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A Study on Milk Quality Characteristics of Simmental (Fleckvieh) Cows Reared Karacabey District of Bursa Province

ABSTRACT

Objective: The aim of this study was to determine the milk quality characteristics of Simmental (SIM) (Fleckvieh) cattle originating from Austria and Germany.

Materials and Methods: a total of 1928 milk samples taken during morning milking in different seasons between 2018 and 2022 from cattle raised in a disease-free private dairy farm in Karacabey District of Bursa Province were evaluated. Milk quality characteristics include fat (MFC), protein (MPC), lactose (MLC), total dry matter content (TDMC), milk urea nitrogen (MUN) amount and Log10SCC were determined.

Results: Parity effects on MLC (P<0.01) and TDMC (P<0.01), calving year effects on all traits (P<0.05) except MFC, lactation month effects on MPC (P<0.01), MLC (P<0.01), MUN (P<0.01) and Log10SCC (P<0.01), and calving season effects on MPC (P<0.01), MLC (P<0.01) and Log10SCC (P<0.01) were determined to be statistically significant. The averages of MFC, MPC, MLC, TDMC, MUN and Log10SCC were 3.83±0.02%, 3.42±0.01%, 4.83±0.01%, 12.78±0.03%, 16.49±0.09 mg/dl and 4.646±0.014 (44.274 cells/mL), respectively.

Conclusion: Although the MFC of SIM cattle originating from Austria and Germany was found to be slightly lower than those reported in the literature, the low SCC content indicates that the prevalence of mastitis in this genotype is quite low

Keywords: Dual purpose cattle, mik fat content, milk protein content, milk urea nitrogen, somatic cell count

Bursa Ili Karacabey Ilçesinde Yetistirilen Simmental (Fleckvieh) Irkı Sığırların Süt Kalite Özellikleri Üzerine Bir Arastırma

ÖZ

Amaç: Bu çalışmanın amacı Avusturya ve Almanya kökenli Simental (SIM) (Fleckvieh) sığırların süt kalite özelliklerinin belirlemesidir.

Materyal ve Method: Bursa İli Karacabey İlçesi'nde hastalıktan ari özel bir işletmede yetiştirilen sığırlarından 2018-2023 yılları arasında farklı mevsimlerde sabah sağımında alınan toplam 1928 süt örneği değerlendirilmiştir. Süt kalite özellikleri olarak yağ oranı (SYO), protein oranı (SPO), laktoz oranı (SLO), toplam kuru madde oranı (TKMO), süt üre azot miktarı (SÜA) ve Log10SHS özellikleri belirlenmiştir.

Bulgular: SLO (P<0.01) ve TKMO (P<0.01) üzerine parite etkisi, SYO dışındaki tüm özellikler üzerine buzağılama yılı etkisi (P<0.05), SPO (P<0.01), SLO (P<0.01), SÜA (P<0.01) ve Log10SHS (P<0.01) üzerine laktasyon ayı etkisi ve SPO (P<0.01), SLO (P<0.01) ve Log10SHS (P<0.01) üzerine de buzağılama mevsimi etkilerinin istatistiksel olarak önemli olduğu tespit edilmiştir. SYO, SPO, SLO, TKMO, SÜA ve Log10SHS özelliklerine ait ortalamalar sırasıyla %3.83±0.02%, 3.42±0.01%, 4.83±0.01%, 12.78±0.03%, 16.49±0.09 mg/dl ve 4.646±0.014 (44.274 hücre/ml) dir.

Sonuç: Avusturya ve Almanya kökenli SIM sığırların SYO'su literatürde bildirilenlerden biraz daha düşük bulunmasına rağmen, SHS içeriğinin düşük olması bu genotipte mastitis prevalansının oldukça düşük olduğunu göstermektedir

Anahtar Kelime: Kombine verimli sığır, süt yağı oranı, süt protein oranı, süt üre azotu, somatik hücre sayısı

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INTRODUCTION

Milk, which is the basic nutrient for the growth and development of mammals in the first period of their lives, also contains animal protein, fat, lactose, mineral substances, etc., which are the basic nutrients needed for adequate and balanced nutrition of humans. Milk yield and composition in cattle, which provide a large portion of the world's milk production, are affected primarily by genetics and also to many environmental factors (Koç, 2007a; Özkan, 2017).

Milk quality in cattle is generally examined in two main groups: the composition of milk (fat, protein, lactose, minerals, non-fat solids, total dry matter, casein, etc.) and hygienic properties such as total bacterial count, somatic cell number and antibiotic residue (Koç and Öner, 2023). The composition of milk varies according to many factors such as the ration composition given to the animal, the milk production level of the cow, the order and period of lactation and the hygiene quality of milk, the hygienic quality of milk is an indicator of the cow's udder health, milking hygiene and storage and transportation conditions in the process until the milk is processed into final products (Koç and Öner, 2023). The total bacterial count is significantly affected by udder health, milking hygiene, milking system and storage conditions of milk until processing, somatic cell count (SCC), which causes significant changes in milk yield and composition, is a milk quality criterion that provides important information about udder health and raw milk quality. In bovine milk, a level of 200,000 cells/ml is accepted as the threshold value, and if the SCC level is above this value, it is accepted that the udder of the cow from which that milk is milked has mastitis (Dohoo and Leslie, 1991).

In studies conducted on the milk components of Simmental (SIM) breed, which is a dual purpose breed, the milk fat content (MFC, %) of the breed is between 3.32% and 4.32%, the milk protein content (MPC, %) is between 3.02% and 3.9%, the milk lactose content (MLC, %) is between 4.19% and 4.96%, total dry matter ratio (TDMC, %) is between 11.23% and 12.6%, SCC is between 15.848 and 128.825 cells/mL, milk urea nitrogen (MUN) is between 12.28 mg/dL and 25.75 mg/dL (Akbulut, 1998; Bendelja et al., 2011; Budimir et al., 2011; Litwińczuk et al., 2011; Pantelić et al., 2013; Önal et al., 2014; Cioch et al., 2015; Cziszter et al., 2016; Nistor et al., 2017; Wei et al., 2021 ; Erdem and Okuyucu, 2023; Franzoi et al., 2023; Koç and Öner, 2023; Buonaiuto et al., 2024;). There are also many studies conducted to determine milk quality characteristics and SCC level in different cattle breeds (Koç, 2006; 2007b; 2011; 2015; Özdede, 2009; Yılmaz, 2010; Kaya et al., 2014; Okuyucu and Erdem, 2017; Koç and Erdem, 2017; Koç and Arı, 2020; Koç and Gürses, 2020).

Although there are many studies on milk yield, fertility, fattening performance and carcass characteristics of Swiss origin SIM cattle, which have been bred in Turkey for many years, it has been emphasized that the number of studies on the milk quality and SCC of the breed is limited (Koç, 2016). On the other hand, it has been noted that the number of studies on the performance of SIM breed (Fleckvieh) of Austrian and German origin, with increased milk yield, which has attracted great attention from breeders in Turkey in recent years, is almost non-existent in our country's conditions. Starting from this point, this study aimed to determine the milk quality characteristics of Austrian and German origin SIM cattle (Fleckvieh).

MATERIAL and METHODS

This study was carried out on SIM breed cattle of Austrian and German origin, raised in a disease-free private farm in Karacabey district of Bursa province, Türkiye. The farm is established on an area of 29700 m2 and the cattle are housed in a barn with a free stall. The shelter has an automatic waterer, automatic hydraulic and chain manure scrapers, a feed through with a lock system, a feed road, cooling fans and shower system, and rubber bedding. Cattle raised in the farm are grouped according to their productivity levels, and Total Mix Ration (TMR) is given three times a day after milking, in the amount and form appropriate to their needs. Lactating cattle are housed in 6 separate paddocks according to their productivity levels, and animals grouped according to milk production levels and lactation periods are milked three times a day. While the roughage used to feed the cattle in the farm is provided from the agricultural lands belonging to the farm and the rented agricultural fields, concentrated feeds and feed additives (premix) are supplied from various feed dealers.

The milk components and SCC level of the breed were determined from a total of 1928 milk samples taken during morning milking in different seasons in the enterprise between 2017 and 2023. Approximately 50 mL of milk samples were taken into sample containers to represent milking, and the samples were kept in the cold chain until analyzed. Milk samples were analyzed using Bentley–Merkim (2021) brand SomaCount FC and

DairySpec FT devices in the milk analysis laboratory operating within the Bursa Provincial Cattle Breeders Association, Türkiye. In the raw milk analysis, the levels of MFC, MPC, MLC, TDMC, MUN and SCC in milk were determined.

Statistical analysis

Statistical analysis of the data was done by using SAS 9.4 package program and the differences between the groups were determined according to the Tukey (P<0.05) multiple comparison test results. The cows subject to this study were grouped into 5 groups according to the lactation number, and the cows in the 5th and above lactation numbers were included in the 5+ lactation number. The 5-year group between 2018 and 2022 was taken into account as the calving year, and due to the low number of data in 2017 and 2023, the data for these years were included in the closest year groups. The first 11 lactation months were taken into consideration as lactation months, and lactation months longer than 11 were included in the 11th lactation month group. Four seasonal groups have been accepted as calving seasons, March-May as the 1st season (spring), June-August as the 2nd season (summer), September-November as the 3rd season (autumn) and December-February as the 4th season (winter). The statistical model used in the analysis of the data is as follows:

$$Yijklm = \mu + ai + bj + ck + dl + eijklm$$

Yijklm is the observatipon of MFC, MPC, MLC, TDMC, MUN and Log10SCC,

μ is oveall mean,

ai is calving year effects (i=2018, 2019,. ….. 2022),

bj is calving season effects (j=1 (spring), 2 (summer), 3 (autumn) and 4 (winter)),

ck is lactation number effects (k= 1, 2, 3, 4 and 5+),

dl is lactation month effects (l=1, 2, …… 11+)

eijklm is residual random error.

RESULTS and DISCUSSION

The averages and standard errors of MFC, MPC, MLC, TDMC, MUN, Log10SCC traits of SIM (Fleckvieh) cattle of Austrian and German origin are given in Table 1.

The average MFC was calculated as 3.83±0.02%, and the effects of lactation number, calving year, lactation month and calving season on this trait were all insignificant (P>0.05). The MFC average obtained in this study for SIM cattle is similar to Kučević et al. (2005) and Nistor et al. (2014) who reported on the same breed as 3.81±0.09% and 3.82±0.378%, respectively. However, Okuyucu and Erdem (2017), Erdem and Okuyucu (2019), Önal et al. (2021) and Kaygısız and Şahin (2023) reported lower means for SIM breed (3.49%, 3.38%, 3.72±0.03%, and 3.68±0.031% respectively) than the mean obtained in this study. On the other hand, in the literature higher means (between 3.84% and 4.32%) reported for MFC of SIM breed (Akbulut, 1998, Petrović et al., 2006; Pantelić et al., 2008; Bendelja et al., 2011; Nikšić et al., 2011; Pantelić et al., 2013; Pantelić et al., 2014; Cziszter et al., 2016 and Litwińczuk, 2016; Franzoi et al., 2020; Wei et al., 2021; Falta et al., 2023; Koç and Öner, 2023; Vrhel et al., 2024; Buonaiuto et al., 2024;. The means of Budimir et al. (2011) for the first 3 lactation numbers for SIM breed were higher than the mean detected in this study. Budimir et al. (2011)'s means were 3.83±0.03%, 3.84±0.01% and 3.86±0.02%, respectively, and Cioch et al. (2015)'s means were 3.99±0.40%, 4.04±0.49% and 3.85±0.44%, respectively.

It is well known that there is an inverse relationship between milk yield and MFC in cattle, and the MFC decreases due to the increase in milk yield. In this study, it can be said that in this farm, where the SIM breed with increased milk yield was raised, a decrease was observed in the MFC due to the roughage/concentrate ratio in the ration being kept in favor of concentrated feed and the forage particle length being kept a little short in order to meet the nutrients needed for increased milk yield. The fact that the MFC obtained in this study was generally slightly lower than previous studies is due to the differences in management and feeding conditions applied in the farm where this study was conducted, as well as the fact that, except for some studies in recent years, the SIM genotype used in previous studies was reported to be of Swiss origin SIM cattle, which have lower milk yield.

Table 1. Means and standard errors of milk quality characteristics of Simmental (Fleckvieh) cattle
Tablo 1. Simmental (Fleckvieh) sığırlarının süt kalite özelliklerinin ortalamaları ve standart hataları

	MFC (%)		MPC (%)		MLC (%)		TDMC (%)		MUN (mg/dl)		$Log_{10}SCC$	
Factor	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$	n	$\bar{X} \pm S_{\bar{X}}$
Parity		NS		NS		**		**		NS		NS
1	415	3.85±0.06	418	3.43±0.02	237	4.91±0.02^{a}	236	12.92±0.08^{a}	217	16.64±0.33	400	4.565±0.035
2	493	3.92±0.05	506	3.44±0.02	503	4.85±0.02^{ab}	500	12.79±0.06^{ab}	277	16.59±0.29	492	4.611±0.031
3	375	3.76±0.06	380	3.37±0.02	377	4.81±0.02^{bc}	378	12.73±0.07^{ab}	371	16.62±0.27	357	4.648±0.038
4	312	3.81±0.07	321	3.42±0.02	314	4.81±0.02^{bc}	315	12.69±0.08^{ab}	319	16.04±0.30	300	4.693±0.039
5+	301	3.79±0.07	303	3.39±0.03	301	4.77±0.02^{c}	301	12.67±0.08^{b}	303	16.57±0.32	278	4.703±0.043
Calving year		NS		**		**		*		**		**
2018	234	3.94±0.08	234	3.37±0.03^{ab}	53	4.80±0.05^{ab}	54	13.03±0.17^{a}	--	----	230	4.486±0.050^{a}
2019	227	3.86±0.08	227	3.40±0.03^{a}	224	4.85±0.02^{a}	224	12.98±0.09^{a}	22	17.66±0.83^{a}	219	4.486±0.048^{a}
2020	283	3.85±0.07	287	3.30±0.02^{b}	284	4.84±0.02^{ab}	284	12.86±0.07^{a}	284	16.91±0.25^{a}	276	4.667±0.041^{b}
2021	549	3.75±0.05	571	3.44±0.02^{a}	565	4.89±0.01^{a}	565	12.42±0.05^{b}	571	16.53±0.17^{a}	539	4.711±0.028^{b}
2022	603	3.73±0.05	610	3.52±0.02^{c}	606	4.77±0.01^{b}	603	12.50±0.05^{b}	610	14.87±0.17^{b}	563	4.869±0.028^{c}
Lac. Month		NS		**		**		NS		**		**
1	153	3.91±0.09	159	3.42±0.03^{ad}	147	4.88±0.03^{ab}	146	12.84±0.10	115	15.43±0.41^{ac}	150	4.628±0.051^{ab}
2	210	3.79±0.07	215	3.23±0.03^{b}	187	4.88±0.03^{ab}	185	12.62±0.09	161	16.92±0.36^{b}	207	4.573±0.043^{ab}
3	182	3.73±0.08	186	3.28±0.03^{bc}	169	4.90±0.03^{a}	167	12.60±0.9	162	16.29±0.36^{abc}	175	4.702±0.047^{ab}
4	167	3.79±0.08	170	3.35±0.03^{ac}	164	4.84±0.03^{ab}	162	12.75±0.09	144	17.07±0.38^{b}	166	4.690±0.048^{ab}
5	148	3.85±0.09	150	3.44±0.03^{ad}	149	4.84±0.03^{ab}	149	12.83±0.10	137	17.44±0.39^{b}	141	4.512±0.052^{a}
6	148	3.81±0.09	153	3.41±0.03^{acd}	152	4.78±0.03^{b}	151	12.73±0.09	144	16.75±0.37^{ab}	143	4.546±0.052^{ab}
7	142	3.75±0.09	143	3.42±0.03^{ad}	134	4.83±0.03^{ab}	135	12.72±0.10	132	16.94±0.39^{b}	135	4.529±0.053^{a}
8	161	3.86±0.08	163	3.50±0.03^{d}	128	4.78±0.03^{b}	128	12.88±0.10	111	16.34±0.41^{abc}	157	4.689±0.049^{ab}
9	165	3.94±0.08	166	3.49±0.03^{d}	128	4.78±0.03^{b}	130	12.94±0.10	109	16.47±0.41^{abc}	156	4.726±0.050^{ab}
10	163	3.82±0.08	166	3.50±0.03^{d}	129	4.81±0.03^{ab}	130	12.71±0.10	91	16.48±0.44^{abc}	154	4.735±0.051^{ab}
11+	257	3.83±0.07	257	3.46±0.02^{ad}	245	4.81±0.02^{ab}	247	12.74±0.07	181	15.27±0.30^{c}	243	4.750±0.041^{b}
Calving Season		NS		**		**		NS		NS		**
1 (spring)	274	3.81±0.06	277	3.32±0.02^{a}	250	4.84±0.02^{ab}	251	12.63±0.08	219	16.48±0.33	251	4.617±0.040^{ab}
2 (summer)	484	3.80±0.05	494	3.40±0.02^{b}	441	4.85±0.02^{a}	442	12.77±0.06	405	16.23±0.28	470	4.696±0.030^{a}
3 (autumn)	571	3.85±0.05	585	3.49±0.02^{c}	562	4.78±0.02^{b}	559	12.85±0.06	479	16.47±0.26	562	4.697±0.027^{a}
4 (winter)	567	3.85±0.05	572	3.42±0.02^{b}	479	4.84±0.02^{a}	478	12.78±0.06	384	16.79±0.28	544	4.564±0.030^{b}
Overall	**1896**	**3.83±0.02**	**1921**	**3.42±0.01**	**1732**	**4.83±0.01**	**1730**	**12.78±0.03**	**1487**	**15.92±0.09**	**1827**	**4.646±0.014 (44.274 cell/mL)**

In this study, the average MPC of SIM cows was determined as 3.42±0.01%. While the MPC showed a significant changes according to calving year (P<0.01), lactation month (P<0.01) and calving seasons (P<0.01), the effect of lactation number on it was insignificant (P>0.05). According to calving years, the highest MFC average was calculated for 2022 (3.52±0.02), while this year was found to be different from all other years (P<0.05), 2021 is also different from 2020 (P<0.05), other differences between the years are insignificant (P>0.05).

The average MPC, which was 3.42±0.03% in the first month of lactation, decreased to 3.23±0.03%, which was the lowest level in the second month of lactation, when the peak lactation milk yield was observed in cattle, as expected, and increased in the following months and reached around 3.5% at the end of lactation (Table 1). MPC, which showed significant changes according to the calving season, reached its lowest value of 3.32±0.02% in the spring season when milk yield was high, and the average MPC, which increased in summer and autumn, decreased again in winter and reached 3.42±0.02%. While summer and winter months are similar (P>0.05), these two seasons are also different from the other two seasons (spring and autumn), which are different from each other (P<0.05). In addition to feed additives adding to the ration against heat stress the cooling fan and shower system in the barn where the cows were raised protects the cows more or less from heat stress in hot summer months especially those who calved in this months and the cows at the beginning of lactation.

The MPC average obtained in this study for SIM cattle (3.42±0.01%) could be compared with Koç and Öner (2023), Koç and Arı (2020), Önal et al. (2021) and Cioch et al. (2015). The means of MPC reported in those studies were 3.45±0.01%, 3.43±0.01%, 3.40±0.015% and 3.44±0.19%, respectively. In the literature for the same breed, Bendelja et al. (2011), Nistor et al. (2014), Cziszter et al. (2016), Litwińczuk (2016), Okuyucu and Erdem (2017), Erdem and Okuyucu (2019) and Wei et al. (2021) reorted lowewr values (3.36±0.016%, 3.12±0.358%, 3.25±0.02%, 3.10±0.30%, 3.02%, 3.07%, and 3.33±0.43% respectively), but Franzoi et al. (2020), Falta et al. (2023), Kaygısız and Şahin (2023), Wrhel et al. (2024) and Buonaiuto et al. (2024) reported higher values (3.52±0.005%, 3.60±0.350%, 3.52±0.18%, 3.54±0.20% and 3.53±0.22% respectively). Cioch et al. (2015) also reported higher MPC values for the SIM cattle at first three lactations as between 3.49±0.19% and 3.55±0.012%.

The average MLC, another component found in milk, was determined as 4.83±0.01% for SIM cattle in this study. The effect of all factors on MLC is significant at the P<0.01 level. The MLC level, which was obtained as 4.91±0.02% in animals in the first lactation, decreased according to the lactation number and became 4.77±0.02% in animals in 5+ lactations. While the difference between these two lactation numbers was statistically significant (P<0.05), the first lactation number was similar to the second lactation number (P>0.05) but different from other lactation numbers (P<0.05). Additionally, 5+ lactation number is also different from the second lactation number (P<0.05) and other differences between lactation numbers were insignificant (P>0.05). The lowest MLC average according to calving years was calculated as 4.77±0.01% for 2022 and it was determined that this year was different (P<0.05) from 2019 (4.85±0.02%) and 2021 that has the highest MLC average as 4.89±0.01%. Other differences between the years were insignificant (P>0.05). The MLC average showed significant differences according to the lactation months and the highest MLC mean was obtained in the 3rd lactation month (3.90±0.03%). While this month was different from the 6th, 8th and 9th lactation months (P<0.05), it is similar to the other lactation months (P>0.05). The MLC average, which varies significantly according to calving seasons, was highest in cows calving in summer (4.85±0.02%) and lowest in autumn calving cows (4.78±0.02%). These two seasons were also different from each other (P<0.05). Unlike MFC and MPC, the MLC level had the lowest average in cows calving in autumn and the highest average in cows calving in summer.

While the average MLC (4.86±0.01%) obtained for SIM cattle in this study is similar to the 4.81±0.019% value reported by Koç and Arı (2020), who studied the same breed, Litwińczuk (2016), Falta et al. (2023) and Vrhel et al. (2024) reported higher MLC for the same breed (4.94±0.32%, 4.94±0.233% and 4.96±0.15% respectively). On the other hand, Bendelja et al. (2011), Okuyucu and Erdem (2017), Erdem and Okuyucu (2019), Franzoi et al. (2020), Koç and Öner (2023), Wei et al. (2021), Önal et al. (2021) and Kaygısız and Şahin (2023) reported values (4.55±0.01%, 4.19%, 4.27%, 4.77±0.003%, 4.24±0.02%, 4.75±0.36%, 4.74±0.01% and 4.73±0.011%, respectively) lower than the mean obtained in this study for MLC.

In this study, the TDMC average of SIM cattle was calculated as 12.78±0.03%. While the effects of lactation number (P<0.01) and calving year (P<0.05) were found to be significant on this trait, the effects of lactation month and calving season were insignificant (P>0.05). According to the lactation number, the highest TDMC average was obtained in cows in the first lactation, as the lactation number increased, the TDMC average decreased, and the lowest average was calculated as 4.77±0.02% for cows in 5+ lactations. The difference between the TDMC averages of cows in the first and 5+ lactations was also found to be statistically significant (P<0.05), while other differences between lactations were insignificant (P>0.05). It is expected that TDMC will decrease as the lactation number increases, because there is a negative correlation between milk yield and TDMC, and it is thought that as the lactation number increases in dairy cattle, the milk TDMC level decreases due to the increase in milk yield.

According to calving years, the highest TDMC average was calculated as 13.03±0.17% in 2018, and the lowest TDMC level, which decreased in the following years, was calculated as 12.41±0.05% in 2021. While the years 2018-2020 are similar to each other in terms of TDMC (P>0.05), these years are different from the years 2021 and 2022, which are also similar to each other (P<0.05). It is thought that the significant difference in TDMC level according to lactation number and calving years is due to the high number of animals in the first and second lactation periods, whose milk yield was lower in the first years of the farm that started operating recently compared to other lactation numbers, thus the TDMC level is found to be higher in the first years than in the following years.

While the TDMC average ((12.78±0.03%) calculated for SIM cattle in this study is close to the value (12.72±0.035%) reported by Kaygısız & Şahin (2023) , however, in some studies (Litwińczuk et al., 2016; Okuyucu and Erdem, 2017; Erdem and Okuyucu, 2019; Koç and Arı, 2020; Wei vd., 2021; Falta vd., 2023; Koç and Öner, 2023) lower values ranging from 11.23% to 12.60% were reported for the same breed.

Another trait emphasized in this study is MUN level in milk is a parameter used to evaluate the protein and energy status of dairy cattle, as it is a trait closely related to the protein level taken in feed. It is considered normal for the MUN level to be between 10-16 mg/dl, and a MUN level higher than 16 mg/dl means the ration protein level is high. Breeders are trying to increase ration protein levels to increase the milk yield of animals. However, high amounts of dietary protein levels are broken down into amino acids in the rumen, and urea is produced from ammonia derived as a result of the normal daily amino acid metabolism of the liver and the breakdown of body proteins in the rumen. If rumen bacteria cannot convert ammonia into microbial protein, this excess ammonia is absorbed by the rumen wall and mixes with the blood. Since high blood ammonia levels are toxic, the liver converts this ammonia into urea and this urea is excreted through urine or milk. On the other hand, if the rumen ammonia level is not low, rumen microorganisms may reduce microbial protein production, causing milk yield and milk protein level to remain low. The increased amount of urea in milk is an indication that the blood ammonia level is high, and there is a decrease in the reproductive fertility of animals with high MUN levels (Anonymous, 2024).

In this study, the mean MUN for SIM cattle was calculated as 16.49±0.09 mg/dL, while the effects of calving year and lactation month were found to be significant (P<0.05) on this trait, the effects of lactation number and calving season were significant (P>0.05). It is seen that the average MUN according to calving years decreased as the years progressed and was realized within appropriate limits in 2022 (Table 1). In the first years after the establishment of the enterprise (here 2018), the MUN level in milk was not examined, but in the following years, it is seen that the enterprise attaches importance to determining the milk MUN level due to its relationship with nutrition. The MUN level was determined to be above the upper limit of MUN as 17.66±0.83 mg/mL in 2019, and it was determined that the MUN level gradually decreased in the following years. While the years 2019-2021 are similar to each other (P>0.05), these years are different from 2022 (P<0.05). According to the lactation months, the MUN average in the 3rd and 4th months of lactation, when feed consumption in cattle increases, was above 17 mg/dL, and the MUN average was above 16 mg/dL in all months except the first lactation month and the last lactation month.

In this study, it can be said that the average MUN determined in the milk of SIM cattle (16.49±0.09 mg/dL) is almost appropriate in terms of ration energy and protein balance. However, as can be seen from Table 1, it should be emphasized that the MUN average was within appropriate limits only in 2022, and was above the upper limit in other years. It is understood that the enterprise has been trying to keep the energy and protein balance in the animals' rations at appropriate levels, especially in recent years, both from the importance it attaches to determining the milk MUN level and from the fact that the MUN level is within appropriate limit in 2022.

The overall mean MUN obtained in this study (16.49±0.09 mg/dL) can be compared with the values reported by Bendelja et al (2011), Franzoi et al (2020), Koç and Arı (2020), Falta et al (2023) and Kaygısız and Şahin (2023) as 24.56±0.34 mg/dL, 20.44±0.11 mg/dL, 12.28±0.138 mg/dL, 25.75±7.419 mg/dL and 17.81±0.353 mg/dL, respectively for the SIM breed than those obtained in this study, while Koç and Arı (2020) reported a lower value (12.28±0.138 mg/dL) than the average obtained in this study for the same genotype.

In this study, the average Log10 SCC of SIM cattle was determined as 4.646±0.014 or 44.274 cells/mL. The effects of calving year, lactation month and calving season on this trait were significant (P>0.01), while the effect of parity was insignificant (P>0.01). It is expected that the SCC level in cattle will increase depending on the increase in the lactation order. This trend was also realized in this study, the average Log10SCC of cows in the first parity increased from 4.565±0.035 (36.728 cells/mL) to 4.703±0.043 (50.466 cells/mL) in animals in the 5+ parity, but, the difference of 13.738 cells/mL between these two parities was not found to be statistically significant (P>0.05).

The Log10SCC level showed significant changes according to the calving years, the lowest Log10SCC average was determined as 30.120 cells/mL in both 2018 and 2019, and the Log10SCC level, which increased regularly in the following years, reached its highest value of 4.703±0.043 (73.961 cells/mL) in 2022. The 2022 calving year was found to be different from all other years (P<0.05), and the years 2020 and 2021, which are similar to each other (P>0.05), are also different from other years (P<0.05). It is thought that the increase in SCC level over the years is due to the fact that the cows raised in the first years of the farm, have lower SCC levels due to their low parity. Because cows in their first lactation have lower milk yields, they are less likely to suffer from mastitis than animals in later lactations.

SCC level, which showed significant changes according to lactation months, decreased in the second month, then increased in the 3rd and 4th months and increased in the 5th-7th months. The SCC level, increased towards the end of lactation, as expected, and reached the highest level of 56.234 cells/mL in the 11+ lactation month. It is thought that the increase in SCC level towards the end of lactation is not due to the increased possibility of cows suffering from mastitis, but to the increase in the number of cells per unit volume due to the decrease in milk yield in the last months of lactation. In this study, while the 11+ lactation months were different from the 5th and 7th lactation months (P<0.05), other differences between the months were insignificant (P>0.05).

In this study, it was determined that the SCC level of SIM cattle showed significant changes according to the calving season (P<0.05). The lowest Log10SCC level was calculated in cows calving in winter (4.646±0.014 or 44.274 cells/mL). While this season is similar to spring (P>0.05), it is different from summer and autumn (P<0.05). The SCC levels of cows calving in summer and autumn were calculated to be 13.015 and 13.130 cells/mL higher than those of cows calving in winter, respectively (P<0.05). Although there are cooling systems in the farm, the higher SCC level found in the summer and autumn than in winter calving cows could be due to low body resistance because the cows calved in these season had high milk yield but, in negative energy balance and lose live weight, as a result of that SCC in milk was increased in these seasons.

In this study, the SCC level obtained for SIM cattle (4.699±0.014 or 50.004 cells/mL) was compared with other studies is lower than the values of Cziszter et al. (2016), Okuyucu and Erdem (2017), Koç and Arı (2020), Önal et al. (2021), Falta et al. (2023), Koç and Öner (2023) and Kaygısız and Şahin (2023) and who reported 233.800 cells/mL, 181.339 cells/mL, 251 768 cells/mL, 192.000±15.32 cells/mL, 109.647.82 cells/mL, 128.825 cells/mL and 178.220±14.532 cells/mL, respectively, while the mean SCC found in this study is higher than the values of 4.23±1.98 (16.982 cells/mL) reported by Wei et al. (2021).

CONCLUSIONS

In this study, important information was obtained about the milk quality characteristics of SIM cattle of Austrian and German origin, to which producers have shown great interest in recent years, but not much research has been done on their performance in our country's conditions. Since the type traits, fertility and milk yield of this genotype were evaluated as separate studies, only milk quality characteristics were evaluated in this study. According to the findings, while the MPC, MLC, TDMC traits of SIM cattle are generally similar to the reports in the literature, the fact that the MFC average is lower than most of the values reported in previous studies is thought to be due to the difference in the SIM genotype grown in the farm where this study was conducted, as well as differences in management and feeding conditions.

The fact that the MUN average, which is an indicator of the ration protein/energy balance given to animals, decreased over the years and was within appropriate limits in 2022, the last year, shows that this is the result of the attention paid to the ration content given to animals in the farm.

The fact that the SCC average was determined at a very low level of 44.274 cells/mL in this farm and this low level maintained in different years can be considered as an indication that the necessary importance is given to the udder health of the cows raised in this disease-free farm and that milking hygiene rules are taken into consideration. Considering the SCC levels obtained in this study and those reported for SIM breed cattle in the literature, it can be seen that the SCC level of the breed is much lower than the Holstein-Friesian breed, which is widely used in milk production around the world and in our country, thus the prevalence of mastitis in this breed is higher than the Holstein-Friesian breed. It is thought that a study on the comparison of reproductive fertility, milk yield and milk quality characteristics in a farm that raises the Holstein-Friesian breed together with the SIM genpotype of Austrian and German origin, with increased milk yield, will provide important information on this subject. Another point that needs to be emphasized here is how correct it is to consider all of the SIM genotypes, which have many different genotypes and productivity characteristics, such as Black Simmental, which has been developed for meat production purposes in the USA, and SIM (fleckvieh) genotypes of German and Austrian origin, which have been developed for dairy purposes, within the scope of a single breed.

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