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Determination of some environmental factors on milk yield traits and milk components in Simmental cows

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Abstract: The aim of the study was to determine the effects of various environmental factors on milk yield and milk components in Simmental cows. In the present study, 33,813 milk yield records from 1631 cows and milk samples from 233 cows were used for milk component analysis. Lactation milk yield (LMY) and 305-day yield (305-DMY) were the milk yield characteristics studied. Environmental factors considered for milk yield characteristics included province, calving year, calving month, parity, age, and lactation length. Milk components analyzed were fat percentage (FP), protein percentage (PP), lactose percentage (LP), somatic cell count (Log_{10}SCC), and dry matter (DM). Environmental factors considered for milk components were province, birth year, control month, calving month, and parity. The results indicated that all environmental factors significantly influenced milk yield characteristics ($p < 0.01$). Specifically, province and birth year significantly affected FP and Log_{10}SCC ($p < 0.01$), whereas calving month, control month, and parity did not significantly affect FP. Province, birth year, and control month significantly influenced PP and DM ($p < 0.01$), while calving month and parity did not significantly affect PP. Province was the only significant factor for LP ($p < 0.01$). Considering all data, the averages of traits were as follows: LMY (5628.1 ± 12.80 kg), 305-DMY (5309.2 ± 11.80 kg), total dry matter yield (TDMY) (22.58 ± 0.51 kg), DM (12.43 ± 0.08%), Log_{10}SCC (2.29 ± 0.04, equivalent to 226239 cells/mL), FP (3.78 ± 0.06%), PP (3.57 ± 0.02%), and LP (4.72 ± 0.01%).

Key words: Simmental, milk component, milk yield, environmental factors

1.Introduction

The livestock sector holds significant importance within the agricultural industry as it fulfills the protein requirements of humans through animal-based products. It's well-established that both genetic and environmental factors play crucial roles in determining yield traits. Understanding the environmental factors that positively impact animal yield characteristics is essential. Moreover, achieving high phenotypic yields in animals necessitates not only an optimal genetic structure but also favorable environmental conditions [1].

According to data from the Turkish Statistical Institute (TURKSTAT), the combined number of cultured cows, crossbred cows, and native cows was approximately 8.3 million, 7.3 million, and 1.2 million, respectively, in 2022. Notably, this marked a 5.6% decrease compared to the previous year, bringing the total number of cows to 17 million heads [2]. Globally, there are an estimated 1 billion cows, with the Food and Agriculture Organization (FAO) suggesting this number may be even higher [3].

In Türkiye, cattle husbandry holds a significant position in the production sector. The Holstein breed, preferred for dairy cow breeding in Türkiye, is closely followed by Simmental, Brown Swiss, and Jersey breeds [4].. Simmental cows, when evaluated for overall characteristics, trace their origins to the Simmewaley region of Switzerland and are classified as dual-purpose. Phenotypically, they typically display a yellow-white coat with a white head. Well-suited to Türkiye's natural conditions, this breed has been favored by breeders. Simmental cows generally yield around 4500-5500 kg of milk, with a milk fat percentage of 4% and a protein percentage of 3.5%. Newborn calves typically weigh between 40-45 kg, while female and male animals weigh 600–650 kg and 900–1100 kg, respectively[5]. Additionally, the age at first calving is influenced by both genetic and environmental factors. It tends to be lower in fast-growing cows and higher in slow-growing ones, with the first calving age in Simmental reported as 30.06 months [6]. Moreover, various environmental factors significantly affect the growth performance of young animals, underscoring the importance of considering these factors in selection programs [7].

In Türkiye, there is a total of approximately 1.6 million Simmental cows registered, with 476,986 heads in the

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preherdbook system and 214,385 heads registered in the herdbook system out of 712,544 Simmental cows [8].

Several studies have been conducted on Simmental cows, with one focusing on the impact of environmental factors on milk yield. It was found that the calving year significantly affects milk yield, while birth type was not found to significantly affect any traits except for gestation length. These findings suggest that the Simmental breed can thrive successfully in Turkish conditions [9]. In Kayseri, another study investigated the environmental factors influencing milk yields of Simmental cows, revealing that farm type and season significantly impact lactation milk yield (LMY) and 305-day milk yield (305-DMY [10]). Similarly, a study conducted in Serbia examined the environmental factors affecting milk yield traits in Simmental cows. Discrete variables such as location, calving season, birth year, season of birth, and parity, along with age as a continuous variable, were included as fixed factors in the model [11]. In another study, the importance of calving interval, somatic cell count, calving age, and parity variables on 305-DMY in Simmental cows was highlighted [12]. An investigation into the environmental factors affecting 305-DMY of Simmental cows raised in subtropical conditions considered variables such as calving year, season, age, parity, birth type, and sex [13]. Additionally, an investigation into the impact of environmental factors on yield traits in Simmental cows raised in three herds examined variables including farm, calving season, parity, year, and birth season interaction, farm and calving season interaction, and farm and parity interaction [14]. Furthermore, a report evaluated milk yield, milk fat yield, and milk fat content, considering environmental factors such as farm, parity, birth season, calving season, and the interaction of these factors in standard lactation [15].

The aim of this study is to assess the impact of various environmental factors on milk yield and milk components in Simmental cows. Fixed environmental factors such as province, calving year, calving month, parity, animal age, and lactation length were considered in relation to milk yield characteristics. Similarly, province, year of birth, month of control, month of calving, and parity were evaluated as fixed environmental factors affecting milk components.

2. Material and methods

2.1. Animal materials

The study utilized milk yield records from Simmental cow herds registered in Türkiye's national herdbook system. It included 33,809 milk yield records from 1631 cows across 10 different provinces (Afyonkarahisar, Bursa, Çorum, Erzincan, Gaziantep, Isparta, İzmir, Kastamonu, Konya, and Tekirdağ), as well as milk samples collected from 233 cows. These cows were bred on dairy farms affiliated with the Cows Breeders Association of Türkiye (CBAT).

2.2. Methods and statistical analysis

Milk yield records and milk samples were collected following the standards set by the International Committee for Animal Registration (ICAR). Milk yield control was conducted every four weeks (B4). Approximately 94.68% of dairy farms utilized a mechanical milk meter and milk measuring bucket for milk measurement, while 5.32% employed an automatic milking system [16]. . Each cow's milk samples were uniformly taken throughout the milking process using a sampler device. Milk sample analyses were carried out using Foss or Bentley raw milk analyzers. The results of these analyses were recorded online from the laboratory directly into the herdbook system [17].

The study encompassed ten provinces: Afyonkarahisar, Bursa, Çorum, Erzincan, Gaziantep, Isparta, İzmir, Kastamonu, Konya, and Tekirdağ. Calving years ranged from 2015 to 2021, with calving months spanning all 12 months. Parity was categorized as 1, 2, 3, 4, and ≥5 for milk yield traits (LMY and 305-DMY), while lactation length ranged from 150 to 400 days. Province, calving year, calving month, and parity were treated as discrete variables, while age and lactation length were considered continuous variables, all serving as fixed environmental factors influencing milk yield characteristics. Additionally, 233 milk samples, each from a different cow, were obtained and utilized to determine milk components. The study focused on six provinces: Erzincan, Gaziantep, İzmir, Kastamonu, Konya, and Tekirdağ. Birth years ranged from 2012 to 2019, control months included February, September, November, and December, and calving months spanned all 12 months. Parity was classified similarly to milk yield traits (1, 2, 3, 4, and ≥5) for the analysis of milk components, including $Log_{10}SCC$, fat percentage (FP), protein percentage (PP), lactose percentage (LP), dry matter (DM), and total dry matter yield (TDMY). Province, birth year, control month, calving month, and parity were considered fixed environmental factors affecting milk components.

Identification of milk components can be given as 305-DMY: total milk production from the first day after calving to 305 days, FP: fat content of milk as a percentage of whole milk, PP: protein content of milk as a percentage of whole milk, LP: lactose content of milk as a percentage of whole milk, DM: dry matter content of milk as a percentage of whole milk, SCC: total number of cells per cells/mL of milk [18].

In this study, the effects of provinces, calving year, calving month, parity, age (in days), and lactation length (in days) on milk yield traits, as well as the effects of province, birth year, control month, calving month, and parity on milk components, were determined using the least squares method. The statistical significance of means was assessed using analysis of variance (ANOVA), and differences between significant means were evaluated using Tukey's multiple comparison test ($p < 0.05$). Due to the nonnormal distribution of SCC data, logarithmic transformation was analyzed according to $\log^{10}$ base before statistical analysis. The general linear model (GLM) procedure in the JMP program was employed for the statistical analysis in this research [19].

The models used in the study are given below:

$$Y_{ijklmn}=\mu + D_i+Y_j+ M_k + P_l+ b_1(X_{ijklmn} - \bar{X}_1) + b_2(X_{ijklmn} - \bar{X}_2) + e_{ijklmn}$$

where Y_{ijklmn} is the observation value of the milk yield trait (LMY and 305-DMY), μ is the population average, D_i is the effect of the ith province (i: 1–10), Y_j is the effect of the jth calving year (j: 2015–2021), M_k is the effect of the kth calving month (k: 1–12), P_l is the effect of the lth parity (l:1-≥5), b_1 is the regression coefficient for animal age (in days), X_{ijklmn} is the 1st record of the animal, ith province, jth calving year, kth calving month, lth parity, $\bar{X}_1$ is the mean of animal age, b_2 is the regression coefficient for lactation length (day) (except 305-DMY), X_{ijklmn} is the 1st record of the animal, ith province, jth calving year, kth calving month, lth parity, $\bar{X}_2$ is the mean of lactation length, e_{ijklmn} is random error (NID,0,σ^2).

$$Y_{ijklmn}=\mu + D_i+Y_j+ M_k + N_l +P_m+U_n+e_{ijklmn}$$

where Y_{ijklmn} is the observation value of the milk component trait (Log_{10}SCC, FP,PP, LP, DM) and (TDMY), μ is the population average, D_i is the effect of the ith province (i:1–6), Y_j is the effect of the jth birth year (j: 2012–2019), M_k is the effect of the kth control month (k:1–4), P_l is the effect of the lth parity (l: 1–≥5), U_n is the effect of the nth calving month (n: 1–12), e_{ijklmn} is random error (NID,0,σ^2).

3. Results

The least squares mean, standard errors, and significance test results for the LMY and 305-DMY of the Simmental according to province, calving year, calving month, parity, animal age, and lactation length are presented in Tables 1 and 2. Similarly, the least squares mean, standard errors, and significance test results for the FP, PP, LP, DM, Log_{10}SCC, and TDMY of animal according to province, birth year, control month, calving month, and parity are presented in Tables 3–5., respectively.

The main effect of each factor is presented according to the item's heading in Tables 1 and 2.

The province factor is constructed around LMY ($p < 0.001$) and 305-DMY ($p < 0.001$). The lowest LMY was observed in Kastamonu as 3812.38 ± 25.81 kg, while the highest was recorded in Gaziantep as 8428.98 ± 141.28 kg. The lowest 305-DMY was found in Kastamonu as 3620.95 ± 25.03 kg, and the highest was in Gaziantep as 7832.43 ± 137.05 kg, respectively. These variations between averages were found to be statistically significant ($p < 0.05$).

LMY and 305-DMY were affected by the calving year ($p < 0.001$). The lowest LMY was recorded in 2018 as 6187.48 ± 32.80 kg, while the highest was observed in 2015 as 7069.29 ± 62.66 kg. The lowest 305-DMY was noted in 2021 as 5779.43 ± 30.19 kg, whereas the highest was determined in 2015 as 6623.42 ± 60.78 kg, respectively. These variations were determined to be statistically significant ($p < 0.05$).

LMY and 305-DMY were affected by the calving month ($p < 0.001$). The lowest LMY was observed in December as 6295.61 ± 36.31 kg, while the highest LMY was in June as 6596.19 ± 40.25 kg. The lowest 305-DMY was recorded in December as 5948.20 ± 35.23 kg, and the highest in June as 6150.65 ± 39.05 kg, respectively. These variations were found to be statistically significant ($p < 0.05$).

LMY and 305-DMY were affected by parity ($p < 0.001$). The lowest LMY was observed in first parity as 5743.63 ± 25.38 kg, the highest LMY was noted in ≥5 parity as 7015.18 ± 57.16 kg. The lowest 305-DMY was determined in first parity as 5405.37 ± 24.61 kg, and the highest 305-DMY was recorded in ≥5 parity as 6542.87 ± 55.42 kg, respectively. These variations between averages were found to be significant ($p < 0.05$). Additionally, animal age and lactation length were identified as significant environmental factors for LMY, while animal age was found to be a significant environmental factor for 305-DMY ($p < 0.001$), respectively.

The main effect of each factor is given below in Tables 3–5. FP, PP, LP, DM, Log_{10}SCC, and TDMY were affected by province ($p < 0.001$). The lowest FP was noted in Konya as 3.50 ± 0.22%, while the highest was observed in Gaziantep as 4.72 ± 0.39%. These variations between averages were found to be significant ($p < 0.05$). The lowest PP was determined in Kastamonu as 2.73 ± 0.18%, whereas the highest PP was observed in Konya as 3.48 ± 0.07%, these variations between averages were found to be important ($p < 0.05$). The lowest LP was recorded in Erzincan as 4.49 ± 0.06%, while the highest was observed in Kastamonu as 5.30 ± 0.14%, these variations between averages were found to be significant ($p < 0.05$). The lowest DM was observed in İzmir as 11.23 ± 0.34%, while the highest was noted in Kastamonu as 13.32 ± 0.75%. These variations between averages were found to be significant ($p < 0.05$). The lowest Log_{10}SCC (cells/mL) was recorded in Erzincan as 1.55 ± 0.11 (35,481), while the highest was noted in Konya as 2.32 ± 0.10 (208930), these variations were found to be significant ($p < 0.05$). The lowest was observed in Kastamonu as 12.00 ± 3.69, while the highest TDMY was determined in Gaziantep as 22.90 ± 2.53, these variations were found to be significant ($p < 0.05$).

FP ($p < 0.001$), PP ($p < 0.001$), LP ($p > 0.05$), DM ($p < 0.05$), Log_{10}SCC ($p < 0.05$) and TDMY ($p < 0.001$) were affected by the birth year. The lowest FP was observed in

2019 as 3.38 ± 0.35%, while the highest FP was noted in 2014 as 5.61 ± 0.45%, these variations were found to be significant ($p < 0.05$). The lowest PP was determined in 2013 as 2.95 ± 0.13%, the highest PP was determined in 2019 as 3.63 ± 0.11%, these variations were found to be significant ($p < 0.05$). The lowest DM was determined in 2013 as 11.94 ± 0.52 %, the highest DM was determined in 2014 as 13.86 ± 0.58%, these variations were found to be significant ($p < 0.05$). The lowest Log_{10}SCC (cells/mL) was recorded in 2019 as 2.08 ± 0.16 (120226), while the highest was determined in 2012 as 2.46 ± 0.20 (288403), these variations between averages were found to be significant ($p < 0.05$). The lowest TDMY was determined in 2013 as 9.17 ± 2.65 kg, while the highest was observed in 2016 as 19.48 ± 1.57 kg, these variations between averages were found to be significant ($p < 0.05$).

FP ($p > 0.05$), PP ($p < 0.001$), LP ($p > 0.05$), DM ($p < 0.001$), Log_{10}SCC ($p < 0.001$), and TDMY ($p < 0.001$) were affected by the control month. The lowest FP was observed in September as 3.26 ± 0.39%, while the highest FP was noted in November as 4.97 ± 0.28%, these variations were found to be statistically not significant ($p > 0.05$). The lowest DM was observed in September as 11.37 ± 0.50%, while the highest was recorded in December as 12.87 ± 0.18%, these variations were detected to be significant ($p < 0.05$). The lowest TDMY was observed in February as 9.76 ± 3.39 kg, while the highest was recorded in December as 22.00 ± 0.90 kg. These variations were found to be significant ($p < 0.05$).

FP, PP, LP, DM, Log_{10}SCC were not affected and TDMY was affected by the calving month ($p < 0.001$). The lowest TDMY was noted in December as 8.12 ± 2.78 kg, while the highest TDMY was recorded in October as 17.74 ± 2.05 kg. These variations between averages were found to be significant ($p < 0.05$).

FP, PP, LP, DM, Log_{10}SCC were not affected and TDMY was affected by parity. The lowest TDMY was observed at first parity as 13.14 ± 2.05 kg, whereas the highest was recorded at second parity as 18.57 ± 1.78 kg. These variations between averages were found to be significant ($p < 0.05$).

4. Discussion

From the results, it can be concluded that the effect of all environmental factors on milk yield characteristics was significant ($p < 0.01$). Specifically, the province and year of birth were significant for FP, PP, TDMY ($p < 0.01$), as well as for Log10SCC and DM ($p < 0.05$), while calving month, control month, and parity did not show significance. Additionally, province, year of birth, and control month were significant for PP and DM ($p < 0.01$), with calving month and parity not being significant. Similarly, province was significant for LP ($p < 0.01$), whereas birth year, calving month, control month, and parity did not show significance in the present study.

In a similar study, parity and calving year were found to have a significant effect ($p < 0.05$) on both milk yield traits and milk components. However, calving season was not found to be significant for either milk yield traits or milk components [1]. The study utilized a total of 1473 records spanning from 1992 to 2001 to investigate environmental factors affecting milk yield in Simmental cows. The least square means of various parameters were determined, including 305-DMY, lactation length, dry period, service period, calving interval, gestation length, and number of inseminations per conception, which were found to be

Table 1. Results of variance analysis for environmental factors for milk yield traits.

	Lactation milk yield (LMY) (kg)			305-day milk yield (305-DMY) (kg)		
Source	DF	SS	F	DF	SS	F
Province	9	$6.49789 \cdot 10^{10}$	2946.79***	9	$5.7185 \cdot 10^{10}$	2754.59***
Calving year	6	937235297	63.75***	6	81998068	59.24***
Calving month	11	292343747	10.84***	11	166440553	6.55***
Parity	4	1805649182	184.24***	4	1622200115	175.81***
Age (day)	1	1309281077	534.38***	1	1060800896	459.88***
	b	−0.66 ± 0.02	***	*b*	−0.59 ± 0.02	***
Lactation length (day)	1	$1.63094 \cdot 10^{10}$	6656.65***	Not included in the model		
	b	16.28 ± 0.19	***			

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$, *b*: Coefficient of regression.

Table 2. Least square means ($\bar{X} \pm S_e$) of some milk yield traits according to the province, calving year, calving month and parity.

Environmental factors	Lactation milk yield (LMY) (kg)		305-day milk yield (305-DMY) (kg)	
	N	$\bar{X} \pm S_e$	N	$\bar{X} \pm S_e$
Province				
Afyonkarahisar	3410	6119.27 ± 31.19^{f}	3410	5763.96 ± 30.24^{d}
Bursa	4666	7891.06 ± 28.20^{b}	4666	7505.86 ± 27.33^{a}
Çorum	5938	5983.44 ± 26.38^{g}	5938	5652.26 ± 25.56^{e}
Erzincan	1628	5383.49 ± 44.47^{h}	1628	5024.83 ± 43.14^{f}
Gaziantep	126	8428.98 ± 141.28^{a}	126	7832.43 ± 137.05^{a}
Isparta	322	6439.70 ± 88.75^{e}	322	5981.83 ± 86.10^{d}
İzmir	4215	7738.96 ± 29.72^{c}	4215	7261.28 ± 28.84^{b}
Kastamonu	9578	3812.38 ± 25.81^{i}	9578	3620.95 ± 25.03^{g}
Konya	3541	6798.26 ± 31.96^{d}	3541	6310.32 ± 30.98^{c}
Tekirdağ	389	6328.38 ± 80.91^{ef}	389	5958.66 ± 78.51^{d}
p		***		***
Calving year				
2015	1867	7069.29 ± 62.66^{a}	1867	6623.42 ± 60.78^{a}
2016	2100	6866.40 ± 53.91^{b}	2100	6458.61 ± 52.30^{b}
2017	3305	6485.96 ± 42.84^{c}	3305	6108.16 ± 41.56^{c}
2018	5414	6187.48 ± 32.80^{e}	5414	5803.29 ± 31.82^{e}
2019	6555	6328.95 ± 27.06^{d}	6555	5943.14 ± 26.25^{d}
2020	7838	6320.67 ± 25.67^{d}	7838	5922.61 ± 24.91^{d}
2021	6734	6187.99 ± 31.12^{e}	6734	5779.43 ± 30.19^{e}
p		***		***
Calving month				
January	3425	6451.95 ± 39.13^{bc}	3425	6102.17 ± 37.97^{ab}
February	3478	6332.45 ± 38.67^{cd}	3478	5962.05 ± 37.51^{c}
March	3803	6445.46 ± 37.42^{bc}	3803	6037.50 ± 36.29^{bc}
April	3159	6550.82 ± 38.68^{ab}	3159	6106.93 ± 37.52^{ab}
May	2867	6565.84 ± 39.05^{ab}	2867	6120.88 ± 37.88^{ab}
June	2422	6596.19 ± 40.25^{a}	2422	6150.65 ± 39.05^{ab}
July	2473	6549.59 ± 39.93^{ab}	2473	6113.45 ± 38.74^{ab}
August	2351	6529.72 ± 40.25^{ab}	2351	6098.23 ± 39.04^{ab}
September	2145	6541.93 ± 41.03^{ab}	2145	6144.23 ± 39.81^{ab}
October	2195	6571.58 ± 40.42^{ab}	2195	6189.08 ± 39.22^{a}
November	2496	6477.56 ± 38.60^{ab}	2496	6121.46 ± 37.46^{ab}
December	2999	6295.61 ± 36.31^{d}	2999	5948.20 ± 35.23^{c}
p		***		***
Parity				
1	11233	5749.63 ± 25.38^{d}	11233	5405.37 ± 24.61^{d}
2	8682	6309.87 ± 24.96^{c}	8682	5930.10 ± 24.21^{c}
3	5938	6557.55 ± 31.26^{b}	5938	6264.96 ± 30.33^{b}
4	3765	6729.73 ± 41.41^{b}	3765	6312.89 ± 40.17^{b}
≥5	4195	7015.18 ± 57.16^{a}	419	6542.87 ± 55.42^{a}
p		***		***
Overall	33813	5628.1 ± 12.80	33813	5309.2 ± 11.80

^{a,b,c},: Different letters on the same column indicate statistically significant difference ($p < 0.05$).*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$, NS: nonsignificant ($p > 0.05$).

Table 3. Results of variance analysis for environmental factors for milk components.

	Fat percentage (FP) (%)			Protein percentage (PP) (%)			Lactose percentage (LP) (%)		
Source	DF	SS	F	DF	SS	F	DF	SS	F
Province	5	15.54	4.47***	5	2.71	7.71***	5	2.79	11.86***
Birth year	7	19.62	4.03***	7	2.36	4.81***	7	0.58	1.76
Control month	3	5.22	2.50	3	2.52	11.95***	3	0.36	2.60
Calving month	11	12.21	1.59	11	1.12	1.45	11	0.46	0.89
Parity	4	2.83	1.01	4	0.47	1.68	4	0.14	0.77
	Dry matter (DM) (%)			Somatic cell count (SCC) ($Log_{10}SCC$)			Test day milk yield (TDMY) (kg)		
Source	DF	SS	F	DF	SS	F	DF	SS	F
Province	5	22.26	3.91***	5	8.864	12.55***	5	2028.84	14.18***
Birth year	7	17.05	2.14*	7	2.639	2.66*	7	839.60	4.19***
Control month	3	13.65	4.00***	3	2.064	4.87***	3	891.50	10.38***
Calving month	11	16.23	1.29	11	1.755	1.12	11	755.85	2.40***
Parity	4	1.81	0.39	4	0.157	0.27	4	604.64	5.28***

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

4700 kg, 300 days, 81 days, 94 days, 379 days, 283.6 days, and 1.76, respectively. The findings indicated that calving year significantly influenced milk yield ($p < 0.001$), while birth type was not found to have a significant impact on any traits except for gestation length [9].

In another study conducted in Kayseri, the impact of environmental factors on milk yields was investigated in Simmental breed. The researcher reported that LMY and 305-DMY were found as 3506.20 kg and 3412.08 kg, respectively [10].

Another report indicates the impact of certain environmental factors on 305-DMY in 2805 Simmental cows. All data were analyzed using the decision tree method with the regression tree algorithm. The analysis revealed that the factors affecting 305-DMY included parity, calving age, somatic cell count, and calving interval. Furthermore, it was determined that cows with a calving age above 5 years exhibited higher 305-DMY, while cows with an SCC exceeding 104,500 cells/mL had the lowest 305-DMY [11].

In this study, LMY ($p < 0.001$), 305-DMY ($p < 0.001$), and FP ($p > 0.05$) were found to be affected by the calving month. The lowest LMY was observed in December, as 6295.61 ± 36.31 kg, while the highest LMY was observed in June as 6596.19 ± 40.25 kg. Similarly, the lowest 305-DMY was observed in December as 5948.20 ± 35.23 kg, and the highest 305-DMY was observed in June as 6150.65 ± 39.05 kg. Additionally, LMY and 305-DMY were influenced by parity ($p < 0.001$). The lowest 305-DMY was observed in the first parity as 5405.37 ± 24.61 kg, while the highest 305-DMY was observed in ≥ 5 parity as 6542.87 ± 55.42 kg. Furthermore, animal age and lactation length were identified as significant environmental factors for LMY ($p < 0.001$), while animal age was found to be a significant environmental factor for 305-DMY ($p < 0.001$).

In another study conducted in Serbia, the location, parity, and calving season were found to have a significant effect ($p < 0.01$) on 305-DMY, while calving season significantly influenced milk fat percentage ($p < 0.05$). Furthermore, age was found to have a significant effect on LMY and FP ($p < 0.01$) but was not significant for milk fat yield. Overall, the effect of environmental factors was highly significant in the model for LMY ($p < 0.01$), while calving season significantly affected 305-DMY ($p < 0.001$). Specifically, the lowest 305-DMY was observed during the summer season as 4010.06 ± 19.85 kg, while the highest 305-DMY was observed during the winter season as 4194.20 ± 19.15 kg. Additionally, 305-DMY was significantly influenced by parity ($p < 0.001$), with the lowest observed in the first parity as 3723.70 ± 17.24 kg, and the highest observed in the fourth parity as 4303.60 ± 25.37 kg. Furthermore, FP was affected by calving season ($p < 0.05$), with the lowest FP observed during the autumn season as 3.74 ± 0.004%, and the highest observed during the winter season as 3.80 ± 0.004%. Thus, environmental factors should be considered in models for estimating the breeding value of animals [12].

In this study, LMY and 305-DMY were found to be affected by calving year ($p < 0.001$). The lowest LMY was observed in 2018 as 6187.48 ± 32.80 kg, while the highest LMY was observed in 2015 as 7069.29 ± 62.66 kg. The lowest 305-DMY was observed in 2021 as 5779.43 ± 30.19 kg, and the highest 305-DMY was observed in 2015 as 6623.42 ± 60.78 kg.

Table 4. Least square means ($\bar{X} \pm S_e$) of some milk components according to the province, birth year, control month, calving month and parity.

Environmental factors	Fat percentage (FP) (%)		Protein percentage (PP) (%)		Lactose percentage (LP) (%)	
	N	$\bar{X} \pm S_e$	N	$\bar{X} \pm S_e$	N	$\bar{X} \pm S_e$
Province						
Erzincan	106	4.36 ± 0.24^{a}	106	3.29 ± 0.07^{abc}	106	4.49 ± 0.06^{c}
Gaziantep	19	4.72 ± 0.39^{a}	19	3.03 ± 0.12^{bc}	19	4.83 ± 0.10^{ab}
İzmir	47	3.81 ± 0.26^{ab}	47	3.45 ± 0.08^{a}	47	4.52 ± 0.06^{c}
Kastamonu	3	3.82 ± 0.57^{ab}	3	2.73 ± 0.18^{c}	3	5.30 ± 0.14^{a}
Konya	43	3.50 ± 0.22^{b}	43	3.48 ± 0.07^{a}	43	4.79 ± 0.05^{b}
Tekirdağ	15	3.96 ± 0.31^{ab}	15	3.30 ± 0.10^{ab}	15	4.83 ± 0.08^{b}
p		***		***		***
Birth year						
2012	5	4.68 ± 0.46^{ab}	5	2.98 ± 0.14^{b}	5	4.93 ± 0.11^{a}
2013	9	3.92 ± 0.41^{b}	9	2.95 ± 0.13^{b}	9	4.71 ± 0.10^{a}
2014	6	5.61 ± 0.45^{a}	6	3.24 ± 0.14^{ab}	6	4.65 ± 0.11^{a}
2015	55	3.61 ± 0.26^{b}	55	3.16 ± 0.08^{b}	55	4.86 ± 0.06^{a}
2016	36	3.65 ± 0.24^{b}	36	3.25 ± 0.07^{b}	36	4.85 ± 0.06^{a}
2017	16	3.61 ± 0.24^{b}	16	3.22 ± 0.09^{b}	16	4.76 ± 0.07^{a}
2018	75	3.77 ± 0.28^{b}	75	3.27 ± 0.09^{b}	75	4.73 ± 0.07^{a}
2019	31	3.38 ± 0.35^{b}	31	3.63 ± 0.11^{a}	31	4.85 ± 0.09^{a}
p		***		***		**NS (0.09)**
Control month						
February	4	4.75 ± 0.52^{a}	4	2.89 ± 0.16^{bc}	4	4.55 ± 0.13^{a}
September	13	3.26 ± 0.39^{a}	13	3.04 ± 0.12^{c}	13	4.84 ± 0.10^{a}
November	105	4.97 ± 0.28^{a}	105	3.35 ± 0.08^{ab}	105	4.93 ± 0.07^{a}
December	111	4.14 ± 0.14^{a}	111	3.57 ± 0.04^{a}	111	4.84 ± 0.03^{a}
p		**NS (0.06)**		***		**NS (0.053)**
Calving month						
January	24	3.73 ± 0.25^{a}	24	3.07 ± 0.08^{a}	24	4.81 ± 0.06^{a}
February	26	4.00 ± 0.24^{a}	26	3.28 ± 0.07^{a}	26	4.81 ± 0.06^{a}
March	18	4.21 ± 0.27^{a}	18	3.26 ± 0.08^{a}	18	4.76 ± 0.07^{a}
April	14	4.69 ± 0.30^{a}	14	3.21 ± 0.09^{a}	14	4.76 ± 0.07^{a}
May	30	3.93 ± 0.25^{a}	30	3.26 ± 0.08^{a}	30	4.83 ± 0.06^{a}
June	19	3.64 ± 0.28^{a}	19	3.05 ± 0.09^{a}	19	4.78 ± 0.07^{a}
July	31	4.15 ± 0.28^{a}	31	3.35 ± 0.10^{a}	31	4.83 ± 0.08^{a}
August	32	3.92 ± 0.26^{a}	32	3.15 ± 0.08^{a}	32	4.77 ± 0.06^{a}
September	19	4.22 ± 0.30^{a}	19	3.11 ± 0.09^{a}	19	4.85 ± 0.08^{a}
October	17	3.94 ± 0.31^{a}	17	3.20 ± 0.10^{a}	17	4.88 ± 0.09^{a}
November	14	3.96 ± 0.36^{a}	14	3.26 ± 0.11^{a}	14	4.88 ± 0.08^{a}
December	8	3.95 ± 0.43^{a}	8	3.14 ± 0.13^{a}	8	4.69 ± 0.11^{a}
p		**NS (0.10)**		**NS (0.15)**		**NS (0.54)**
Parity						
1	65	4.19 ± 0.32^{a}	65	3.04 ± 0.10^{a}	65	4.87 ± 0.08^{a}
2	69	4.04 ± 0.27^{a}	69	3.16 ± 0.08^{a}	69	4.83 ± 0.07^{a}
3	32	4.14 ± 0.28^{a}	32	3.21 ± 0.09^{a}	32	4.72 ± 0.07^{a}
4	39	4.12 ± 0.28^{a}	39	3.30 ± 0.08^{a}	39	4.75 ± 0.07^{a}
≥5	28	3.65 ± 0.30^{a}	28	3.35 ± 0.09^{a}	28	4.79 ± 0.07^{a}
p		**NS (0.39)**		**NS (0.15)**		**NS (0.54)**
Overall	233	3.78 ± 0.06	233	3.57 ± 0.02	233	4.72 ± 0.01

^{a,b,c},: Different letters on the same column indicate statistically significant difference ($p < 0.05$). *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$, NS: nonsignificant ($p > 0.05$).

Table 5. Least square means ($\bar{X} \pm S_e$) of some milk components in Simmental cows according to the district, birth year, control month, calving month, and parity.

Environmental factors	Dry matter (DM) (%)		Somatic cell count (SCC) [Log_{10}SCC (cells/mL)]		Test day milk yield (TDMY) (kg)	
	N	$\bar{X} \pm S_e$	N	$\bar{X} \pm S_e$	N	$\bar{X} \pm S_e$
Province						
Erzincan	106	13.03 ± 0.31^{a}	106	1.55 ± 0.11^{c} (35481)	106	16.81 ± 1.57^{a}
Gaziantep	19	12.66 ± 0.50^{a}	19	2.35 ± 0.17^{b} (223872)	19	22.90 ± 2.53^{a}
İzmir	47	11.23 ± 0.34^{b}	47	2.94 ± 0.12^{a} (870964)	47	21.06 ± 1.71^{a}
Kastamonu	3	13.32 ± 0.75^{a}	3	2.15 ± 0.25^{bc} (141254)	3	12.00 ± 3.69^{b}
Konya	43	12.21 ± 0.28^{ab}	43	2.32 ± 0.10^{b} (208930)	43	17.20 ± 1.43^{a}
Tekirdağ	15	12.13 ± 0.40^{ab}	15	2.41 ± 0.14^{b} (257040)	15	14.64 ± 2.04^{b}
p		***		***		***
Birth year						
2012	5	12.96 ± 0.58^{ab}	5	2.46 ± 0.20^{a} (288403)	5	14.67 ± 2.95^{abc}
2013	9	11.94 ± 0.52^{b}	9	2.42 ± 0.18^{a} (263027)	9	9.17 ± 2.65^{c}
2014	6	13.86 ± 0.58^{a}	6	2.42 ± 0.20^{a} (263027)	6	13.22 ± 2.92^{abc}
2015	55	12.01 ± 0.33^{b}	55	2.10 ± 0.11^{b} (125893)	55	18.39 ± 1.67^{ab}
2016	36	12.20 ± 0.31^{ab}	36	2.11 ± 0.11^{b} (128825)	36	19.48 ± 1.57^{a}
2017	16	12.00 ± 0.38^{ab}	16	2.31 ± 0.13^{a} (204174)	16	14.78 ± 1.94^{abc}
2018	75	12.15 ± 0.36^{ab}	75	2.40 ± 0.12^{a} (261189)	75	12.87 ± 1.82^{bc}
2019	31	12.33 ± 0.45^{ab}	31	2.08 ± 0.16^{b} (120226)	31	15.49 ± 2.30^{abc}
p		*		*		***
Control month						
February	4	12.86 ± 0.67^{ab}	4	1.71 ± 0.23^{b} (51286)	4	9.76 ± 3.39^{b}
September	13	11.37 ± 0.50^{b}	13	2.75 ± 0.17^{a} (562341)	13	11.43 ± 2.55^{b}
November	105	12.62 ± 0.36^{a}	105	2.55 ± 0.12^{a} (354813)	105	15.85 ± 1.80^{b}
December	111	12.87 ± 0.18^{a}	111	2.14 ± 0.06^{b} (138038)	111	22.00 ± 0.90^{a}
p		***		***		***
Calving month						
January	24	12.24 ± 0.32^{a}	24	2.27 ± 0.11^{a} (186209)	24	13.24 ± 1.65^{ab}
February	26	12.57 ± 0.31^{a}	26	2.31 ± 0.11^{a} (204174)	26	16.77 ± 1.57^{ab}
March	18	12.63 ± 0.35^{a}	18	2.36 ± 0.12^{a} (229087)	18	15.34 ± 1.78^{ab}
April	14	13.08 ± 0.38^{a}	14	2.47 ± 0.13^{a} (295121)	14	16.22 ± 1.93^{ab}
May	30	12.44 ± 0.32^{a}	30	2.34 ± 0.11^{a} (218776)	30	13.15 ± 1.64^{ab}
June	19	11.80 ± 0.36^{a}	19	2.43 ± 0.12^{a} (269153)	19	15.83 ± 1.82^{ab}
July	31	12.68 ± 0.41^{a}	31	2.21 ± 0.14^{a} (162181)	31	15.91 ± 2.10^{ab}
August	32	12.20 ± 0.33^{a}	32	2.29 ± 0.11^{a} (194984)	32	15.39 ± 1.68^{ab}
September	19	12.42 ± 0.38^{a}	19	2.43 ± 0.13^{a} (269193)	19	14.07 ± 1.94^{ab}
October	17	12.41 ± 0.40^{a}	17	2.16 ± 0.14^{a} (125893)	17	17.74 ± 2.05^{a}
November	14	12.52 ± 0.46^{a}	14	2.17 ± 0.16^{a} (147911)	14	15.33 ± 2.35^{ab}
December	8	12.17 ± 0.55^{a}	8	2.05 ± 0.19^{a} (112202)	8	8.12 ± 2.78^{b}
p		**NS (0.22)**		**NS (0.33)**		***
Parity						
1	65	12.59 ± 0.40^{a}	65	2.23 ± 0.14^{a} (169824)	65	13.14 ± 2.05^{b}
2	69	12.39 ± 0.35^{a}	69	2.28 ± 0.12^{a} (190546)	69	18.57 ± 1.78^{a}
3	32	12.43 ± 0.36^{a}	32	2.32 ± 0.12^{a} (208930)	32	15.11± 1.82^{ab}
4	39	12.54 ± 0.36^{a}	39	2.35 ± 0.12^{a} (223872)	39	13.44 ± 1.80^{ab}
≥5	28	12.21 ± 0.38^{a}	28	2.25 ± 0.13^{a} (177828)	28	13.54 ± 1.94^{ab}
p		**NS (0.80)**		**NS (0.85)**		***
Overall	233	12.43 ± 0.08	233	2.29 ± 0.04 (226239)	233	22.58 ± 0.51

^{a,b,c},: Different letters on the same column indicate statistically significant difference ($p < 0.05$).*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$, NS: nonsignificant.

In another study, various environmental factors including calving year, season, age, parity, birth type, and sex were investigated for their effects on LMY, 305-DMY, adjusted mature-age 305-day lactation milk yield (305-d MAMY), LL, and dry periods (DP). The study included a total of 1904 records from 2001 to 2014, with LMY, 305-DMY (n = 706), and 305-d MAMY recorded as 6413.04kg, 6060.30 kg and 6871.21 kg, respectively. Significant effects were observed for calving year, birth type, and sex on LMY ($p < 0.05$). Similarly, calving year, calving age, birth type, and sex were found to have significant effects on 305-DMY ($p < 0.05$). Moreover, 305-d MAMY was significantly affected by calving year, birth type, and calf sex ($p < 0.05$). These findings suggest that the milk yield traits of Simmental cattle, when raised under optimal feeding and management conditions in subtropical environments, comply with global standards [13].

In this study, FP, PP, LP, DM, and Log_{10}SCC were not found to be significant, while TDMY was affected by calving month ($p > 0.05$). Similarly, Petrovic et al. [14] reported that the effect on lactation traits of environmental factors such as farm, calving season, parity, year, and birth season interaction, as well as farm and calving season interaction, and farm and parity interaction, were found to be significant ($p < 0.01$), but the calving season did not have a significant effect on milk fat content.

It was reported that the impact of various environmental factors on milk and milk fat yield was investigated during the first three lactations. In this study, milk yield, milk fat yield, and milk fat content were evaluated in relation to environmental factors such as farm, parity, birth season, calving season, and their interactions during a standard lactation period. The study involved 241 Simmental cows. The effects of farm, parity, and year of birth on milk yield and milk fat yield were found to be highly significant ($p < 0.05$) [15].

In this study, LMY, 305-DMY, and FP were found to be affected by province ($p < 0.001$). The lowest LMY was observed in Kastamonu as 3812.38 ± 25.81 kg, while the highest LMY was observed in Gaziantep as 8428.98 ± 141.28 kg. Similarly, the lowest 305-DMY was observed in Kastamonu as 3620.95 ± 25.03 kg, and the highest 305-DMY was observed in Gaziantep as 7832.43 ± 137.05 kg. Furthermore, the lowest FP was determined in Konya as 3.50 ± 0.22%, while the highest FP was determined in Gaziantep as 4.72 ± 0.39%.

The report shows that 305-DMY ($p < 0.001$), FP (%) ($p < 0.001$), and fat yield (FY) (kg) ($p < 0.001$) were affected by province. The lowest 305-DMY was determined in Nis as 3771.22 ± 41.20 kg, the highest 305-DMY was determined in Jagodina as 4852.59 ± 50.47 kg, the lowest FP (%) was determined in Jagodina as 3.91 ± 0.01%, the highest FP (%) was determined in Nis as 3.99 ± 0.02% and the lowest FY (kg) was determined in Nis as 150.48 ± 1.86 kg, the highest FY (kg) was determined in Jagodina as 189.86 ± 2.00 kg, respectively [15].

In this study, LMY and 305-DMY were affected by parity ($p < 0.001$). The lowest LMY was determined in first parity as 5749.63 ± 25.38 kg, the highest LMY was determined in ≥5 parity as 7015.18 ± 57.16 kg and the lowest 305-DMY was determined in first parity as 5405.37 ± 24.61 kg, the highest 305-DMY was determined in ≥ 5 parity as 6542.87 ± 55.42 kg, respectively.

In another study, 305-DMY ($p < 0.001$), FP (%) (nonsignificant (NS) and FY (kg) ($p < 0.001$)) were affected by parity. The lowest 305-DMY was determined in first lactation as 4121.23 ± 66.77 kg, the highest 305-DMY was determined in third lactation as 4784.28 ± 65.25 kg and the lowest FY (kg) was determined in first lactation as 161.73 ± 2.56 kg, the highest FY (kg) was determined in third lactation as 189.10 ± 2.55 kg, respectively [15].

In the present study, FP ($p < 0.001$), PP ($p < 0.001$), LP ($p > 0.05$), DM ($p < 0.05$), Log_{10}SCC ($p < 0.05$), and TDMY ($p < 0.001$) were affected by birth year. The lowest FP was determined in 2019 as 3.38 ± 0.35%, the highest FP was determined in 2014 as 5.61 ± 0.45%.

In another study, 305-DMY ($p <0.001$), FP (%) (NS) and FY (kg) ($p < 0.001$) were affected by birth year. The lowest 305-DMY was determined in first group of birth year as 4352.31 ± 76.56 kg, the highest 305-DMY was determined in second group of birth of year as 4764.31 ± 120.31 kg and the lowest FY (kg) was determined in first group of birth year as 171.06 ± 3.07 kg, the highest FY (kg) was determined in second group of birth of year as 187.15 ± 4.53 kg, respectively [15].

It is reported that 305-DMY (NS), FP (%) ($p <0.05$), and FY (kg) (NS) were affected by birth season. The highest FP (%) was determined in summer as 3.97 ± 0.01% and the lowest FY (kg) was determined in autumn as 3.91 ± 0.01 %, respectively [15].

In the present study, LMY, 305-DMY and TDMY were affected by calving month ($p < 0.001$). The lowest LMY was determined in December as 6295.61 ± 36.31 kg, the highest LMY was determined in June as 6596.19 ± 40.25 kg and the lowest 305-DMY was determined in December as 5948.20 ± 35.23 kg, the highest 305-DMY was determined in June as 6150.65 ± 39.05 kg, respectively. In another study, 305-DMY, FP (%) and fat yield (FY) were not affected by calving season [15].

In Simmental cows, the researchers investigated the effect of daily milk production on milk composition characteristics. They divided the Simmental cows into two groups: those producing more than 27 kg of milk per day and those producing 27 kg or less. Milk samples were collected every 30 days, and the total protein, fat, lactose, and dry matter content were determined. In the lower production group, the total protein content was found to be 3.35%, while in the higher production group, it was 3.30% ($p < 0.05$), indicating significance. Fat content was 4.01% in the lower production group and 3.90% in the higher production group, which was not significant ($p > 0.05$). Lactose content was 4.59% in the lower production group and 4.68% in the higher production group, showing significance ($p < 0.05$). Similarly, dry matter content was 12.26% in the lower production group and 12.13% in the higher production group, also showing significance ($p < 0.05$). Comparing these findings with the present study, it appears that the fat percentage of these animals is lower, while PP is higher. LP and DM values were found to be closer to each other in both groups [20].

In another study, a correlation coefficient of 0.41 was observed between SCC and body length, followed by 0.21 between SCC and leg circumference. Additionally, it was noted that an increase in 305-DMY leads to an increase in LP. Moreover, it was stated that a reduction in SCC would occur with increased LP and reduced body length selection. The study concluded that growth traits could be used easily and inexpensively to improve milk quality from Simmental cows [16]. In a study conducted on Simmental cows raised in Serbia, researchers investigated the correlations between reproduction and production. A total of 3056 Simmental cow yield records were utilized. The results of the study indicated diverse degrees of variation between fertility and milk performance properties in terms of phenotypic correlations [21]. Another study on Simmental cows examined the interaction between milk components and daily milk yields. The results revealed significant negative correlations. For instance, there was a negative correlation observed between daily milk yield and kappa casein (–0.47), as well as between lactose and somatic cell count (–0.37) [22].

In this study, it was observed that LMY ($p < 0.001$), 305-DMY ($p <0.001$), FP ($p > 0.05$), and PP ($p > 0.05$) were affected by calving month.

The study investigated the influence of calving season and parity on milk yield components and the changes in milk components with lactation stage in Simmental cows. It was found that calving season and parity were statistically significant factors affecting 305-DMY, fat percentage, and protein percentage [23].

In another study focusing on Simmental cows, the factors influencing 305-DMY were investigated. A high correlation between 305-DMY and parity was found ($p < 0.01$) [24]. This finding was also consistent with the significance observed in the current study. Furthermore, the study examined the impact of breed, season, and milk production on the physicochemical properties of milk. It was determined that FP ($p < 0.001$) and PP ($p < 0.001$) were affected by the season of lactation. Specifically, the lowest PP was observed in spring as 3.32 ± 0.07%, while the highest PP was observed in summer as 3.45 ± 0.03%. These differences between averages were found to be significant ($p < 0.001$). Similarly, the lowest FP was observed in spring as 3.99 ± 0.06%, while the highest FP was observed in winter as 4.09 ± 0.08%. These differences between averages were also detected as significant ($p < 0.001$) [25].

In this study, LMY, 305-DMY, TDMY, DM, Log_{10}SCC, FP, PP, and LP were found to be 5628.1 ± 12.80 kg, 5309.2 ± 11.80 kg, 22.58 ± 0.51 kg, 12.43 ± 0.08%, 2.29 ± 0.04 (226239 cells/mL), 3.78 ± 0.06%, 3.57 ± 0.02%, 4.72 ± 0.01%, respectively.

The average milk yield of Romanian Simmental cows was reported to be 4053 ± 139.1 kg. Additionally, the mean of FP was 3.82 ± 0.03%, and the mean of PP was 3.12 ± 0.03% in the same animals. Furthermore, a high phenotypic correlation coefficient between milk yield and milk fat yield suggested that selecting for milk yield could improve the overall milk production of cows [26]. It was reported that Simmental cows in Bulgaria exhibited relatively high milk production per first lactation. The average 305-DMY was reported as 5016 ± 70.81 kg, with FP and PP for 305-DMY recorded as 4.217 ± 0.02% and 3.398 ± 0.01%, respectively. For the full lactation period, the average LMY was 5564 ± 128.0 kg, with FP and PP for LMY reported as 4.25 ± 0.02% and 3.41 ± 0.01%, respectively. Additionally, the farm and year of calving were identified as important factors affecting all milk production traits studied ($p < 0.001$) [27].

In this study, LMY and 305-DMY were significantly affected by calving month ($p < 0.001$). The lowest LMY was observed in December as 6295.61 ± 36.31 kg, while the highest LMY was observed in June as 6596.19 ± 40.25 kg. Similarly, the lowest 305-DMY was determined in December as 5948.20 ± 35.23 kg, whereas the highest 305-DMY was determined in June as 6150.65 ± 39.05 kg.

The calving season was identified as a significant factor affecting full lactation milk yield ($p < 0.05$), but it did not show significance in relation to milk quality traits. Additionally, the study revealed that cows calving in the winter and spring exhibited the highest milk yield compared to those calving in other seasons [27].

In a study conducted at a private company in Aydın Province, the milk quality traits of Simmental cows and Red-Holstein were investigated. No significant differences were found between these two breeds except for casein content. Specifically focusing on the Simmental breed, the study determined the PP, LP, TDM and SCC. Additionally, the SCC was evaluated by taking its logarithm into account. The results for the Simmental breed were reported as follows: PP 3.40 ± 0.015%, LP 4.81 ± 0.19%, TDM 11.23 ± 0.048%, and SCC (Log^{10}) 5.401 ± 0.0118% (251,768 cells/

mL). Comparing these findings with the data presented in the current study, there appears to be similarity between them [28].

The milk yield characteristics of Simmental cows were studied at the Agricultural Research Farm at Atatürk University. The least squares means with standard errors for actual milk yield, 305-day milk yield, actual milk fat yield, milk fat percentage, and lactation length were determined as 2862.1 ± 310.6 kg, 2683 ± 258.3 kg, 113.7 ± 14.2 kg, 3.97 ± 0.18%, and 305.3 ± 34.2 days, respectively. It was observed that the animals in the current study exhibited higher milk yield compared to the findings of the conducted study [29].

As a result, the study aimed to assess the impact of various environmental factors on milk yield and milk components in Simmental cows. The findings indicated that all environmental factors significantly influenced milk yield characteristics ($p < 0.01$). Specifically, province and birth year were significant for FP, PP, DM, and $Log_{10}SCC$ ($p < 0.01$). However, calving month, control month, and parity showed no significance regarding FP, LP. Similarly, province, birth year, and control month were significant for PP and DM ($p < 0.01$), while calving month and parity were not. Additionally, province was significant for LP ($p < 0.01$), while birth year, calving month, control month, and parity were not. These findings underscore the importance of optimizing environmental conditions to enhance milk yield in animals. It is evident that a range of environmental factors play a crucial role in determining milk yield and its components. Hence, these factors should be carefully considered to facilitate improvements in future studies.

Conflict of interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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Informed consent

No ethics committee document was deemed necessary for this study as it solely involved the collection of numerical data.

References

1. Kul E, Abacı SH, Çobanoğlu Ö, Gürcan EK, Çankaya S. Estimation of genetic and environmental parameters for milk traits in Jersey. Mediterranean Agricultural Sciences 2018; 31 (3): 311-315. https://doi:10.29136/mediterranean.403500

2. Türkiye İstatistik Kurumu (TÜİK). Türkiye Hayvancılık İstatistikleri. TÜİK Kurumsal.

3. Food and Agriculture Organization of the United Nation. FAOSTAT.

4. Tarım İşletmeleri Genel Müdürlüğü. TİGEM 2022 Yılı Hayvancılık Sektör Raporu, Tarım İşletmeleri Genel Müdürlüğü, Bakanlıklar, Ankara (in Turkish).

5. Soysal Mİ, Sarıkaya S, Baklan H, Soysal İ. Süt Sığırcılığı Notları. Başak Ofset, Değişim Grafik, Topkapı-İstanbul, 2008(in Turkish).

6. Galiç A, Şekeroğlu H, Kumlu S. İzmir ili Siyah Alaca ırkı sığır yetiştiriciliğinde ilk buzağılama yaşı ve süt verimine etkisi. Akdeniz Üniversitesi Ziraat Fakültesi Dergisi 2005; 18 (1): 87-93 (in Turkish).

7. Alkoyak K, Öz S. The effect of nongenetic factors on calf birth weight and growth performance in Anatolian buffaloes. Turkish Journal of Veterinary and Animal Sciences 2022; 46: 609-616, https://doi:10.55730/1300-0128.4232.

8. Türkiye Damızlık Sığır Yetiştiricileri Merkez Birliği. Irklara göre soy kütüğü ve ön soy kütüğüne kayıtlı hayvan sayım istatistiği. Türkiye Damızlık Sığır Yetiştiricileri Merkez Birliği 2023, Ankara, Türkiye.

9. Çilek S, Tekin ME. Environmental factors affecting milk yield and fertility traits of Simmental cows raised at the Kazova State Farm and phenotypic correlations between these traits. Turkish Journal of Veterinary and Animal Sciences 2005; 29 (4): 987-993.

10. Özkan M, Güneş H. Effects of some factors on milk yield characteristics of Simmental cows on commercial farms in Kayseri. İstanbul Üniversitesi, Veteriner Fakültesi Dergisi 2011; 37 (2): 81-88.

11. Akıllı A, Atıl H, Takma Ç. A decision tree model to determine some environmental factors affecting 305-daymilk yield in Simmental cows. Journal of Agricultural Faculty of Gaziosmanpaşa University (JAFAG) 2022; 39 (3): 191-198, https://doi:10.55507/gopzfd.1175502

12. Petrovic DM, Bagdonovic V, Petrovic MM, Bogosavlievic-Boskovic S, Dokovic R et al. Effect of non-genetic factors on standard lactation milk performance traits in Simmental cows. Annals of Animal Sciences 2015; 15 (1): 211-220.

13. Bolacali M, Öztürk Y. Effect of non-genetic factors on milk yield traits in Simmental cows raised subtropical climate condition. Arguivo Brasileiro de Medicina Veterinarina e Zootecnia 2018; 70: 297-305, https://doi:10.1590/1678-4162-9325

14. Petrovic MD, Skalicki Z, Petrovic MM, Bogdonavic V. The effect of systematic factors on milk yield in Simmental cows over complete lactations. Biotechnology in Animal Husbandry 2009; 25 (1-2): 61-71.

15. Petrovic MD, Petrovic MM, Bogdanovic V, Dedovic R, Rakonjac S et al. Effect of fixed and continuous environmental factors on milk production in the first three standard lactations in Simmental cows. In: Proceeding of the 11th International Symposium Modern Trends in Livestock Production; Belgrade, Serbia; 2017, pp. 11-13.

16. Şahin O, Yılmaz İ. Analysis of breeding activities in cattle special in Türkiye. In: Yaşar M, Akkaya A (Editor). Stratejik Sektör: Tarım-2. Ankara, Türkiye.: Iksad; 2023, pp. 141-453.

17. Şahin O. Analysis of the effect of region province and breed on somatic cell count in dairy cattle in Turkey by regression three method. Emirates Journal of Food and Agriculture 2023; 35 (6): 588-597. https://doi:10.9755/ejfa. 2023.v35.i6.3100

18. Wei C, Luo HP, Wang YC, Huang XX, Zhang MH et al. Analyses of the genetic relationship between lactose, somatic cell score and growth traits in Simmental cattle. Animal 2021 Jan; 15 (1): 100027, https://doi: 10.1016/j.animal.2020.100027

19. JMP 5.0.1a. A Business Unit of SAS Copyright, 1989-2002 SAS Institute Inc. 2023

20. Mlynek K, Glowinska B, Salomonczyk E, Tkaczuk J, Stys W. The effect of daily milk production on the milk composition and energy management indicators in Holstein-Friesian and Simmental cows. Turkish Journal of Veterinary and Animal Sciences 2018; 42: 223-229, https://doi.org/10.3906/vet-1711-31

21. Pantelic V, Niksic D, Maksimovic N, Ostojic-Andric D, Lazarevic M et al. Phenotypic correlation of traits of production and reproduction of Simmental cows in different regions of Serbia. Biotechnology in Animal Husbandry 2019; 35 (3): 219-228, https://doi.org/10.2298/BAH1903219P

22. Falta D, Zapletalova L, Hanus O, Kucera J, Vecera M et al. The interaction between the milk production, milk components with a low frequency of analysis and factors affecting the milk composition in dual-purpose Simmental Cows. Czech Journal of Animal Science 2023; 68 (3): 99-110, https://doi.org/10.17221/197/2022-CJAS.

23. Şekerden Ö. Effects of calving season and lactation order on milk yield and milk components in Simmental cows. Turkish Journal of Veterinary Animal Sciences 1999; 23 (7): 79-86.

24. Gorgulu O. Path analysis on effective factors affecting 305-D milk yield in Simmental Cattle. International Journal of Agriculture & Biology 2011; 13 (3): 381-385.

25. Khastayeva AZ, Zhamurova VS, Mamayeva LA, Kozhabergenov AT, Karimov NZ et al. Qualitative indicators of milk of Simmental and Holstein cows in different season of lactation. Veterinary World 2021; 14 (4): 956.

26. Nistor E, Bambidis VA, Pentea M. Production traits of Romanian Simmental cows at first lactation. Slovak Journal of Animal Science 2014; 47 (3): 132-141.

27. Karamfilov S, Nikolov V. First lactation milk production of cows of the Simmental breed reared in Bulgaria. Bulgarian Journal of Agricultural Science 2019; 25 (2): 363-369.

28. Koc A, Ari C. Milk yield, reproduction and milk quality characteristics of Simmental and Red-Holstein cattle raised at a dairy farm in Aydin Province: 2. Milk quality. Turkish Journal of Agriculture-Food Science and Technology 2020; 8 (10): 2074-2080. https://doi.org/10.24925/turjaf.v8i19.2074-2080.3512

29. Ugur F, Yanar M, Ozhan M, Tuzemen N, Aydin R et al. Milk production characteristics of Simmental cattle reared in the research farm of Ataturk University. Turkish Journal of Veterinary and Animal Sciences 1995; 19 (5): 365-368.