + \varepsilon ij$

Yij is the observation value

μ is the overall mean

Ai is effect of calving year (i= 2011, 2012, 2013)

eij is random error.

The statistical analyses were performed by the general linear model (GLM) procedure of SPSS9 package program (SPSS, 2004). The means were compared by Duncan's multiple range test.

Results

In this study, the change in milk yield and its composition according to calving year in Jersey cows are presented in Table 1. TDMY, 305 DMY, fat percentage, protein percentage and protein yield were affected by calving year. However, fat yield not effected by calving year. The effect of calving year on TDMY, 305 DMY, milk fat percentage, fat yield, protein percentage and protein yield were significantly important in Holstein cows (Table 2).

As a seen Table 1, the TDMY in Jersey cows was the lowest in 2011 (14.56 kg) and the highest in 2012 (16.34 kg) and 2013 (16.83 kg). The highest 305 DMY was determined in 2011 (5116.2 kg) and 2012 (5484.2 kg), but the lowest in 2013 (4604.8 kg). The fat percentage was the highest in 2011 (5.36%) and decreased gradually from 2012 (4.90%) to 2013 (4.74%). The protein percentage was the highest in 2011 (3.44%), but the lowest in 2012 (3.33%). The highest protein yield was determined in 2012 (0.54 kg) and 2013 (0.57 kg), but the lowest in 2011 (0.50 kg).

The highest TDMY for Holstein cows was found to be in 2012 (27.48 kg) and 2013 (27.94 kg) and the lowest in 2011 (20.71 kg). The 305 DMY was also determined the highest in 2012 (9143.8 kg) and 2013 (9119.0 kg), but the lowest in 2011 (8000.1 kg). The fat percentage was the highest in 2011 (3.80%), but the lowest in 2012 (3.52%). The fat yield was the lowest in 2011 (0.78 kg) and increased gradually in 2012 (0.96 kg) and 2013 (1.02 kg). The highest protein percentage was determined in 2011 (3.28%) and 2012 (3.21%), while the protein yield was determined the highest in 2012 (0.88 kg) and 2013 (0.86 kg).

Table 1. Milk yield and its components by calving year in Jersey cows.

Calving Year		TDMY (kg)	305 DMY (kg)	Fat %	Fat Yield* (kg/d)	Protein %	Protein Yield* (kg/d)
2011	n	93	93	93	93	93	93
	$\bar{X}$	14.56^{b}	5116.2^{a}	5.36^{a}	0.77	3.44^{a}	0.50^{b}
	S	2.97	1395.7	0.69	0.15	0.21	0.10
	Min.	6.60	2268.0	3.94	0.28	2.91	0.21
	Max.	22.37	10226.0	7.48	1.17	4.03	0.72
2012	n	108	108	108	108	108	108
	$\bar{X}$	16.34^{a}	5484.2^{a}	4.90^{b}	0.80	3.33^{c}	0.54^{a}
	S	3.16	1491.9	0.58	0.16	0.16	0.10
	Min.	3.74	1480.0	3.41	0.18	2.94	0.13
	Max.	23.26	11874.0	6.52	1.25	3.79	0.74
2013	n	75	75	75	75	75	75
	$\bar{X}$	16.83^{a}	4604.8^{b}	4.74^{c}	0.80	3.40^{b}	0.57^{a}
	S	3.29	954.6	0.41	0.16	0.09	0.11
	Min.	8.08	2126.0	3.94	0.34	3.14	0.27
	Max.	23.47	7255.0	5.96	1.12	3.58	0.78
	P	**0.004**	**<0.001**	**<0.001**	**0.808**	**<0.001**	**0.018**
	b**	**-0.006 (0.013)**	-	**0.001 (0.060)**	**<0.001 (0.208)**	**<0.001 (0.034)**	**<0.001 (0.046)**

a.b.c The differences between the group means with different letters in the same column are significant (P<0.05).

TDMY: Test day milk yield, 305 DMY: 305-day milk yield, Min: Minimum, Max: Maximum.

**b: The regression coefficient calculated for the lactation period and the values given in brackets indicate the significance level.

Calving Year		TDMY (kg)	305 DMY (kg)	Fat %	Fat Yield* (kg/d)	Protein %	Protein Yield* (kg/d)
2011	n	59	59	59	59	59	59
	$\bar{X}$	20.71[b]	8000.1[b]	3.80[a]	0.78[c]	3.28[a]	0.68[b]
	S	5.75	2249.4	0.60	0.22	0.28	0.19
	Min.	11.19	3711.0	2.04	0.36	2.46	0.37
	Max.	41.13	13585.0	5.23	1.30	4.08	1.16
2012	n	71	71	71	71	71	71
	$\bar{X}$	27.48[a]	9143.8[a]	3.52[b]	0.96[b]	3.21[a]	0.88[a]
	S	3.79	1772.3	0.57	0.15	0.28	0.11
	Min.	17.68	3659.0	2.45	0.61	2.46	0.56
	Max.	35.76	13775.0	5.01	1.52	4.00	1.13
2013	n	176	176	176	176	176	176
	$\bar{X}$	27.94[a]	9119.0[a]	3.69[ab]	1.02[a]	3.09[b]	0.86[a]
	S	5.54	2090.1	0.59	0.21	0.29	0.16
	Min.	11.87	3179.0	2.42	0.42	2.40	0.38
	Max.	43.00	15809.0	5.89	1.65	3.97	1.35
	P	**<0.001**	**0.003**	**0.017**	**<0.001**	**0.002**	**<0.001**
	b**	**0.004 (0.286)**	-	**<0.001 (0.724)**	**<0.001 (0.376)**	**<0.001 (0.512)**	**<0.001 (0.127)**

[a.b.c] The differences between the group means with different letters in the same column are significant (P<0.05).

TDMY: Test day milk yield, 305 DMY: 305-day milk yield, Min: Minimum, Max: Maximum.

**b: The regression coefficient calculated for the lactation period and the values given in brackets indicate the significance level.

Discussion and Conclusion

The effect of calving year on TDMY (P=0.004), 305 DMY (P<0.001), fat percentage (P<0.001), protein percentage (P<0.001) and protein yield (P<0.018) genotyped according to DGAT1 gene for Jersey cows were found to be statically significant. However, fat yield was not affected by calving year (Table 1). Similar conclusions were reached by Gurses et al[10] and Teke and Akdag[11], who documented that the effect of calving year was significant on 305 DMY in Jersey cow. Missanjo et al[12] found similar results and concluded that calving year had a significant effect on milk, fat and protein yields of Jersey cattle. The results found in this study are also consistent with literature.[13] The differences between the years may be related to care-feeding, selection and management.

In the present study, the TDMY (P<0.001), 305 DMY (P=0.003), milk fat percentage (P=0.017), fat yield (P<0.001) protein percentage (P=0.002), and protein yield (P<0.001) genotyped according to DGAT1 gene in Holstein cows were affected by calving year (Table 2). Results clearly indicate that an elevated milk production according to years reflected as a decrease in milk fat and protein percentage in the investigated farms. This result for 305 DMY was similar to results with reported by many literatures.[4,14-18] Contrary to the present finding, Arslan and Cak[19] reported that effects of calving year on 305 DMY was not significantly important in Holstein cows. Koc and Kizilkaya[20] observed that calving year on TDMY was sig-

nificantly important. Atasever and Stadnik[21] determined that calving year on daily milk yield, fat and protein was significantly important in Holstein cows. Adediran et al[22] reported that highly significant effects of year of calving on protein and fat yields in Holstein breed. On the contrary, Sekerden[23] reported that effect of calving year on fat yield and protein yield was not important in Holstein cows. This difference between studies may be related to different environment, nutritional, management and barn conditions.

In conclusion, in 2011 to 2013, milk yield and its composition in both Holstein and Jersey cows were significantly related to calving years. It may be said that the feeding, maintenance-management factors between years have an important effect on the productivity of the dairy cows.

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