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A Research on Fertility, Herd Life, Milk Production and Milk Quality Characteristics of Simmental (Fleckvieh) Cows: 2. Milk Quality

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ABSTRACT

The aim of this study was to determine the milk quality characteristics of Simmental (SIM) cows of Austrian origin, which have increased the interest of breeders in Türkiye in recent years. For this aim, the milk analysis results of a farm located in Menemen County, İzmir/Türkiye from 2012 to 2021 were used. Milk fat (MF, %), protein (MP, %), lactose (ML, %), total dry matter (TDM, %) contents and somatic cell count (SCC, cell/ml) were determined. In order to determine the current situation, milk samples were taken from the cows (90 heads) in August 2021, and in addition to the above milk components, the solid non-fat (SNF) and freezing point (FP) were determined. The effects of sampling season, calving month, lactation month, sampling season x calving month and sampling season x lactation month interactions were found to be statistically significant for all traits ($P<0.05$). Parity and calving month effects on $Log_{10}SCC$ were also detected to be statistically significant ($P<0.05$). The mean MF, MP, ML, TDM, FP and SCC of SIM cattle were 3.71±0.018%, 3.42±0.009%, 4.63±0.009%, 12.49±0.03, -0.535±0.003°C and 5.14±0.01 (138.038 cells/ml), respectively. It was concluded that the milk components of Austrian-origin SIM cattle are not very different from the Holstein-Friesian (HF) breed, however, in the low SCC average for many years, besides the important contribution of the measures taken against mastitis in the farm, the resistance against mastitis may be higher in this genotype. This situation is thought to be the reason why breeders in Türkiye prefer Austrian-origin SIM cattle in addition to high milk yield and carcass weight.

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Introduction

Milk quality is examined in two groups as nutritive properties, namely milk components and hygienic properties. While the fat (MF), protein (MP), lactose (ML), mineral, solid-non-fat (SNF), total dry matter (TDM), casein (MC) contents and etc. in milk are taken into account in the nutritional properties of milk, when the hygienic quality of milk is mentioned, total bacterial count, somatic cell count (SCC) and antibiotic residue are understood.

In the studies on the milk components of Simmental (SIM) cattle (Akbulut, 1998; Şekerden et al., 1999; Polanski et al., 1992; Koç and Arı, 2020), MF (3.90-4.1%), MP (3.38-3.90%), ML (4.86%), SNF (8.6-9.09%), TDM (11.18-12.6%), MC (2.5-2.7%), freezing point (FP, -0.577°C), milk urea nitrogen (MUN, 12.07 mg/dL), oleic acid (OA, 0.258 g/100 g) and beta hydroxy butyric acid (BHBA, 0.284 mmol/L) levels were determined. In addition, there were also studies on milk compounds in Holstein-Friesian (HF) and Brown-Swiss (Koç, 2007a), HF (Koç, 2008; Kaya et al., 2014), HF and Montbeliarde (MB) breeds (Koç, 2009; 2011), Red-Holstein (RH) breed (Yılmaz, 2010; Koç, 2015; Koç and Arı, 2020), RH and HF breeds (Koç and Gürses, 2020), HF, SIM and crossbred cattle (Okuyucu and Erdem, 2017) and milk transported to the dairy facilities (Yörükoğlu, 2019).

Hygienic quality characteristics of milk are related to the health of the udder of the cow from which the milk is produced, milking hygiene and storage and transportation conditions of the milk in the process until it is processed into the final products. Mastitis, which is an udder disease and is known as the costliest disease causing significant economic losses in dairy cattle worldwide, is an inflammation of the mammary tissue, which usually occurs due to bacteria, fungi and virus-based factors, causing damage to the udder tissue as well as causing changes in the composition of milk.

Somatic cell count (SCC), as a raw milk quality criterion, provides information about the state of udder health. The SCC level in milk is accepted as a threshold value of 200,000 cells/ml and if the SCC is above this number, the udder of the cow from which that milk is produced is considered to have mastitis (Dohoo and Leslie, 1991). The increase in SCC in raw milk causes changes in the composition of the milk as well as the deterioration of the udder health and also leads to significant decreases in cow milk yield.

Somatic cells (macrophages, neutrophil cells, lymphocytes and epithelial cells) are the body's main defense mechanisms against diseases and intramammary infections. The main factor affecting SCC in milk is infection of the udder and it is under influence of many factors such as cow genotype, udder morphology, parity, lactation period, teat end hyperkeratosis, cow age, stress condition, season, milking hygiene and equipment and etc.

There are studies to determine the level of SCC in different cattle breeds (Özdede, 2009; Koç, 2006; 2007b; 2011; 2015; Yılmaz, 2010; Kaya et al., 2014; Okuyucu and Erdem, 2017; Koç and Arı, 2020; Koç and Gürses , 2020) and a study to determine the level of SCC in milk transported to dairy facilities (Yörükoğlu, 2019).

In the study of Koç (2016), in which he compiled studies on SIM cattle, while there were many studies on milk yield, fertility, fattening performance and carcass characteristics of Swiss origin SIM cattle raised in Türkiye, it was emphasized the number of studies on milk components and somatic cell count (SCC) of the breed is quite limited. On the other hand, the number of studies conducted on the performance of high yielding Austrian and German origin SIM cattle (Fleckvieh), which breeders have shown great interest in Türkiye in recent years, is almost non-existent.

In this study, it was aimed to determine the milk components and SCC level of Austrian origin SIM cattle (Fleckvieh) raised in a private farm in Menemen District of İzmir province, Türkiye, as well as to investigate the effects of some environmental factors on these traits.

Material and Methods

The study was carried out in a SIM herd brought from Austria in 2008 in Menemen District of İzmir Province, Türkiye. As raw milk components like MF (%), MP (%), ML (%), TDM (%) and SCC (cell/ml), the data of the farm were used. For this purpose, the farm had the milk samples analyzed three times a year from lactating cows between 2012 and 2020. In addition to the milk analyzes that the farm had done in previous years, milk samples were taken from lactating cows during morning milking on August 10, 2021, and analyzed to observe the current situation of the farm when the research was conducted. Since this study is a master's degree study, it is also aimed for the thesis author to gain experience in taking and analyzing milk samples.

Thus, in addition to the above milk traits, SNF (%) and FP (^{o}C) in the milk were determined by analyzing these milk samples taken from 90 heads cows. Approximately 50 ml of milk samples were taken from each cow in sterile containers to represent milking, and the samples were analyzed with a Bentley brand Milk Analyzer in the Laboratory of the Department of Animal Science, Faculty of Agriculture, Ege University, İzmir/Türkiye, on the same day. The necessary distinction was made by placing the letter "c" next to the abbreviation of the traits obtained as a result of the analysis of the milk sample taken in August, in order to express that it is different from the traits obtained from the analyzes made by the farm.

Statistical Analysis

Statistical analysis of the data was made in the SAS (2004) package program. SCC data were analyzed using Log_{10} transformation before statistical analysis.

The lactation periods of the SIM cows whose milk samples were taken to determine the current situation were divided into 4 groups, those on the 5-90th day of lactation were Period-I, those on the 91-240th day were Period-II, those at 241-310 days were Period-III and their lactation day more than 310 days were accepted as Period-IV. In addition, animals with 4 or more parities were included in the 4+ parity.

The following statistical model was used in the analysis of MF, MP, ML, TDM and Log_{10}SCC traits determined from milk analyzes performed by the farm three times a year between 2012 and 2020:

$$y_{ijklmn} = \mu+a_i+b_j+c_k+d_l+f_m+(ad)_{il}+(af)_{im}+e_{ijklmn} \qquad (5)$$

Here y_{ijklmn}; observation value of the traits, μ; the mean of the traits, a_i; sampling season effect (j=winter, spring, summer, autumn), b_j; parity effect (j=1, 2, 3, 4, 5+), c_k; calving year effect (k=2012, 2013, …., 2020), d_l: calving month effect (l=1, 2, …., 12), f_m: lactation month effect (m=1, 2, ….., 15), $(ad)_{il}$: sampling season x calving month interaction effect, $(af)_{im}$: sampling season x lactation month interaction effect and e_{ijklmn}; error term.

The following statistical model was used for traits (MFc, MPc, MLc, TDMc, SNFc, FPc and Log_{10}SCCc) to determine the current situation:

$$y_{ijk} = \mu + a_i + b_j + e_{ijk} \qquad (6)$$

Here y_{ijk}; observation value of the trait, μ; the mean of the trait, a_i; parity effect (j=1, 2, 3, 4+), b_j; lactation period effect (j=1, 2, 3, 4+) and e_{ijk}; error term.

Results

The milk components and Log_{10}SCC averages and standard errors of SIM cows belonging to the milk analysis results performed by the farm three times a year between 2012 and 2020 are given in Table 1. The overall averages of MF, MP, ML, TDM, and Log_{10}SCC were found to be 3.71±0.018%, 3.42±0.009%, 4.63±0.009%, 12.49±0.03%, and 5.14±0.009 (138.038 cells/ml), respectively. The effects of sampling season, calving year, lactation month, sampling season x calving month and sampling season x lactation month interactions on MF, MP, ML, TDM, and Log_{10}SCC were found to be significant ($P<0.05$), in addition to a significant effect of parity on Log_{10}SCC, and calving month effect on ML and Log_{10}SCC ($P<0.01$).

Milk components

In terms of MF, the mean (3.79±0.08%) of the first sampling season (January-February-March) was similar to the mean (3.94±0.04%) of the fourth season (October, November, December) ($P>0.05$), and these two seasons were determined to be different from the means of the second (3.37±0.06%) and third (3.33±0.05%) seasons ($P<0.05$).

Table 1. LSMEANS and standard errors of milk components and somatic cell counts of SIM cattle

Factor	n	MF, %	MP, %	ML, %	TDM, %	$Log_{10}SCC$
		$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$
Sampling season		**	**	**	**	**
1 (Winter)	448	3.79±0.08^{a}	3.26±0.03^{a}	4.77±0.03^{a}	12.78±0.12^{a}	5.17±0.03^{a}
2 (Spring)	436	3.37±0.06^{b}	3.14±0.02^{b}	4.24±0.02^{b}	11.59±0.09^{b}	5.14±0.02^{a}
3 (Summer)	577	3.33±0.05^{b}	3.54±0.02^{c}	4.75±0.02^{a}	12.15±0.08^{c}	5.24±0.02^{b}
4 (Autumn)	1122	3.94±0.04^{a}	3.57±0.01^{c}	4.64±0.02^{c}	12.71±0.05^{a}	5.12±0.01^{a}
Parity		NS	NS	NS	NS	**
1	767	3.60±0.04	3.36±0.02	4.60±0.02	12.26±0.06	5.16±0.02^{a}
2	649	3.57±0.04	3.40±0.02	4.59±0.02	12.30±0.06	5.14±0.02^{a}
3	574	3.70±0.05	3.35±0.02	4.61±0.02	12.36±0.07	5.23±0.02^{b}
4	370	3.58±0.05	3.36±0.02	4.58±0.02	12.29±0.08	5.14±0.02^{a}
5+	223	3.59±0.07	3.41±0.03	4.63±0.03	12.34±0.10	5.17±0.03^{ab}
Calving year		**	**	**	**	**
2012	108	3.90±0.10^{ae}	3.72±0.04^{a}	4.84±0.04^{a}	12.95±0.15^{ab}	4.59±0.04^{a}
2013	456	3.95±0.05^{a}	3.61±0.02^{a}	4.87±0.02^{a}	12.94±0.08^{a}	4.85±0.02^{b}
2014	374	3.56±0.06^{bd}	3.40±0.02^{b}	4.82±0.03^{a}	12.86±0.09^{a}	5.00±0.02^{c}
2015	437	3.78±0.05^{ab}	3.45±0.02^{b}	4.81±0.02^{a}	13.46±0.08^{b}	5.07±0.02^{c}
2016	169	3.96±0.08^{ac}	3.45±0.03^{b}	4.84±0.03^{a}	13.53±0.12^{b}	5.20±0.03^{de}
2017	99	3.59±0.10^{bcd}	3.22±0.04^{c}	4.49±0.04^{b}	12.22±0.16^{c}	5.24±0.04^{de}
2018	313	3.38±0.06^{d}	2.91±0.02^{d}	4.20±0.02^{c}	11.37±0.09^{d}	5.27±0.02^{d}
2019	237	3.60±0.07^{bde}	2.89±0.03^{d}	4.11±0.03^{c}	11.35±0.10^{d}	5.09±0.03^{ce}
2020	197	3.35±0.08^{d}	3.43±0.03^{b}	4.56±0.03^{b}	11.60±0.12^{d}	5.51±0.03^{f}
2021	193	3.02±0.08^{f}	3.67±0.03^{a}	4.46±0.03^{b}	10.82±0.11^{e}	5.84±0.03^{g}
Calving month		NS	NS	**	NS	**
1	255	3.56±0.08	3.36±0.03	4.60±0.03^{abc}	12.21±0.12	5.03±0.03^{a}
2	194	3.49±0.09	3.44±0.04	4.66±0.04^{ad}	12.24±0.14	4.98±0.04^{a}
3	206	3.46±0.10	3.39±0.04	4.50±0.04^{be}	11.90±0.15	5.01±0.04^{ac}
4	124	3.51±0.15	3.34±0.06	4.46±0.06^{abe}	11.99±0.22	5.12±0.06^{abc}
5	56	3.64±0.15	3.24±0.06	4.41±0.06^{ab}	12.18±0.23	5.21±0.06^{abc}
6	138	3.86±0.11	3.40±0.05	4.63±0.05^{abc}	12.73±0.17	5.27±0.04^{bcd}
7	274	3.73±0.09	3.36±0.03	4.62±0.04^{abc}	12.44±0.13	5.27±0.03^{bd}
8	251	3.70±0.09	3.45±0.04	4.71±0.04^{cd}	12.58±0.13	5.25±0.03^{bcd}
9	223	3.70±0.08	3.42±0.03	4.68±0.04^{cde}	12.57±0.13	5.34±0.03^{b}
10	309	3.56±0.08	3.39±0.03	4.64±0.03^{abd}	12.34±0.12	5.18±0.03^{cd}
11	269	3.60±0.08	3.36±0.03	4.64±0.03^{abd}	12.35±0.11	5.22±0.03^{bcd}
12	284	3.46±0.08	3.38±0.03	4.64±0.03^{abd}	12.18±0.12	5.10±0.03^{ad}
Lactation month		**	*	*	**	**
1	138	3.41±0.13^{ab}	3.39±0.05^{ab}	4.72±0.05^{a}	12.20±0.19^{ab}	5.14±0.05^{abcdf}
2	144	3.25±0.11^{a}	3.40±0.04^{ab}	4.66±0.05^{ab}	11.94±0.16^{a}	5.02±0.04^{ab}
3	192	3.49±0.09^{abc}	3.42±0.04^{ab}	4.68±0.04^{a}	12.30±0.13^{ab}	5.05±0.03^{abc}
4	179	3.72±0.10^{bc}	3.39±0.04^{ab}	4.61±0.04^{ab}	12.45±0.15^{ab}	5.11±0.04^{abcd}
5	173	3.49±0.09^{abc}	3.28±0.04^{a}	4.58±0.04^{ab}	12.09±0.13^{ac}	4.98±0.03^{a}
6	197	3.58±0.08^{abc}	3.32±0.03^{ab}	4.59±0.04^{ab}	12.26±0.13^{ab}	5.05±0.03^{abc}
7	154	3.54±0.09^{abc}	3.34±0.04^{ab}	4.56±0.04^{ab}	12.18±0.14^{ab}	5.07±0.04^{abcd}
8	184	3.42±0.09^{abd}	3.36±0.04^{b}	4.45±0.04^{b}	11.89±0.13^{a}	5.13±0.03^{abcd}
9	201	3.45±0.09^{abc}	3.43±0.04^{ab}	4.53±0.04^{ab}	12.04±0.14^{ac}	5.15±0.04^{abcdf}
10	174	3.74±0.13^{abc}	3.38±0.05^{ab}	4.58±0.06^{ab}	12.52±0.20^{ab}	5.21±0.05^{bcde}
11	151	3.77±0.17^{abc}	3.24±0.07^{ab}	4.53±0.07^{ab}	12.41±0.25^{ab}	5.29±0.06^{cde}
12	141	4.01±0.13^{c}	3.39±0.05^{ab}	4.65±0.06^{ab}	12.96±0.20^{b}	5.29±0.05^{de}
13	102	3.93±0.12^{cd}	3.48±0.05^{a}	4.70±0.05^{a}	12.79±0.18^{bc}	5.39±0.05^{e}
14	100	3.72±0.11^{bc}	3.40±0.04^{ab}	4.60±0.05^{ab}	12.41±0.17^{ab}	5.32±0.04^{e}
15	353	3.59±0.06^{abc}	3.41±0.02^{b}	4.56±0.03^{ab}	12.20±0.09^{ab}	5.28±0.02^{ef}
Cal. season X Cal. mo	2583	*	**	*	**	**
Cal. season X Lac. mo	2583	**	**	**	**	**
Overall mean	2583	3.69±0.02	3.43±0.01	4.64±0.01	12.48±0.03	5.14±0.009

MF: Milk fat, MP: Milk protein, ML: Milk lactose, TDM: Total dry matter, SCC: Somatic cell count, NS: non-significant, *: $P<0.05$, **:$P<0.01$, a,b,c,d,e,f,g: the difference between groups with the same letter is insignificant according to $P<0.05$.

Table 2. Milk components, freezing point (FP) and somatic cell count (SCC) of SIM cattle

Factor	n	MFc, %	MPc, %	MLc, %	TDMc, %	SNFc, %	FPc, °C	Log$_{10}$SCC
		$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$
Parity		NS	NS	*	NS	*	**	NS
1	47	4.3±0.20	3.44±0.07	4.73±0.07 ^{ab}	13.14±0.23	8.76±0.09^{ab}	-0.538±0.005^{a}	5.23±0.104
2	20	3.87±0.26	3.50±0.09	4.85±0.08 ^{a}	12.86±0.29	8.99±0.12 ^{a}	-0.540±0.006^{a}	4.99±0.134
3	9	4.64±0.39	3.48±0.14	4.71±0.13 ^{ab}	13.39±0.43	8.75±0.18 ^{ab}	-0.533±0.010^{ab}	4.95±0.201
4+	14	4.01±0.31	3.30±0.11	4.46±0.10 ^{b}	12.40±0.34	8.38±0.14 ^{b}	-0.509±0.008 ^{b}	5.23±0.158
Lactation period		*	NS	NS	NS	NS	NS	NS
1 (5-90 days)	43	4.25±0.22^{ab}	3.43±0.08	4.77±0.07	13.04±0.24	8.80±0.10	-0.536±0.005	4.93±0.11
2 (91-240 days)	15	3.91±0.30 ^{a}	3.34±0.11	4.62±0.10	12.49±0.33	8.58±0.14	-0.519±0.007	5.05±0.15
3 (241-310 days)	9	3.85±0.39 ^{ab}	3.44±0.14	4.78±0.13	12.69±0.43	8.84±0.18	-0.531±0.010	5.15±0.20
4 (>310 days)	23	4.89±0.24 ^{b}	3.50±0.09	4.58±0.08	13.55±0.27	8.67±0.11	-0.534±0.006	5.27±0.12
Overall mean	90	4.32±0.12	3.44±0.04	4.72±0.04	13.09±0.14	8.76±0.06	-0.535±0.004	5.11±0.006

MFc: Milk fat, MPc: Milk protein, MLc: Milk lactose, TDMc: Total dry matter, SNFc: Solid non-fat, PF: Freezing point, SCCc: Somatic cell count, NS: non-significant, *: P<0.05, **:P<0.01, a,b: the difference between groups with the same letter is insignificant according to P<0.05.

In terms of MP, the averages of the third (3.54±0.02%) and the fourth (3.57±0.01%) seasons were found to be similar (P>0.05), while these two seasons had higher averages than the other two seasons (P<0.05). The lowest MP mean (3.14±0.02%) was obtained for the second season (April-May-June) in which the milk yield of the cows was higher in general, this season group was also different from the first (3.26±0.03%) season (P<0.05).

In terms of ML, the first (4.77±0.03%) and third (4.75±0.02%) season were similar to each other and these two seasons were different (P<0.05) from the second (4.24±0.02%) and fourth (4.64±0.02%) season. The difference between the ML means of the second and the fourth seasons were also found to be significant (P<0.05).

In terms of TDM, the second sampling season with the lowest mean (11.59±0.09%) was different from all other seasons (P<0.05), however with the highest mean the first season (12.78±0.12%) was similar to the fourth season (12.71±0.05%). These two seasons means were different from the mean (12.15±0.08) of the third season (P<0.05).

Significant differences were obtained between calving years in terms of MF, MP, ML and TDM (P<0.01), while the difference in calving months was significant only for ML (P<0.01). The mean ML of the cows gave birth in May was the lowest (4.41±0.06%) and this month was found to be different from August (4.71±0.04%), which has the highest mean of ML (P<0.05).

Significant differences were found between lactation months in terms of MF, MP, ML and TDM (P<0.05). The MF mean of the second lactation month was found to be the lowest (3.25±0.11%) and this month was different from the fourth and 12-14th lactation months (P<0.05). The highest MF mean was obtained at the 12th month with 4.01±0.13%. In terms of MP, only the 5th and 13th lactation months were found to be different from the 8th and 15th lactation months, and the other differences were insignificant (P>0.05). In terms of ML, the 8th lactation month with the lowest mean (4.45±0.04%) was different from the first (4.72±0.05%), third (4.68±0.04%) and 13th (4.70±0.05) lactation months (P<0.05) and other differences between the months were insignificant (P>0.05).

The highest TDM mean was obtained for the 12th month of lactation (12.96±0.20%) and this month was determined to be different (P<0.05) from the second (11.94±0.16%), the fifth (12.09±0.13%), the eighth (11.89±0.13%) and the ninth (12.04±0.14%) lactation months.

In order to determine the current situation, the averages and standard errors of the analysis results of the milk samples taken from the lactating animals in the morning milking on 10.08.2021 are given in Table 2. Mean MFc, MPc, MLc, TDMc, SNFc, FPc and Log$_{10}$SCCc of SIM cattle were 4.32±0.12%, 3.44±0.04%, 4.72±0.04%, 13.09±0.14%, 8.76±0.06%, -0.535±0.003 °C and 5.11±0.06 (128,825 cells/ml), respectively.

While the effect of parity on MLc (P<0.05), SNFc (P<0.05) and FPc (P<0.01) was significant, its effect on MFc, MPc, TDMc and Log$_{10}$SCCc was insignificant (P>0.05).

In terms of MLc, the mean in the second parity (4.85±0.08%) differed from the mean of the fourth lactation (4.46±0.10) (P<0.05), while the other differences among the parities were insignificant (P>0.05). Similar to MLc, the difference between the second and fourth parities was found to be significant (P<0.05) for SNFc, while other differences were insignificant (P>0.05) among the parities.

In terms of FPc, 4+ parity mean (-0.509±0.008 °C) was detected to be different from the first (-0.538±0.005 °C) and second (-0.540±0.006 °C) parities (P<0.05), other differences between the parities were statistically insignificant (P>0.05).

The effect of lactation period was found to be significant (P<0.05) only for MFc, while the effect of this factor on other traits was insignificant (P>0.05). The only significant difference was between the second lactation period with a mean of 3.91±0.30% and the fourth lactation period with a mean of 4.89±0.24% (P<0.05), other differences between lactation periods were insignificant.

Somatic cell count

According to the results of the analysis of the milk samples performed by the farm, all factors effects on Log$_{10}$SCC were found to be significant (P<0.01; Table 1). The highest average of Log$_{10}$SCC was obtained for the third sampling season (5.24±0.02; 173,780 cells/ml) and this season was detected to be different from other seasons and other seasonal differences were insignificant (P>0.05).

The highest Log$_{10}$SCC mean in terms of parity was obtained for the third parity (5.23±0.02; 169,824 cells/ml) and this parity was similar only to the fifth parity (5.17±0.03; 147.911 cells/ml) (P>0.05), but different from other parities (P<0.05), other differences between the parities were insignificant (P>0.05). The lowest $Log_{10}SCC$ mean was determined to be 5.14±0.02 (138.038 cells/ml) for the second and fourth parities.

Considering the $Log_{10}SCC$ according to calving years, a regular increase was observed over the years, if the decline in 2019 (5.09±0.03; 123,027 cells/ml) is not taken into account. The mean, which was 4.59±0.04 (38.905 cells/ml) in 2012, when the lowest $Log_{10}SCC$ level was realized, increased to 5.84±0.03 (691.831 cells/ml) in 2021.

According to the calving months, the lowest $Log_{10}SCC$ mean was obtained for February (4.98±0.04 or 95,499 cells/ml) and this month was similar to January, March, April, May and December (P>0.05) but different from other months (P<0.05). On the other hand, while the highest $Log_{10}SCC$ mean was obtained for September (5.34±0.03; 218,776 cells/ml)), this month was different from the first five months and October and December (P<0.05) but, similar to other months (P>0.05).

The $Log_{10}SCC$ level in cows in the first month of lactation was 5.14±0.05 (138,038 cells/ml), maintained this low level in the following months, and decreased to the lowest level of 4.98±0.03 (95,499 cells/ml) in the fifth month of lactation. Towards the end of lactation, as expected, a regular increase occurred and reached its highest level in the 13th lactation month (5.39±0.05; 245,471 cells/ml), and it was around 200,000 cells/ml in the two months following this month (Table 1).

On the other hand, as a result of the analysis of milk samples taken at morning milking on 10.08.2021 to determine the current situation, the mean of $Log_{10}SCCc$ was calculated as 5.11±0.06 (128,825 cells/ml), and the effect of lactation period and parity on $Log_{10}SCCc$ was found to be insignificant (P>0.05; Table 2). With the progression of lactation, the mean of $Log_{10}SCCc$ increased as expected, and the mean in the first period was 4.93±0.11 (85.114 cells/ml) and increased to 5.27±0.12 (186,209 cells/ml) in the fourth lactation period, but 101,092 cells/ml difference between these two periods was found to be is insignificant (P>0.05).

Discussion

Milk components

In this study, the MF mean (3.69±0.02%), which varies significantly according to the sampling season, calving year and lactation months, can be considered low for SIM breed. However, if it is remembered that there is an inverse relationship between milk yield and milk components, it is expected that although the milk yield of SIM cattle used in this study is increased, the fat content in milk will decrease (dilution effect). While it is noteworthy that the MF is low in years when milk yield is high, an increase in the MF towards the end of lactation is an expected situation (Table 1). On the other hand, it is noteworthy that high air temperatures and humidity seen in spring and summer seasons cause a significant decrease in the MF. It should be emphasized that the application of an effective cooling system will provide significant benefits to the business in order to eliminate this negativity.

The average of the MF (3.69±0.02%) determined for SIM cattle is lower than those of the results reported by Polanski et al. (1992) and Akbulut (1998) for the same breed, by Koç (2011) for HF and MB breeds and by Kaya et al. (2014) for the evening milking mean of HF. However, the MF mean calculated in this study was higher than the results reported by Okuyucu and Erdem (2017) for HF, SIM and crosses, the morning milking mean of HF breed reported by Kaya et al. (2014) and the mean determined from the milk samples taken from milk tanks by Yörükoğlu (2019).

The dilution effect similar to MF is also valid for MP. While the decrease in MP average is noteworthy, especially in the summer months, it would be beneficial to make significant changes in the ration as well as an effective cooling system.

The MP mean (3.43±0.01%) of SIM breed found in this study was lower than the mean of Şekerden et al. (1999) for the SIM breed (%3.9±0.41), however similar to the seasonal averages for the same breed reported by Polanski et al. (1992) who reported seasonal averages between 3.41% and 3.46% for the same breed and morning and evening milking (3.41% and 3.44%) means for HF breed reported by Kaya et al. (2014). On the other hand, the MP mean obtained for SIM in this study is higher than the mean of RH breed (3.22±0.029) reported by Yılmaz (2010), the means of HF and MB breeds reported by Koç (2011), the averages reported by Koç and Arı (2020) for RH and SIM breeds (3.38% and 3.40%, respectively), and the average determined by Yörükoğlu (2019) from the mean of milk tanks samples (3.22%) and higher than the average (3.02%) for SA, SIM and crossbred cattle reported by Okuyucu and Erdem (2017).

While the season has a significant impact on ML, it is seen that the ML, which varies relatively less than other milk components, had very low values in 2018 and 2019. It is thought that these lower values may be due to the fact that the sampling in these years coincided with the high productive months. As a matter of fact, the ML in the spring months (4.24±0.02%) was found to be considerably lower than other months (Table 1).

The mean ML of SIM (4.64±0.01%) determined in this study is higher than the averages reported by Koç (2011) for the MB and HF breeds (4.57% and 4.53%, respectively), but lower than the mean of Yılmaz (2010) for RH breed (4.73%), the morning and evening milking means of Kaya et al. (2014) for HF breed (4.77% and 4.79%, respectively), the means of RH and SIM breeds (4.86±0.028 and 4.81±0.019%, respectively) of Koç and Arı (2020) and the mean of Okuyucu and Erdem (2017) for HF, SIM and crossbred cattle (4.19%), but it is close to the mean (4.63%) of Yörükoğlu (2019) from the samples taken from the milk tanks.

The effect of high productivity in spring months on milk components is also clearly seen in TDM. Moreover, it is thought that the significant decrease in the TDM average, especially in recent years, is related to the increase in milk yield of cows in the enterprise in recent years (Table 1). TDM mean determined as 12.48±0.03% for SIM breed in this study was lower than the means of Şekerden et al. (1999) for the same breed (12.6±0.81), Kaya et al. (2014) for the evening milking (13.06%) for HF breed, however TDM mean calculated in this study for SIM breed is higher than means of Kaya et al. (2014) for the morning milking mean (11.99%) for HF breed, Koç (2011) for MB and HF breeds (11.88±0.103% and 11.47±0.148%, respectively), Koç and Arı (2020) for RH and SIM breeds (11.18%±0.069% and 11.23±0.048%, respectively), Okuyucu and Erdem (2017) for HF, SIM and crossbred cattle (11.76%) and Yörükoğlu (2019) from the mean taken from the milk tanks.

In order to determine the current situation from the analysis of milk samples taken in August 2021, the means of MFc, MLc and TDMc (4.32±0.12%, 3.44±0.04%, 4.72±0.04% and 13.09±%, respectively) were higher than the overall means (3.71±0.018%, 4.63%±0.009% and 12.49±0.03, respectively) found between 2012 and 2020 (Tables 1 and 2). However, when compared with the averages of August 2021 with the years between 2012 and 2020, it was seen that the means of the MP and MPc were almost similar (Tables 1 and 2). It is thought that the higher values in terms of milk components of SIM cattle in the summer months were due to the low milk yield of the cows due to the high air temperature and humidity seen in the region during these months.

The mean MFc found for the SIM (4.32±0.12%) breed in this study was higher than the means reported in the literature for the same breed by Akbulut (1998) and Polanski et al. (1992), and Okuyucu and Erdem (2017) for HF, SIM and crossbred cattle and Yörükoğlu (2019) for the mean of the samples taken from the milk tanks (3.54%).

Şekerden et al. (1999) for SIM (3.9±0.41%), Koç and Arı (2020) for RH (3.38±0.021%) and SIM (3.40±0.015%) breeds, and Okuyucu and Erdem (2017) for HF, SIM and crossbred cattle (3.02%), and Yörükoğlu (2019) for the samples taken from the milk tanks reported higher values than MPc mean (3.44±0.04) found in this study, but Polanski et al. (1992) reported similar seasonal values (range 3.41% to 3.46%) to the MPc mean determined in this study for SIM breed.

The MLc mean determined in this study (4.72±0.04%) was similar to the value reported by Yılmaz (2010) for the RH (4.73±0.024%), but lower than the values reported by Koç and Arı (2020) for the RH (4.86±0.028%) and SIM (4.81±0.019%) breeds, but higher than the means reported by Okuyucu and Erdem (2017) in HF, SIM and crossbred cattle (4.19%), and by Yörükoğlu (2019) in samples taken from milk tanks (4.64%).

The mean TDMc determined for SIM cattle (13.09±0.14%) was higher than all the values determined by Şekerden et al. (1999) for the same breed (12.6±0.81), Okuyucu and Erdem (2017) for HF, SIM and crossbred cattle (11.76%), Koç and Arı (2020) for RH and SIM cattle (11.18%±0.069 and 11.23±0.048%, respectively) and Yörükoğlu (2019) for the samples taken from milk tanks (12.00%).

In this study, the mean SNFc (8.76±0.06%) obtained in this study for the SIM breed was determined to be higher than the values reported by Şekerden et al. (1999) for same breed (8.6±0.32%), Koç (2009) for HF and MB breeds (8.23±0.067% and 8.35±0.047%, respectively), Koç (2011) for MB and HF breeds (8.35±0.047% and 8.23±0.067%, respectively), Koç (2015) for RH breed (8.35±0.047% and 8.23±0.067%, respectively for the morning and evening milkings), Okuyucu and Erdem (2017) for HF, SIM and crossbred cattle (8.32%) and Yörükoğlu (2019) for the samples taken from milk tanks (8.46%). However, Koç (2007a) for HF and Brown-Swiss breeds (9.61±0.048), Koç (2008) for HF breed (9.78±0.024), Yılmaz (2010) for RH breed (8.94±0.036), Kaya et al. (2014) for HF breed (8.83% and 8.80%, respectively for morning and evening milking), Koç and Arı (2020) for RH and SIM breeds (9.09±0.037% and 9.09±0.025%, respectively), Koç and Gürses (2020)) for the first lactating RH and HF cows (9.7±0.09% and 9.9±0.04%, respectively) reported higher SNFc than the mean found in this study for SIM cattle.

The raw milk FP value is used to determine the cheating in milk and the FP of unprocessed bovine milk is between -0.53 and -0.55 ºC and the FP decreases due to the increase in the dry matter content of the milk (Anonymous, 2019). The mean FPc (-0.535±0.003 ºC) for SIM cattle determined in this study was similar to the mean found by Yörükoğlu (2019) from the samples taken from milk tanks (-0.536 ºC), however higher than the value reported by Koç and Arı (2020) for RH and SIM breeds (-0.577±0.0012 and -0.579±0.0009 ºC, respectively).

Somatic cell count (SCC)

The Log_{10}SCC mean (5.14±0.01 or 138,038 cells/ml) detected in this study were lower than the values Özdede (2009) who reported 179,730, 238,899, 267,005 and 204,877 cells/ml, respectively for spring, summer, autumn and winter seasons for the Ankara Cattle Breeders' Association member farms, the values of Koç (2006) who determined the means between 319,448 cells/ml and 497,279 cells/ml for HF breed after conducting a study for two years in four farms () in Aydın Province, Türkiye, the values of Koç (2007b) who reported the means of 218.524 cells/ml and 344,112 cells/ml, respectively, for MB and HF breeds , the value of Koç (2011) for HF breed (199.022 cells/ml), a value (181,339.1 cells/ml) of Okuyucu and Erdem (2017) who conducted a study in small-scale farms rearing HF, SIM and crossbred cattle under semi-intensive conditions in Bafra district of Samsun province, Türkiye, and the mean (586 000 cells/ml) reported by Yörükoğlu (2019) for the samples taken from milk tanks arriving at milk processing facilities in four districts of İzmir Province, Türkiye. In addition, the Log_{10}SCC mean detected in this study was also lower than the means (251,768 cells/ml 261,216 cells/ml) reported by Koç and Arı (2020) for SIM and RH breeds raised together in a private farm in Aydın province, Türkiye. Koç (2011) reported similar value for MB breed (138,644 cells/ml) to the mean found in this study for SIM breed.

On the other hand, Yılmaz (2010) for RH cows (63,753 cells/ml) reared in a farm in Aydın Province, Türkiye, Kaya et al. (2014) for HF cows (67,764 cells/mL and 119,950 cells/mL, respectively for the morning and evening milking), Koç (2015) for RH cows (91,833 cells/mL and 100,462 cells/mL, respectively for the morning and evening milking) and Koç and Gürses (2020) for the first lactating RH and HF cows reared in a farm in Aydın Province, Türkiye, reported lower values than those obtained in this study.

In this study, the Log_{10}SCCc mean (5.11±0.06 or 128,825 cells/ml) determined in this study for SIM cows was lower than the results of Özdede (2009) for the member farms of the Ankara Province Cattle Breeders' Association, Koç (2006) for HF breed raised in four different farms in Aydın Province, Koç (2007b; 2011) for

MB and HF breeds, Okuyucu and Erdem (2017) for HF, SIM and crossbred cattle (181,339.1 cells/ml), Koç and Arı (2020) for RH and SIM breed (261,216 and 251,768 cells/ml, respectively) and Yörükoğlu (2019) for the milk transported to milk processing facilities in İzmir Province, Türkiye. Yılmaz (2010) for RH breed (63,753 cells/ml), Kaya et al. (2014) for the morning and evening milkings means of HF breed (67,764 and 119,950 cells/ml, respectively), and Koç (2015) for morning and evening milking of RH breed (91,833 and 100,462 cells/ml, respectively), and Koç and Gürses (2020) for the first lactating RH and HF breeds (39,811 and 50,119 cells/ml, respectively) reported lower values than those determined in this study.

In this study, the average of $Log_{10}SCC$ (5.14±0.009 or 138.038 cells/mL) obtained as a result of the milk analysis performed by the farm by taking milk samples three times a year between 2012 and 2021 was found to be slightly higher than the average of $Log_{10}SCCc$ (5.11±0.006 or 128.825 cells/mL) obtained from the milk samples taken in the morning milking on 10.08.2021 to determine the current situation. It is thought that the increase in the $Log_{10}SCC$ level in 2020 and 2021, when the Covid-19 pandemic was seen, could be resulted from the disruption of various practices such as health protection, herd and milking management in the enterprise due to various measures taken throughout the country due to the pandemic in these years. Based on this, a high $Log_{10}SCC$ average seen in 2021, when the pandemic was felt intensely, it is possible to talk about a mastitis epidemic in the enterprise during this year.

Conclusion

In this study, in addition to the results of milk analysis performed three times a year between 2012 and 2021 in a farm in Menemen district of İzmir province, Türkiye, which raises Austrian origin SIM (Fleckvieh) cattle, which has increased the interest of dairy cattle breeders in Türkiye in recent years, to determine the current situation on 10.08.2021, the milk samples at the morning milking from the lactating cows were analyzed and some important information was obtained about milk components and SCC level of Austrian origin SIM cows.

The fact that the overall SCC mean (138,038 cells/ml) from 2012 to 2021 years, and the low SCC mean (128,825 cells/ml) determined for evaluating the current situation revealed that the mastitis prevalence in Austrian-origin SIM cattle is quite low. However, especially considering the high SCC level in 2021 and 2020, it is thought that various measures taken throughout all over the world and Türkiye due to the Covid-19 Pandemic led to the disruption of practices such as milking management and hygiene, health protection, etc. in the farm, and accordingly, an increase in mastitis cases in the herd increased as a result of that the hygienic quality of milk decreased in these years.

In conclusion, all the milk analysis results are examined, it has been seen that the milk components of Austrian origin SIM cattle are not much different from those of HF breed which is raised widely in Türkiye and in the world. However, the low SCC mean obtained for Austrian origin SIM cattle in this study revealed that, besides the significant contribution of the measures taken against mastitis in this farm, the resistance to mastitis of this genotype could be higher, and this characteristic of Austrian origin SIM cattle is thought to be among the reasons for preference of high yielding Austrian-origin SIM cattle in Türkiye.

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