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# A Research on Fertility, Herd Life, Milk Production and Milk Quality Characteristics of Simmental (Fleckvieh) Cows: 1. Reproduction, Herd Life and Milk Production Characteristics

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A B S T R A C T

The aim of this study was to determine the fertility, herd life and milk yield characteristics of Simmental (SIM) cows of Austrian origin, which have increased the interest of cattle breeders in Türkiye in recent years. From the records of the farm between 2011 and 2021, the first calving age (FCA), calving interval (CI), herd life (HL), productive life (PL), lactation length (LL), lactation milk yield (LMY) and 305 days milk yield (305-dMY) were calculated. A total of 307 FCA, 619 CI, 212 HL and PL, 447 LL, 271 LMY and 497 305-dMY data were used. The means of FCA, CI, HL, PL, LL, LMY and 305-dMY for SIM cows were 842.35±5.30 days (28.1 months), 422.98±3.18 days, 75.48±1.72 months, 47.15±1.73 months, 363.52±3.52 days, 10,596±152 kg and 8647.0±58.0 kg, respectively. Based on the long FCA and CI averages of Austrian-origin SIM cattle, although it can be interpreted that there are some problems in terms of reproductive efficiency in the farm, finding long HL and PL and high milk yield, it can be said that the farm contributes to the increase of milk yield per cow by turning the negativity caused by the reproductive efficiency into an advantage.

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## Introduction

Milk yield per cow shows significant differences between the farms raising the same foreign breed in Türkiye, depending on the applied management and feeding conditions. This situation reveals that the genetic potential of foreign breeds reared in many farms, especially Holstein-Friesian (HF), are not sufficiently utilized. It could be possible for the breeders to benefit from the full genetic potentials of these animals by providing appropriate management-feeding and health protection conditions at the farm level.

Simmental (SIM) is a breed that is preferred worldwide both in pure and crossbreeding due to its characteristics such as high growth rate, milk yield, milk fat and protein ratio, docility and adaptability (Koç, 2016a). Although it is difficult to determine the universal standard of the breed due to the development of various SIM-origin genotypes around the world, it is reported that there is no risk of narrowing the gene pool of this breed (Koç, 2016a). By using the SIM breed in intensive crossbreeding in many European countries such as Germany, Austria, France, Italy, Switzerland and in the former Soviet Union, different genotypes were developed. Breeders in the USA, on the other hand, brought the breed's meatiness to the fore and obtained genotypes called Black SIM and Red SIM, whose body color differs from the classical SIM colors, completely black and completely red (Koç, 2016a).

In Türkiye, for a long time, raw milk: concentrate feed parity has decreased below 1.5, close to 1.0, and occasionally below 1.0 (https://ulusalsutkonseyi.org.tr/cig-sut-yem-paritesi-627/). In recent years, the high prices of red meat due to the shortage of red meat in our country, the fertility problems experienced in HF cattle, and the relatively low resistance to diseases, especially mastitis, have led producers to prefer alternative cattle breeds, thus some producers have replaced HF breeds. Alternative breeds such as Red-Holstein (RH), Montbeliarde (MB), especially the Austrian and German origin SIM (Fleckvieh) breed with increased milk yield, have begun to be preferred more by cattle breeders. For this reason, a significant number of pregnant SIM heifers have been brought to Türkiye in recent years and this trend has made the SIM breed the second most grown foreign breed after HF, surpassing the Brown-Swiss breed, today.

Fertility, accepted as the basis of all yields in livestock, is also important in terms of transferring genetic variation to the next generation. There are some studies on the fertility of SIM cattle in Türkiye (Akbulut, 1998; Şekerden et al., 1999; Çilek and Tekin, 2006; Özkan and Güneş, 2011a; Erdem et al., 2015; Koç, 2016b; Koç, 2017; Okuyucu et al., 2018; Koç and Arı, 2020).

As a factor affecting profitability in dairy cattle, herd life (HL) is defined as the time elapsed between the date an animal was born and joined the herd and the date it was removed from the herd or left the herd for various reasons. Another measure of the HL is Productive life (PL) that is defined as a cow entering the herd, typically first-born heifers, and leaving the herd, typically because they are culled from the herd as voluntarily or compulsorily. Oltenacu (2009) stated that HL is expressed by the proportion of those still alive at the age of 48 months in the north of the USA, and that the ratio of those still alive at this age in HF cows decreased from 80% to 60% between 1957 and 2002, indicating that HL has decreased. There are some studies on HL in cattle in Türkiye and abroad (Savaş et al., 1999; Yaylak, 2003; Işık, 2006; Mundan and Karabulut, 2008; Sawa and Bogucki, 2010; Kara et al., 2010; Boğokşayan and Bakır, 2013; Fouz et al., 2014; Weller and Ezra, 2015; Gavrilă et al., 2015; Olechnowicz et al., 2016; Koç, 2017; Tutka, 2019).

There are also some previous studies on the milk yield of foreign cattle breeds raised in Türkiye, including the SIM breed (Şekerden and Erdem, 1997; Akbulut, 1998; Şekerden et al., 1999; Koç, 2001; 2006; 2009; 2016b; Çerçi, 2006; Çilek and Tekin, 2006; Yılmaz, 2010; Özkan and Güneş, 2011b; Erdem et al., 2015; Okuyucu et al., 2018; Koç and Arı, 2020; Koç and Gürses, 2020).

Although it has been brought to Türkiye to a large extent in recent years, the number of studies on fertility, herd life and milk yield of high yielding Austrian and German origin SIM (Fleckvieh) cattle is almost non-existent. That is why in this study, it was aimed to determine the fertility, HL and milk yield characteristics and some environmental factors affecting these from the records of Austrian origin SIM cattle raised in a private farm in the Menemen District of İzmir, Türkiye.

## Material and Methods

The study was carried out in a farm located in Menemen District of İzmir Province, Türkiye, which raises SIM breed brought from Austria. From the herd management program used in the farm, the first calving age (FCA) and calving interval (CI) characteristics were calculated from the birth and insemination records of the existing animals and the animals culled from the herd. While 370 data were evaluated for the FCA, with a duration ranging from 310 days to 650 days, 619 data were evaluated for the CI. Two data (273 days and 299 days) with CI less than 310 days and 38 data with CI more than 650 days (663 days and 1294 days) were not included in the statistical analysis.

Lactation length (LL), lactation milk yield (LMY) and 305-day milk yield (305-dMY) from the milk yield records of the existing and culled cows were emphasized. The data for the 305-dMY varies between 5437 kg and 11768 kg, while the data for the LMY varies between 5930 kg and 22,569 kg. While LL and LMY data with a lactation period between 240 days and 550 days were taken into account, data with LL over 240 days for 305- dMY trait were evaluated, and 3 cows' 305-dMY values shorter than 240 days were excluded from the statistical analysis in addition to evaluate the first 305-d milk yield of the cows whose LL was longer than 305-d. Data with a LL longer than 550 days were excluded from statistical analysis, so 50 LL and 16 LMY data were excluded from evaluation according to this criterion.

### *Statistical analysis*

Statistical analysis of the data was made in the SAS (2004) package program, and the comparison of subgroups was made according to Tukey (P<0.05). The following statistical model was used in the analysis of FCA:

$$y_{ijk} = \mu + a_i + b_j + e_{ijk} \quad (1)$$

Here, $y_{ijk}$ is the observation value of the trait, μ; the mean of the trait, $a_i$; birth year effect (i= 2008, 2009, 2011, …..2019), $b_j$; birth month effect (j=1, 2, 3, …..12) and $e_{ijk}$; error term.

The following statistical model was used in the analysis of CI:

$$y_{ijklm} = \mu + a_i + b_j + c_k + d_l + e_{ijklm} \quad (2)$$

Here $y_{ijklm}$; observation value of the trait, μ; the mean of the trait, $a_i$; origin effect (i=born in Austria, born in Türkiye), $b_j$; calving year effect (j= 2011, 2012, ….. 2020), $c_k$; calving month effect (k=1, 2, …., 12), $d_l$: parity effect (l=1, 2, 3, 4 and 5+) and $e_{ijklm}$; error term.

The following statistical model was used in the analysis of HL and PL traits:

$$y_{ijklm} = \mu + a_i + b_j + c_k + d_l + e_{ijklm} \quad (3)$$

Here $y_{ijklm}$; observation value of the trait, μ; the mean of the trait, $a_i$; culling year (i=2014, 2015, ….2020), $b_j$; culling season (j=winter, spring, summer, autumn), $c_k$; number of calving (k=1, 2, 3, 4 and 5+), $d_l$: reason for removing the herd (l= slaughtering, death, sale for slaughtering or breeding) and $e_{ijklm}$; error term.

The statistical model used in the analysis of LL, LMY and 305-dMY is as follows

$$y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl} \quad (4)$$

Here $y_{ijkl}$; observation value of the trait, μ; the mean of the trait, $a_i$; calving year effect (j= 2011, 2012, ….. 2020), $b_j$; calving month effect (j=1, 2, …., 12), $c_k$; parity effect (k=1, 2, 3, 4 and 5+) and $e_{ijkl}$; stands for the error term.

## Results

### *Fertility traits*

The mean FCA of SIM cattle was 842.35±5.30 days (28.08 months), and the effects of birth year (P<0.01) and month (P<0.05) on FCA were significant (Table 1). The longest mean of FCA was obtained for 2008 year (1019.04±30.56 days; 34.0 months), and the shortest for

2016 year (796.04±18.28 days; 25.5 months), and in all years the mean was calculated below 900 days (30 months), except 2008. In terms of birth month, the mean FCA ranged between 818.31±17.16 days (August) and 899.95±18.89 days (March).

The mean CI of SIM cattle was calculated as 422.98±3.18 days (14.1 months). The effects of calving year (P<0.01), calving month (P<0.01) and parity (P<0.05) on CI were significant (Table 1). In the statistical analysis of the CI data of SIM cattle, the effect of origin included in the model was also determined to be significant (P<0.05) and, the mean CI in cattle born in Austria (442.01±6.72 days) was 26.71 days longer than in cattle born in Türkiye (415.30±9.22 days).

The effect of calving year on CI was significant (P<0.01). The mean CI was calculated over 400 days for the years 2011-2020, the shortest year was 2012 (404.75±16.58 days), and the longest year was 2015 (469.16±10.09 days). While the month with the shortest CI mean was determined for cows that calved in December with 396.08±9.55 days, the longest month was determined for cows that calved in March with 476.42±13.97 days (Table 1). The difference of 37.32 days between the mean CI of cattle in the first lactation and the cattle in the third lactation was significant (P<0.05).

### *Longevity traits*

Detailed records on the reasons for the culled cows from the herd could not be reached. The factors, averages and standard errors affecting the HL and PL traits of SIM cattle are given in Table 2. The overall means of HL and PL were calculated as 75.48±1.72 months and 47.15±1.73 months, respectively. The effects of the culling year and number of calving on HL and PL were significant (P<0.01), while the effects of the culling season and reason for culling were insignificant (P>0.05).

Table 1. First calving age (FCA, days) and calving interval (CI, days) of SIM cattle

| Factor | FCA | | CI | |
|---|---|---|---|---|
| | n | $\bar{X} \pm S_{\bar{X}}$ | n | $\bar{X} \pm S_{\bar{X}}$ |
| Birth/Calving year# | | ** | | ** |
| 2008 | 11 | 1019.04±30.56[a] | - | - |
| 2009 | 83 | 843.88±11.44[bc] | - | - |
| 2011 | 27 | 812.31± 19.04[bc] | 89 | 406.20±17.33[ab] |
| 2012 | 25 | 804.91± 20.04[bc] | 59 | 404.75± 16.58[a] |
| 2013 | 16 | 896.29± 24.20[b] | 75 | 422.49± 11.58[ab] |
| 2014 | 31 | 872.81± 17.90[bc] | 74 | 412.19± 10.31[a] |
| 2015 | 33 | 852.81± 16.79[bc] | 60 | 469.16± 10.09[b] |
| 2016 | 29 | 796.04± 18.28[c] | 43 | 427.63± 12.07[ab] |
| 2017 | 35 | 823.50± 16.50[bc] | 51 | 462.97± 11.66[ab] |
| 2018 | 25 | 888.86± 19.08[b] | 58 | 424.87± 10.92[ab] |
| 2019 | 55 | 823.06± 13.54[bc] | 62 | 429.07± 10.68[ab] |
| 2020 | - | - | 48 | 427.22± 11.98[ab] |
| Birth/Calving month | | * | | ** |
| 1 | 27 | 872.02± 18.92[ab] | 49 | 405.93±11.73[ac] |
| 2 | 27 | 881.90± 19.38[ab] | 42 | 432.51± 12.43[abc] |
| 3 | 29 | 899.95± 18.89[a] | 33 | 476.42± 13.97[b] |
| 4 | 24 | 864.03± 20.65[ab] | 27 | 468.15± 15.65[b] |
| 5 | 23 | 853.95± 21.63[ab] | 16 | 472.67± 19.08[ab] |
| 6 | 25 | 848.49± 20.35[ab] | 37 | 426.98± 12.83[abc] |
| 7 | 50 | 841.22± 14.38[ab] | 61 | 422.96± 9.96[abc] |
| 8 | 35 | 818.31± 17.16[b] | 66 | 399.48± 9.65[c] |
| 9 | 30 | 853.52± 17.61[ab] | 59 | 428.44± 10.03[abc] |
| 10 | 42 | 862.16± 14.97[ab] | 102 | 406.42± 8.04[c] |
| 11 | 29 | 877.23± 18.17[ab] | 60 | 407.82± 9.94[c] |
| 12 | 29 | 818.33± 18.46[ab] | 67 | 396.08± 9.55[c] |
| Parity | - | - | | * |
| 1 | - | - | 240 | 446.88±7.06[a] |
| 2 | - | - | 162 | 436.44±7.32[ab] |
| 3 | - | - | 112 | 414.51± 8.18[b] |
| 4 | - | - | 61 | 428.62± 11.47[ab] |
| 5+ | | - | 44 | 416.83± 14.31[ab] |
| Origin | | | | * |
| Austria | - | - | 303 | 442.01±6.72[a] |
| Türkiye | - | - | 316 | 415.30±9.22[b] |
| Overall | 370 | 842.35±5.30 | 619 | 422.98±3.18 |

*: P<0.05, **:<0.01, a,b,c: the difference between groups with the same letter is insignificant according to P<0.05. #: Since the animals were brought to the farm as pregnant heifers from Austria and the animals born in the farm gave their first birth at the age of about two, there is no FCA data for 2010 in the farm records.

Table 2. Herd life (HL) and productive life (PL) of SIM cattle

| Factor | n | HL, mo | PL, mo |
|---|---|---|---|
| | | $\bar{X} + S_{\bar{X}}$ | $\bar{X} + S_{\bar{X}}$ |
| Culling year # | | ** | ** |
| 2014 | 22 | 68.47±2.74[a] | 40.82±2.51[a] |
| 2015 | 10 | 77.85±4.61[abc] | 49.20± 4.23[ab] |
| 2016 | 13 | 83.81±4.35[bc] | 52.59± 3.99[ab] |
| 2017 | 46 | 78.88±3.13[abc] | 48.77± 2.87[ab] |
| 2018 | 52 | 73.83± 2.77[ab] | 43.82± 2.54[a] |
| 2019 | 37 | 78.70± 3.57[abc] | 50.05± 3.27[ab] |
| 2021 | 32 | 84.81±3.37[c] | 54.65± 3.09[b] |
| Culling season | | NS | NS |
| 1 | 96 | 77.46±2.79 | 48.58±2.56 |
| 2 | 19 | 78.24±3.47 | 47.56±3.18 |
| 3 | 43 | 77.53±2.59 | 48.90±2.37 |
| 4 | 54 | 78.98±3.20 | 49.18±2.93 |
| No. of birth | | ** | ** |
| 1 | 41 | 48.62± 2.66[a] | 18.36± 2.43[a] |
| 2 | 47 | 66.77± 2.82[b] | 36.38± 2.58[b] |
| 3 | 32 | 73.99± 2.64[b] | 45.37± 2.42[c] |
| 4 | 41 | 89.81± 2.85[c] | 60.38± 2.61[d] |
| 5+ | 51 | 111.07± 2.91[d] | 82.29± 2.67[e] |
| Culling reason | | NS | NS |
| Slaughtering | 170 | 74.05±1.43 | 45.95±1.31 |
| Death | 4 | 83.95±6.15 | 53.53±5.64 |
| Selling | 38 | 76.15±2.56 | 46.19±2.35 |
| Overall | 212 | 75.48±1.72 | 47.15±1.73 |

NS: non-significant, **:P<0.01, a,b,c,d: The difference between groups with the same letter is insignificant according to P<0.05. #: No record of the 2020 for culling.

It is understood that 212 animals were culled from the herd in the farm between 2014-2021 and, 17.9% (38 heads) of these animals were voluntarily culled from the herd and sold for breeding or slaughtering, and 82.1% (174 heads) were culled compulsorily. 1.9% (4 heads) of the forcibly culled animals were removed from the herd by death and 80.2% by being sent to slaughter.

According to the year of culling, the longest mean HL and PL were calculated as 84.81±3.37 months and 54.65±3.09 months, respectively, for 2021, while the shortest was 68.47±2.74 months and 40.82±2.51 months for 2014, respectively. Of the 212 herds, 19.3% (41 heads) once, 22.2% (47 heads) twice, 15.1% (32 heads) thrice, 19.3% (41 heads) four times and 24.1% (51 heads) were culled after five or more calving.

***Milk yield traits***

LL, LMY and 305-dMY were emphasized as milk yield traits of SIM cattle, and the averages and standard errors of the factors affecting these traits are given in Table 3. The mean of LL, LMY and 305-dMY were calculated as 363.52±3.52 days, 10,596±152 kg and 8647.0±58.0 kg, respectively. The effects of calving month on LL (P<0.01), calving year (P<0.01), calving month (P<0.01) and parity (P<0.01) on LMY (P<0.01), while only calving year effect on 305-dMY was significant (P<0.01).

The LL of SIM cattle raised in the farm was generally long, with 352.47±11.09 days the shortest in 2020 and the longest in 2015 with 388.53±10.44 days. When the situation is evaluated in terms of calving month, the LL average was over 400 days in March, April and May, and May was the month with the longest LL with 430.22±22.85 days.

While LMY average was above 10 tons in all other years except 2014, it exceeded 12 tons in 2019 and 2020 (Table 3). In terms of calving month, LMY average was over 10 tons in all other months except January, and it was around 12 tons in March, April and May, when the LL was longer in these months. In terms of the parity, while the third parity had a LMY average below 10 tons, it was around 11.5 tons on average due to the long LL during the first lactation.

The average of 305-dMY of SIM cattle was the lowest (6895.50±107.40 kg) in 2011 due to the fact that all of the cows were in the first parity, this year was followed by 2012 with 7719.70±114.32 kg and the averages, which were between 8-9 tons between 2013 and 2018, increased to over 10 tons in 2019 and 2020.

While the average of 305-dMY in terms of calving month was between 8-9 tons, the average of 305-dMY in terms of parity was over 8.5 tons or over for all parities (Table 3).

Table 3. Means and standard errors of lactation length (LL), lactation milk yield (LMY) and 305-day milk yield (305-dMY) of SIM cattle

| Factor | n | LL, day | | LMY, kg | | 305-dMY, kg |
|---|---|---|---|---|---|---|
| | | $\bar{X} + S_{\bar{X}}$ | | $\bar{X} + S_{\bar{X}}$ | | $\bar{X} + S_{\bar{X}}$ |
| Calving year | | NS | | ** | | ** |
| 2011 | 80 | 382.28±13.02 | 17 | 10277.08±670.84[ab] | 85 | 6895.50±107.40[a] |
| 2012 | 40 | 381.40±14.24 | 39 | 10036.59±480.09[a] | 49 | 7719.70±114.32[b] |
| 2013 | 45 | 379.70±13.77 | 39 | 10622.43±488.93[ab] | 50 | 8113.36±113.93[bd] |
| 2014 | 16 | 352.72±19.39 | 11 | 9625.98±728.16[ab] | 17 | 8786.37±162.46[ce] |
| 2015 | 52 | 388.53±10.44 | 28 | 10909.97±442.05[ab] | 59 | 8699.75±84.57[ce] |
| 2016 | 15 | 370.09±19.27 | 9 | 10178.81±754.51[abc] | 17 | 8339.84±156.61[cd] |
| 2017 | 36 | 387.24±12.05 | 19 | 11071.07±510.44[abc] | 44 | 8652.71±94.97[cde] |
| 2018 | 58 | 360.48±10.20 | 38 | 10507.78± 381.39[a] | 62 | 8922.44± 85.46[e] |
| 2019 | 60 | 360.23±10.02 | 37 | 12124.92±382.65[bc] | 67 | 10165.44± 81.97[f] |
| 2020 | 45 | 352.47±11.09 | 34 | 12765.94±395.16[c] | 47 | 10726.97±93.18[g] |
| Calving month | | ** | | ** | | NS |
| 1 | 36 | 346.40±12.72[ac] | 22 | 9790.35 ±507.50[a] | 41 | 8551.71±102.48 |
| 2 | 26 | 376.90±14.76[abc] | 22 | 10419.27±494.86[ab] | 31 | 8562.45±116.81 |
| 3 | 23 | 413.96±15.52 [b] | 16 | 12318.91±575.80[b] | 27 | 8700.27±125.00 |
| 4 | 20 | 420.11±17.35[b] | 11 | 11893.86±699.09[ab] | 21 | 8691.77±145.38 |
| 5 | 10 | 430.22±22.85[ab] | 8 | 12623.05±769.27[bc] | 11 | 8733.35±189.54 |
| 6 | 27 | 364.41±14.31[abc] | 17 | 10600.88±555.67[ab] | 30 | 8602.51±117.50 |
| 7 | 46 | 364.20±11.15[abc] | 32 | 10374.27±408.79[ab] | 49 | 8518.99±93.10 |
| 8 | 44 | 335.17±11.37[c] | 27 | 10479.21±433.66[ab] | 47 | 8795.46±95.07 |
| 9 | 39 | 361.32±12.05[abc] | 15 | 10840.55±571.39[ab] | 46 | 8830.90±96.90 |
| 10 | 80 | 354.57±9.13[ac] | 42 | 10203.36±366.83[ab] | 86 | 8864.64±75.69 |
| 11 | 40 | 347.46±11.60[ac] | 24 | 10200.84±456.24[ab] | 49 | 8784.34±91.85 |
| 12 | 56 | 343.46±9.96[c] | 35 | 10000.13±389.43[a] | 59 | 8790.11±83.30 |
| Parity | | NS | | ** | | NS |
| 1 | 172 | 383.80±8.09 | 81 | 11506.60±295.30[a] | 189 | 8720.43±65.72 |
| 2 | 111 | 365.65±8.74 | 89 | 10274.18± 322.38[b] | 123 | 8629.40±73.37 |
| 3 | 94 | 358.77±9.39 | 61 | 9989.93± 390.04[b] | 104 | 8639.46±77.75 |
| 4 | 32 | 373.81±13.43 | 21 | 11422.46± 498.86[ab] | 37 | 8745.20±107.86 |
| 5+ | 38 | 375.55±12.52 | 18 | 10867.12± 533.05[ab] | 44 | 8776.55±101.85 |
| Overall | 447 | 363.52±3.52 | 271 | 10596±152 | 497 | 8647.0±58.0 |

NS: non-significant, **: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.

## Discussion

### *Fertility traits*

The overall mean of FCA found for SIM breed (842.35±5.30 days or 28.08 months), which showed significant changes according to calving year and calving months, was found to be approximately 4 months longer than the 24 months accepted ideal for foreign cattle breeds. While the FCA overall mean had longer values ranging from 2.5 months (2016) to 10 months (2008) depending on the year of birth, it had longer values ranging from 4 (August and December) to 6 months (March) depending on the month of birth.

The mean FCA found for SIM cattle in this study was lower than all reported values (Akbulut, 1998; Şekerden et al., 1999; Özkan and Güneş, 2011a; Koç, 2016b, 2017) for the same breed. Akbulut (1998) and Koç (2016b) both of them compiled studies on SIM cattle raised in Türkiye, reported the average of FCA as 908±52.7 days, and 913±37.03 days, respectively. On the other hand, the averages of 955.2±13.62 days (Koç, 2016b) and 851.6±6.19 days (Koç et al., 2011) reported for MB and RH breeds reared in Aydın province conditions, respectively, are higher than the average obtained in this study.

As widely known, heifers are inseminated at the age of 14-16 months. If the heifers' birth is between January and April, it would clarify that insemination was applied on summer time, when the air temperature and humidity are high. Because of that FCA is prolonged in these months due to the increased rate of unclear estrus, decrease of the fertilization of sperm and egg, increase in embryonic deaths and failure of the embryo to attach to the uterus. In fact, it is observed that some animal breeders sometimes do not inseminate during this period because they know that the success of insemination is low in the summer months.

Similar to FCA, the overall CI mean for SIM cattle (422.98±3.18 days or 14.1 months) average is also determined as longer than 365 days, which is considered ideal, between 39.8 days (2012) and 104.2 days (2015) according to calving years, and between 34.1 days (December) and 111.4 days (March) according to calving months.

The mean CI (422.98±3.18 days) calculated for SIM cattle in this study was determined to be higher than the values reported by Akbulut (1998), Çilek and Tekin (2006), Özkan and Güneş (2011a), Erdem et al. (2015), Koç (2016b), Koç and Arı (2020) for the same breed and higher than the averages reported by Koç (2016b) for MB, Koç and Arı (2020) for the RH, Koç et al. (2011) for RH. The mean of 446.88±7.06 days calculated for the SIM breed in this study in the first parity is higher than the mean (421.4±7.66 days) reported by Koç and Gürses (2020) for RH and HF breeds at the first parity.

***Longevity traits***

The 75.48-month HL average calculated for SIM cattle in this study can be considered a positive situation when Oltenacu (2009)'s rate of survival at 48 months of age is taken as a criterion. However, when both HL and PL are considered and considering that CI should be 12 months, cows with one birth stay in the herd for 18.36 months and cows with two births stay in the herd for 36.38 months and they culled at the age of 48.62±2.66 months and 66.77±2.82 months, respectively (Table 2), indicating that there is a fertility problem on the farm. It is understood that the farm prefers to keep these cows in the herd for a longer period of time, probably because their milk yield is satisfactory, instead of culling the animals that have fertility problems at an earlier age. On the other hand, it should be considered as a high rate that 19.3% of the cows after giving birth once, and 22.2% of the cows after giving birth twice removed from the herd.

The mean HL found for SIM cattle (75.48±1.72 months or 2264.4 days) in this study was longer than the values of Koç (2017) who found 1674.88±133.89 days (55.82 months), 1614.16±133.56 days (53.81 months) and 1634.93±110.54 days (54.5 months) for HF, RH and SIM breeds reared in the same farm, respectively, and the value (2073 days or 69.1 months) of Yaylak (2003) and the value (2229.07±18.53 days or 74.3 months) of Boğokşayan and Bakır (2013).

The mean PL (47.15±1.73 months or 1414.5 days) found for SIM cattle in this study was longer than the values of Koç (2017) who found 871.38±120.05 days (29.05 months), 773.84±120.65 days (25.8 months) and 740.49±99.11 days (24.7 months) for HF, RH and SIM breeds, respectively, and also the values reported for HF by Yaylak (2003), Kara et al. (2010) and Boğokşayan and Bakır (2013). Yaylak repoted 1060 days or 35.3 months, Kara et al. (2010) reported 36.8 ± 2.60 months and Boğokşayan and Bakır (2013) reported 1236.10±13.87 days (41.2 months) for HF breed.

***Milk yield traits***

In this study, although the LL of the SIM breed was found to be 58.5 days longer than the standard lactation period, the average LMY of the breed was above 10 tons in all years except 2014. In addition, since all cows on the farm are in 1st and 2nd lactation in the first 2 years, if these years are not taken into account, 305-dMY being over 8 tons should be considered as a very high milk production level for the SIM breed.

The mean LL obtained in this study of SIM cattle (363.52±3.52 days) was determined to be higher than the all means reported by Abkulut (1998), Çilek and Tekin (2006), Özkan and Güneş (2011b), Erdem et al. (2015), Koç (2016b), Koç and Arı (2020) for the same breed, and Çerçi (2006) for HF, Koç (2006) for HF and Brown-Swiss breeds, Yılmaz (2010) and Koç and Arı (2020) for RH breed and Koç (2016b) for MB breed.

The mean LMY obtained for the SIM breed (10,596±152 kg) in this study was higher than 3072±146 kg as reported by Akbulut (1998), 3368.11±38.49 kg as reported by Özkan and Güneş (2011b), 5746.5±65.47 kg reported by Erdem et al. (2015), 4756±59.41 kg and 5918.7±75.30 kg reported by Okuyucu et al. (2018) for the first and the second parity cows of SIM breed raised in intensive dairy cattle farms in the Konya region, and 7357.03±88.12 kg reported by Koç and Arı (2020) for SIM breed. Additionally, the LMY average calculated for the SIM breed in this study is higher than all of the LMY values reported by Çerçi (2006) for the HF breed, Koç (2016b) for the MB breed, Yılmaz (2010) and Koç and Arı (2020) for the RH breeds.

Similar to Koç (2009) who conducted a study on HF and MB breeds and Yılmaz (2010) for RH breed, the effect of year on 305-dMY was found to be significant in this study, but unlike Koç (2009) and Yılmaz (2010), the parity effect on 305-dMY was detected to be insignificant in this study ($P<0.05$).

In terms of the 305-dMY (8647.0±58.0 kg) mean of the SIM breed, a similar situation with LL and LMY was seen when compared with the mean values obtained in other studies. In this study, the 305-dMY average obtained for the SIM breed was determined to be higher than all the means reported by Şekerden and Erdem (1997), Akbulut (1998), Şekerden et al. (1999), Çilek and Tekin (2006), Özkan and Güneş (2011b), Erdem et al. (2015), Koç (2016b), Koç and Arı (2020) for the same breed, Koç (2001) and Çerçi (2006) for HF, Koç (2006) for HF and Brown-Swiss, Koç (2009) for HF and MB breeds, Yılmaz (2010) and Koç and Arı (2020) for RH, Koç (2016b) for MB and Koç and Gürses (2020) for the RH and HF.

In this study, LL, LMY and 305-dMY averages obtained for the SIM breed were found to be higher than all the averages reported for the same breed and other breeds in previous studies in Türkiye. The high LMY and 305-dMY averages of SIM breed reveals the reason why breeders have increased interest in breeding this breed of Austrian and German origin in recent years, in addition to its other characteristics.

In addition to the fact that the SIM breed has a high LMY and 305-dMY average in this farm, the management and feeding practices applied in the farm where it is grown are appropriate, as can be understood from the CI average of this breed (422.98±3.18 days) that the high milk yield potential of the breed by keeping the days open period long, it is understood that the LL was extended (363.52±3.52 days) to benefit from it.

## Conclusion

Some important information was obtained about fertility, longevity and milk yield of Austrian origin SIM (Fleckvieh) cattle, known as dual purpose cattle but with increased milk yield, for which the interest of dairy cattle breeders in Türkiye has increased in recent years.

The FCA (842.35±5.30 days or 28.1 months) and CI (422.98±3.18 days or 14.1 months) means of SIM cattle found in this study were about four and two months longer than expected, respectively. The mean HL and PL of this breed were calculated as 74.48±1.72 months and 47.15±1.73 months. When the PL, FCA and CI averages of

SIM cattle are taken into account, it is understood that 3.34 births per cow participating in the herd are obtained. On the other hand, although the mean LL of SIM cattle (363.52±3.52 days) was about one year, the mean LMY (10,596±152 kg) was over 10 tones, and the mean of 305-dMY (8647.0±58.0 kg) was over 8.5 tones. The fact that FCA and CI averages are longer in these farm conditions where Austrian origin SIM cattle raised can be interpreted as a number of problems in terms of reproductive efficiency of SIM cattle, however, considering the high milk yield of this genotype and the dry period from the LL (363.52±3.52 days) and CI (422.98±3.18 days) averages, it is understood that the share of the dry period, which is an unproductive period, was tried to be reduced. Thus, it can be said that the milk yield per cow and accordingly the profitability of the farm increase.

In conclusion, it has been determined that the milk yield of Austrian origin SIM cattle is as high as the milk yield of HF breed, which is widely grown in Türkiye and the world, and even higher in some farms. While this genotype provides significant advantages in terms of HL, carcass yield and price are generally higher than the HF breed when culled animals are sent to slaughter, and considering the instability in milk prices and the increase in red meat prices, it is understood why breeders preferred to breed this genotype in recent years.

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