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A RESEARCH ON MILK YIELD, PERSISTENCY, MILK CONSTITUENTS AND SOMATIC CELL COUNT OF RED HOLSTEIN COWS RAISED UNDER MEDITERRANEAN CLIMATIC CONDITIONS

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Abstract

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Phenotypic and genetic parameter estimation of lactation length (LL), 305 days milk yield (305-dMY) and persistency traits ($P_{2:1}$, $P_{3:1}$, $P_{3:2}$ and P_{Tomax}) of Red Holstein (RH) cows reared at a dairy cattle farm under the Mediterranean climatic conditions were estimated. In addition, the effects of environmental factors on milk constituents and somatic cell count (SCC) of RH were determined. The averages of LL, 305-dMY, $P_{2:1}$, $P_{3:1}$, $P_{3:2}$ and P_{Tomax} calculated from 362 lactation records were 353.0±3.73 d, 7652.8±80.68 kg, 86.9±0.77%, 62.1±1.12%, 70.7±1.01% and 5.1±0.05, respectively. The heritabilities estimated by using individual animal model for these traits were determined to be 0.14±0.08, 0.44±0.06, 0.19±0.07, 0.31±0.07, 0.28±0.07 and 0.23±0.07, respectively. The averages of milk protein content (MPC) and Log_{10}SCC for RH cows calculated from the analysis of 202 milk samples were 3.2±0.03% and 63.753 cells/mL, respectively. It can be said that RH cows had higher milk yield and better udder health status than some other breeds reared in the region. Due to higher temperature and relative humidity in summer under the Mediterranean climatic conditions, some precautions need to be taken against heat stress on this form and the dairy farms in the region.

Key words: persistency, 305-days milk yield, heritability, milk protein content, somatic cell count

*Abbreviations***:** 305-dMY: 305 day milk yield, BS: Brown-Swiss, h^2: heritability, HF: Holstein-Friesian, LL: Lactation length, LMY: Lactation milk yield, M: Montbeliarde, MLC: Milk lactose content, MPC: Milk protein content, NFDMC: Non-fat dry matter content, $P_{2:1}$: Milk yield produced between 101 and 200 days of lactation divided into the first 100 days of milk yield, $P_{3:1}$: Milk yield produced between 201 and 300 days of lactation divided into the first 100 days of milk yield, $P_{3:2}$: Milk yield produced between 201 and 300 days of lactation divided into the yield produced between 101 and 200 days of the lactation, P_{Tomax}: 305-dMY divided into the first 50 days yield of the lactation, RH: Red-Holstein, SCC: Somatic cell count, STMY: Sampling time milk yield

Introduction

Daily milk yield of a cow changes significantly during lactation. In the first two months of lactation after calving, an increase in daily milk yield up to the peak yield is resulted from the increase of secretory cells in the mammary gland. After the peak, the yield decreases because of the slower rate of the secretory cells creation than the rate of dying cells. The reduction rate in milk yield after the peak yield is called persistency of lactation (Kaya and Kaya, 2003). Persistency is important in high yielding dairy cows and it is accepted that a cow with higher persistency is more profitable for the herd. Persistency of lactation can be calculated from the decrease rate of monthly milk production as well as calculated from the decrease rate of 100 day-production ($P_{2:1}$, $P_{3:1}$ and $P_{3:2}$). In addition, persistency can also be calculated by dividing 305-day-milk yield (305-dMY) into the first 50 day-milk yield (P_{Tomax}).

It was reported that persistency is the highest at primiparus cows and the averages of $P_{2:1}$, $P_{3:1,}$ $P_{3:2}$ and P_{Tomax} in Holstein-Friesian (HF) were 84.6±11.5%, 61.5±15.8%, 72.6±15.3% and 4.92±0.65% (Kaya and Kaya, 2003), the averages of $P_{2:1}$, $P_{3:1}$ and $P_{3:2}$ in Browns-Swiss (BS) were 94.35%, 62.55% and 65.87%, respectively (Çakilli and Güneş, 2007).

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Lactation length (LL) averages of HF were reported between 284 days and 340 days, lactation milk yield (LMY) averages were between 4556.64 kg and 7704.25 kg, 305-dMY averages were between 4455.25 kg and 7290.32 kg (Kumlu and Akman, 1999; Koc, 2001; 2006; 2011; Duru and Tuncel, 2002; Kaya et al., 2003).

Heritability of persistency was reported as 0.500±0.204 (Kaygisiz et al., 1995) and 0.071±0.059 (Tekerli, 2010). For four different HF herds, reported heritabilities are 0.10, -0.03,- 0.01 and 0.12 for $P_{2:1}$; 0.15, 0.08, 0.12 and 0.19 for $P_{3:1}$; 0.10, 0.10, 0.11 and 0.03 for $P_{3:2}$; and 0.06, 0.06, 0.05 and 0.15 for P_{Tomax} (Kaya and Kaya, 2003).

Heritabilities for LL were reported between 0.01 and 0.157±0.116 (Koc, 2001; Atay et al., 1995; Cetin and Koc, 2011), for LMY were reported between 0.14±0.051 and 0.52±0.10 (Gürdoğan and Alpan, 1990; Koc, 2001; Çerci, 2006), for 305-dMY were reported between 0.13±0.049 and 0.68±0.11 (Ulusan et al., 1988; Koc, 2001; Ertuğrul et al., 2002; Ünalan and Cebeci, 2004; Tuna, 2004).

Besides the milk yield, milk constituents and its hygienic quality have become important issues in dairy sector. Milk protein content (MPC) was reported for HF was 3.5±0.49% (Şekerden, 2002), 3.33±0.004% (Topaloğlu and Gunes, 2005) and 2.86±0.059% (Koc, 2011), for Montbeliarde (M) breed it was 2.93±0.040% (Koc, 2011).

Milk lactose content (MLC) for HF and M breeds were 4.53±0.041% and 4.57±0.029%, respectively (Koc, 2011). Non-fat dry matter content (NFDMC) of milk were 7.9±1.05% (Sekerden, 2002), 9.61±0.048% (Koc, 2007), 9.78±0.024% (Koc, 2008) and 8.23±0.067% (Koc, 2011) for HF, 10.12±0.093% for BS (Koc, 2007) and 8.35±0.047% for M (Koc, 2011).

Somatic cell count (SCC) averages for HF were reported as 138.000±4.313 cells/ml (Topaloglu and Gunes, 2005), 1.311.768±239.631 cells/ml and 732.810±146.264 cells/ml respectively for August and November (Eyduran et al., 2005), 583.445 cells/ml (Koc, 2006), 512.861 cells/ml (Koc, 2008), 199.022 cells/ml (Koc, 2001); for BS cows it was 358.096 cells/ml (Koc, 2006) and 315.065 cells/ml (Koc and Kizilkaya, 2007); and for M cows it was 138.644 cells/ml (Koc, 2011).

In this study, it was aimed to estimate the genetic and phenotypic parameters of LL, LMY, 305-dMY and persistency traits ($P_{2:1}$, $P_{3:1,}$ $P_{3:2}$ and P_{Tomax}) of RH raised in a herd in Aydın province, Turkey and to determine the effects of environmental factors on MPC, MLC, NFDMC and SCC.

Materials and Methods

Red Holstein (RH) cattle are recessive homozygote of HF for coat color and have been accepted as a different breed all over the world since 1970s. This breed was also brought to Turkey at the end of 1990s. The origin of the RH herd used its data in this study is Germany, but in the herd the sperms used for AI from the USA, Canada, Italy, Germany, etc.

Pedigrees, reproductive performances and milk yield data of the herd were obtained from the records of the Cattle Breeders' Association of Turkey and the producer. Total of 362 lactation records for 128 cows collected between 2001 and 2008 were used. LL values between 220 days and 550 days were included into the analysis (Kumlu and Akman, 1999). For the calculation of persistency, four different parameters ($P_{2:1}$, $P_{3:1}$, $P_{3:2}$ and P_{Tomax}) were used (Kaya and Kaya, 2003). $P_{2:1}$ is the milk yield produced between 101 and 200 days of lactation divided into the first 100 days of milk yield, and $P_{3:1}$ is the milk yield produced between 201 and 300 days of lactation divided into the first 100 days of milk yield and $P_{3:2}$ is the milk yield produced between 201 and 300 days of lactation divided into the yield produced between 101 and 200 days of the lactation. On the other hand, P_{Tomax} was calculated by dividing 305-dMY into the yield of the first 50 days of lactation.

Additionally, total of 202 milk samples from the lactating cows at the morning and evening milkings were taken on 19/3/2009 and on 26/06/2009 for the analysis of milk constituents and SCC. The samples were taken before the milking and the data of MPC, MLC and NFDMC with more than 200.000 cells/ml were not included in the statistical analysis, because of the significant changes in milk constituents. Milk samples were analyzed with Bentley 150 Infrared Milk Analyzer for the determination of MPC, MLC and NFDMC and analyzed with Bentley Somacount 150 for SCC.

Statistical analysis of data

Before the statistical analysis of milk yield and persistency traits, the data were divided into five parities (1, 2, 3, 4 and 5+), 12 calving months and eight calving years (2001, 2002, ….. and 2008). The statistical model used for the analysis is as follows:

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

y_{ijkl} is the observation of LL, LMY, 305-dMY, $P_{2:1}$, $P_{3:1}$, $P_{3:2}$ and P_{Tomax}; μ is the overall mean; a_i is parity effects (i= 1, 2, 3, 4 and 5+); b_j is lactation month effects (j= 1, 2, …. and 12); c_k is year effects (k= 2001, …..2008); and e_{ijkl} is random error.

For the statistical analysis of milk constituents (MPC, MLC and NFDMC) and SCC, and sampling time milk yield (STMY), the data were divided into two calving seasons group, cows calved between November and April were grouped into winter season, and cows calved between May and October were grouped into summer season. In addition, five parities, four sampling time and thirteen lactation months were accepted; cows lactating more than 13 months were included into 13th month. Before the statistical analysis, based-10-logarithmic transformation was applied to the SCC to create a normal distribution. The statistical model used for STMY, MPC, MLC, NFDMC and SCC is as follows:

$$y_{ijklm} = \mu + a_i + b_j + c_k + d_l + (ab)_{ij} + (bc)_{jk} + e_{ijklm} \quad \text{.........} \quad (2)$$

y_{ijklm} is the observation of STMY, MPC, MLC, NFDMC and SCC; μ is the overall mean; a_i is parity effects (i= 1, 2, 3, 4 and 5+); b_j is calving season effects (j= 1 for winter and 2 for summer); c_k is sampling time effects (I= 1 for winter-morning, 2 for winter-evening, 3 for summer-morning and 4 for summer-evening); d_l is lactation month effects (1, 2,…, 12, 13+); $(ab)_{ij}$ is parity x calving season interaction effects; $(bc)_{jk}$ is calving season x sampling time interaction effects and e_{ijklm} is random error.

The data were analyzed using the GLM procedure of SAS (1999). The differences between the least squares means of fixed factor levels were considered statistically significant at P < 0.05 (2-tailed) based on Tukey's adjustment type I error rate.

In this study, heritability (h^2) was estimated by using DFREML 3.0 (Meyer, 1998) for milk yield and persistency traits. For the estimation of heritability, Individual Animal Model was used and 718 animals were included into the pedigree file. It was determined that 8 animals were inbred with an inbreeding coefficient of 14.85%.

Results

The least square means of LL, LMY, 305-dMY are given in Table 1, $P_{2:1}$, $P_{3:1}$, $P_{3:2}$ and P_{Tomax} are given in Table 2, the

Table 1
Least square means and std. errors for milk yield of Red-Holstein

Factors	n	The first 50-day milk yield, kg	Lactation length, day	Lactation milk yield, kg	305-day milk yield, kg
Calving month		**	NS	*	*
1	52	1.629.9 ± 43.27^{ABa}	338.9 ± 10.55	8395.7 ± 294.46^{Aab}	7756.7 ± 205.63^{Aab}
2	52	1555.1 ± 42.93^{ABab}	337.9 ± 10.47	8089.0 ± 292.18^{Aab}	7465.6 ± 204.03^{Aab}
3	44	1624.4 ± 44.42^{ABa}	346.4 ± 10.84	8236.1 ± 302.31^{Aab}	7674.8 ± 211.11^{Aab}
4	18	1732.4 ± 69.53^{Aa}	363.5 ± 16.96	9696.9 ± 473.18^{Aa}	8532.4 ± 330.43^{Aa}
5	17	1637.7 ± 73.92^{ABab}	343.2 ± 18.03	8519.7 ± 503.01^{Aab}	7857.0 ± 351.26^{Aab}
6	19	1468.6 ± 70.25^{ABab}	349.2 ± 17.14	8147.9 ± 478.09^{Aab}	7555.2 ± 333.86^{Aab}
7	33	1394.3 ± 52.90^{Bb}	338.0 ± 12.91	7857.5 ± 360.03^{Ab}	7131.1 ± 251.41^{Ab}
8	23	1372.6 ± 63.46^{BCb}	356.3 ± 15.48	7957.3 ± 431.88^{Aab}	7021.0 ± 301.59^{Ab}
9	42	1479.9 ± 47.35^{ABab}	339.7 ± 11.55	8234.1 ± 322.24^{Aab}	7747.2 ± 225.02^{Aab}
10	14	1561.8 ± 79.48^{ABab}	330.0 ± 16.39	8756.9 ± 540.89^{Aab}	8217.2 ± 377.71^{Aab}
11	13	1510.9 ± 83.84^{ABab}	391.5 ± 20.45	9476.9 ± 570.56^{Aab}	8357.4 ± 398.43^{Aab}
12	35	1676.4 ± 52.42^{ACa}	363.2 ± 12.79	9243.2 ± 356.74^{Aab}	8325.7± 249.12^{Aa}
Calving year		**	NS	**	**
2001	71	1401.4 ± 51.78^{Aa}	341.9 ± 12.63	7500.7 ± 352.38^{Aa}	7026.8 ± 246.07^{Aa}
2002	43	1425.8 ± 58.9^{ABab}	385.4 ± 14.37	8775.1 ± 400.82^{ABabc}	7623.5 ± 279.90^{ABab}
2003	49	1487.2 ± 51.81^{ABabc}	345.8 ± 12.64	8162.0 ± 352.54^{ABab}	7524.1 ± 246.19^{ABa}
2004	38	1647.9 ± 52.00^{ABCbcd}	356.7 ± 12.68	8664.1 ± 353.87^{ABabc}	7884.13± 247.11^{ABab}
2005	46	1652.7 ± 45.59^{BCcd}	338.1 ± 11.12	9174.6 ± 310.24^{Bbc}	8499.1 ± 216.65^{Bbc}
2006	58	1728.9 ± 40.63^{Cd}	357.3 ± 9.91	9523.2 ± 276.51^{Bc}	8493.1 ± 193.09^{Bb}
2007	43	1583.3 ± 46.61^{ABCabcd}	355.6 ± 11.37	8667.1 ± 317.20^{Babc}	7653.2 ± 221.51^{ABac}
2008	14	1502.0 ± 82.98^{ABCabcd}	317.8 ± 20.24	8074.2 ± 564.70^{ABabc}	7723.6 ± 394.34^{ABab}
Parity		**	NS	*	**
1	115	1350.9 ± 37.77^{Aa}	368.0 ± 9.21	8523.6 ± 257.06^{Aab}	7413.1 ± 179.51^{Aa}
2	104	1540.4 ± 35.94^{Bb}	353.1 ± 8.77	8572.2 ± 244.59^{Aab}	7732.9 ± 170.80^{ABab}
3	66	1748.2 ± 44.70^{Cc}	345.5 ± 10.90	9251.7 ± 304.22^{Aa}	8465.8 ± 212.44^{Bb}
4	33	1637.2 ± 59.67^{BCbc}	341.9 ± 14.55	8434.0 ± 406.04^{Aab}	7843.8 ± 283.55^{ABab}
5+	44	1491.7 ± 47.86^{ABab}	340.7 ± 11.67	8056.4 ± 325.66^{Ab}	7561.6 ± 227.42^{ABa}
Overall mean	362	1523.2 ± 18.05	353.0 ± 3.73	8484.5 ± 109.28	7652.8 ± 80.68

*:P<0.05; **:P<0.01. NS: Not significant. A,B,C: Significance at P<0.01. a,b,c,d: Significance at P<0.05.

heritability are given in Table 3, and the least square means of STMY and SCC are given in Table 4 and MPC, MLC and NFDMC are given in Table 5. The averages of LL, LMY, 305-dMY, $P_{2:1}$, $P_{3:1}$, $P_{3:2}$ and P_{Tomax} were 353.0±3.73 days, 8484.5±109.28 kg, 7652.8±80.68 kg, 86.9±0.77%, 62.1±1.12%, 70.7±1.01% and 5.1±0.05, respectively.

The higher means of $P_{2:1}$ than $P_{3:1}$ indicates that the persistency of lactation between 101 days and 200 days is higher than that of 201 days and 300 days. On the other hand, as the P_{Tomax} taken, it was seen that 305-dMY was more than five times higher than the first 50 days of the production.

The highest persistency was obtained for the first parity and the persistency was decreased as the milk yield increased. As can be seen in Table 2, the high milk yielding cows had difficulty to persist milk yield compared to the low milk yielding cows.

Table 3
Heritabilities for milk yield and persistency traits of Red-Holstein

Traits	h^2
Lactation length	0.14 ± 0.08
Lactation milk yield	0.47 ± 0.07
305-d milk yield	0.44 ± 0.06
$P_{2:1}$	0.19 ± 0.07
$P_{3:1}$	0.31 ± 0.07
$P_{3:2}$	0.28 ± 0.07
P_{Tomax}	0.23 ± 0.07

Table 2
Least square means and std. errors for persistency traits of Red-Holstein

Factors	n	$P_{2:1}$, %	$P_{3:1}$, %	$P_{3:2}$, %	P_{Tomax}
Calving month		*	**	**	NS
1	52	83.7 ± 2.15^{Aab}	52.9 ± 3.01^{Aa}	62.6 ± 2.75^{Aa}	4.8 ± 0.14
2	52	83.4 ± 2.13^{Aab}	54.3 ± 2.99^{ABac}	63.5 ± 2.73^{Aa}	5.1 ± 0.14
3	44	70.4 ± 2.20^{Aa}	52.5 ± 3.09^{Aa}	65.4 ± 2.83^{ABba}	4.8 ± 0.14
4	18	86.7 ± 3.45^{Aab}	58.9 ± 4.84^{ABab}	68.5 ± 4.421^{Bab}	5.0 ± 0.23
5	17	85.1 ± 3.67^{Aab}	62.3 ± 5.15^{ABab}	73.5 ± 4.70^{ABab}	4.9 ± 0.24
6	19	89.3 ± 3.49^{Aab}	66.8 ± 4.89^{ABab}	75.1 ± 4.47^{ABab}	5.2 ± 0.23
7	33	91.0 ± 2.63^{Ab}	62.6 ± 3.68^{ABab}	68.2 ± 3.36^{ABab}	5.3 ± 0.17
8	23	88.4 ± 3.15^{Aab}	73.3 ± 4.42^{Bb}	83.1 ± 4.04^{Bb}	5.3 ± 0.21
9	42	89.7 ± 2.35^{Ab}	66.5 ± 3.30^{ABab}	73.3 ± 3.01^{ABab}	5.4 ± 0.15
10	14	95.9 ± 3.94^{Ab}	73.2 ± 5.54^{ABbc}	75.2 ± 5.05^{ABab}	5.4 ± 0.26
11	13	94.2 ± 4.16^{Ab}	72.2 ± 5.84^{ABab}	76.6 ± 5.33^{ABab}	5.6 ± 0.27
12	35	86.3 ± 2.60^{Aab}	60.2 ± 3.65^{ABab}	69.1 ± 3.33^{ABab}	5.1 ± 0.17
Calving year		NS	NS	NS	NS
2001	71	86.8 ± 2.57	62.6 ± 3.61	71.9 ± 3.29	5.2 ± 0.17
2002	43	92.8 ± 2.92	72.8 ± 4.10	78.3 ± 3.75	5.5 ± 0.19
2003	49	88.3 ± 2.57	59.0 ± 3.61	65.2 ± 3.29	5.2 ± 0.17
2004	38	83.2 ± 2.58	56.8 ± 3.62	67.9 ± 3.31	4.9 ± 0.17
2005	46	89.1 ± 2.26	65.9 ± 3.18	73.2 ± 2.90	5.3 ± 0.15
2006	58	88.0 ± 2.02	60.3 ± 2.83	67.5 ± 2.58	5.1 ± 0.13
2007	43	85.8 ± 2.31	59.4 ± 3.25	68.5 ± 2.96	4.9 ± 0.15
2008	14	88.1 ± 4.12	67.2 ± 5.78	76.8 ± 5.28	5.2 ± 0.27
Parity		*	*	**	*
1	115	92.8 ± 1.87^{Aa}	73.5 ± 2.63^{Aa}	79.9 ± 2.40^{Aa}	5.5 ± 0.12^{Aa}
2	104	85.2 ± 1.78^{Ab}	63.6 ± 2.50^{ABb}	73.4 ± 2.29^{ABab}	5.1 ± 0.12^{Aab}
3	66	85.2 ± 2.22^{Ab}	59.1 ± 3.11^{Bb}	68.6 ± 2.84^{ABb}	4.9 ± 0.14^{Ab}
4	33	88.0 ± 2.96^{Aab}	59.4 ± 4.16^{ABb}	66.7 ± 3.79^{ABb}	5.0 ± 0.19^{Aab}
5+	44	86.9 ± 2.38^{Aab}	59.4 ± 3.33^{Bb}	67.2 ± 3.04^{Bb}	5.2 ± 0.16^{Aab}
Overall mean	362	86.9 ± 0.77	62.1 ± 1.12	70.7 ± 1.01	5.1 ± 0.05

*:P<0.05; **:P<0.01. NS: Not significant. A,B: Significance at P<0.01. a,b,c: Significance at P<0.05.

Table 4
Least square means and std. errors of sampling milk yield and somatic cell count for Red-Holstein

Factors	n	Sampling time milk yield, kg	Somatic cell count	
			Log_{10} SCC	SCC, cells/mL
Calving season		NS	**	
Winter	106	11.3 ± 0.47	4.6032 ± 0.14551^{Aa}	40.105
Summer	96	11.3 ± 0.44	5.1375 ± 0.13433^{Bb}	137.246
Parity		NS	NS	
1	81	11.9 ± 0.39	4.6784 ± 0.11986	47.687
2	30	11.7 ± 0.63	4.9332 ± 0.19544	85.743
3	39	12.3 ± 0.52	4.8443 ± 0.16183	69.872
4	10	9.9 ± 1.02	4.8776 ± 0.31646	75.44
5+	42	10.7 ± 0.55	5.0182 ± 0.17209	104.28
Sampling time		**	NS	
1 (WM)	52	12.2 ± 0.46^{Aa}	4.7358 ± 0.14407	54.425
2 (WE)	53	9.8 ± 0.46^{Bb}	4.6772 ± 0.14298	47.555
3 (SM)	49	12.0 ± 0.51^{Aa}	5.0313 ± 0.15574	107.473
4 (SE)	48	11.1 ± 0.51^{ABab}	5.0372 ± 0.15641	108.943
Lactation month (13 months)		**	**	
Calv.Season (X) Sampling time		**	*	
Calv. Season (X) Parity		**	NS	
Overall mean	202	11.4 ± 0.28	4.8045 ± 0.06946	63.753

*:P < 0.05; **:P < 0.01; NS: Not significant. WM: Milk protein content, MLC: Milk lactose content, NFDMC: Non-fat dry matter content, WM: Winter-morning, WE: Winter-evening, SM: Summer-morning, SE: Summer-evening. A,B: Significance for P < 0.01. a,b: Significance for P < 0.05

Table 5
Least square means and std. errors of some milk constituents for Red-Holstein

Factors	Milk constituents			
	n	MPC, %	MLC, %	NFDMC, %
Calving season		*	NS	NS
Winter	81	3.1 ± 0.05^{Aa}	4.7 ± 0.05	8.8 ± 0.08
Summer	69	3.3 ± 0.05^{Ab}	4.6 ± 0.04	8.8 ± 0.08
Parity		**	**	NS
1	69	3.1 ± 0.04^{Aa}	4.8 ± 0.04^{Aa}	8.9 ± 0.07
2	20	3.3 ± 0.09^{Aab}	4.7 ± 0.08^{ABab}	9.0 ± 0.14
3	26	3.3 ± 0.06^{Ab}	4.7 ± 0.05^{ABb}	8.9 ± 0.10
4	8	3.0 ± 0.10^{Aa}	4.6 ± 0.09^{ABb}	8.5 ± 0.17
5+	27	3.2 ± 0.07^{Aab}	4.6 ± 0.06^{Bb}	8.7 ± 0.11
Sampling time		**	NS	NS
1 (WM)	42	3.2 ± 0.05^{ABac}	4.7 ± 0.04	8.87 ± 0.073
2 (WE)	39	3.3 ± 0.05^{Aa}	4.6 ± 0.04	8.93 ± 0.074
3 (SM)	36	3.1 ± 0.06^{Bb}	4.7 ± 0.05	8.70 ± 0.093
4 (SE)	33	3.1 ± 0.06^{Bbc}	4.7 ± 0.05	8.74 ± 0.093
Lactation month (13 months)		**	**	NS
Calv.Season (X) Sampling time		**	NS	NS
Calv. Season (X) Parity		**	*	NS
Overall mean	150	3.2 ± 0.03	4.7± 0.02	8.9 ± 0.04

*:P < 0.05; **:P < 0.01; NS: Not significant. MPC: Milk protein content, MLC: Milk lactose content, NFDMC: Non-fat dry matter content, WM: Winter-morning, WE: Winter-evening, SM: Summer-morning, SE: Summer-evening. A,B: Significance for P < 0.01. a,b,c: Significance for P < 0.05.

Heritabilities of LL, LMY, 305-dMY, $P_{2:1}$, $P_{3:1}$, $P_{3:2}$ and P_{Tomax} were 0.14±0.08, 0.47±0.07, 0.44±0.08, 0.19±0.07, 0.31±0.07, 0.28±0.07 and 0.23±0.07, respectively (Table 3).

Least square means of STMY, MPC, MLC, NFDMC and SCC were 11.4±0.28 kg, 3.2±0.03%, 4.7±0.02%, 8.9±0.04% and 4.8045±0.06946 (63.753 cells/mL), respectively (Tables 4 and 5).

Discussion

The averages of LL, LMY and 305-dMY of RH were higher than some other studies (Atay et al., 1995; Kumlu and Akman, 1999; Koc, 2001; 2006; 2011; Duru and Tuncel, 2002; Kaya et al., 2003; Çerci, 2006; Erdem et al., 2007) for HF, and higher than a few studies (Koc, 2006; Cakili and Günes, 2007) for BS and higher than Koc (2011) for M breed. In addition to the high milk producing capacity, the higher LMY found for RH was also due to higher LL. On the other hand, because of all cows were at the first parity, LMY was found to be the lowest in 2001.

In this herd, cows calving in winter months had higher milk yield than those of summer calving cows. If the 40% of the 305-dMY produced in the first 100 days of lactation was taken into consideration, the milk yield of cows was affected significantly from the higher temperature and relative humidity in summer months.

The average of $P_{2:1}$ found for RH in this study is higher than HF (Kaya and Kaya, 2003) and BS (Cakilli and Günes, 2007). The average of $P_{3:1}$ in this study is similar to the literature (Kaya and Kaya, 2003; Cakilli and Günes, 2007). The results found for RH in this study for $P_{3:2}$ and P_{Tomax} were lower than HF (Kaya and Kaya, 2003), but higher than BS for $P_{3:2}$ (Cakilli and Günes, 2007).

The average of STMY for RH was higher than values reported for HF (Koc, 2007; Koc and Kızılkaya, 2007) and BS (Koc, 2007). Statistically significant ($P<0.05$) sampling time and lactation month's effects on STMY found in this study are similar to Koc and Kizilkaya (2007).

The average of MPC found for RH in this study is lower than the results of a few studies for HF (Şekerden, 2002; Topaloglu and Günes, 2005; Koc, 2011) and for M breed (Koc, 2011). MLC mean for RH was higher than a study for HF and M breeds (Koc, 2011). NFDMC mean found in this study for RH was lower than HF (Kasimoğlu and Akgün, 1998; Koc, 2007; 2008) and BS (Koc, 2007), but higher than the studies for HF and for M breeds (Şekerden 2002; Koc, 2011).

SCC mean for RH (63.753 cells/ml) found in this study is lower than the results of some previous studies conducted on HF, BS and M breeds (Topaloglu and Günes, 2005; Koc, 2006; 2007; 2008; 2011; Eyduran et al., 2005; Koc and Kızılkaya, 2007). The lower SCC mean found for RH in this study could be due to the different udder morphology and mastitis resistance of this breed in addition to precautions taken in this herd to mastitis.

The decrease seen in LMY, 305-dMY and 50-dMY for cows calved in July and August shows that the cows calved in summer months had a physiological difficulties to produce milk at the beginning of lactation because of heat stress caused by higher temperature and relative humidity. Because of that, a reduction in the milk yield of the first few months of lactation was observed and LMY and 305-dMY were decreased.

Persistency was higher in cows calved in summer months and in lower milk yielding of cows at the beginning of lactation. In contrast to this, the persistency traits were lower in cows calved in winter and cows with higher milk production at the beginning of lactation. This result shows that in high yielding cows; it was difficult to persist the high yield during the lactation.

Heritabilities

In this study, h^2 of LL (0.14±0.08) for RH is lower than an estimate for HF (Atay et al., 1995), but higher than the estimates for HF (Koc, 2001; Ertugrul et al. 2002; Tuna, 2004; Cerci, 2006; Cetin and Koc, 2011) and higher than an estimate for M (Cetin and Koc, 2011). For LMY, the h^2 (0.47±0.07) is higher than the estimates for HF (Atay et al., 1995; Koc, 2001; Çerçi, 2006; Cetin and Koc, 2011) and an estimate for M (Cetin and Koc, 2011), but lower than the estimates for HF (Gürdogan and Alpan, 1990). For 305-dMY, h^2 (0.44±0.06) is higher than the estimates for HF (Atay et al., 1995; Tekerli, 2000; Koc, 2001; Ertuğrul et al., 2002; Ünalan and Cebeci, 2004; Tuna, 2004) and an estimate for M (Cetin and Koc, 2011) but, similar to estimates for HF (Cerci, 2006; Cetin and Koc, 2011) and for BS (Ulusan et al., 1988).

The heritabilities for $P_{2:1}$, $P_{3:1}$, $P_{3:2}$ and P_{Tomax} found in this study for RH are lower than an estimate (Kaygisiz et al., 1995) for HF, but higher than the estimates for HF (Tekerli, 2000; Kaya and Kaya, 2003).

Conclusions

The decrease seen in LMY, 305-dMY and MPC in summer months revealed that heat stress caused a significant problem in the cows calved in summer months. Depending on lower milk yield at the beginning of lactation, LMY and 305-dMY were also decreased significantly. MPC of milk is also affected significantly in summer, as well. In contrast to these, persistency traits become higher in cows calved in summer. Persistency is explained by the milk yield of cow at the beginning of lactation. Therefore, in cows with similar milk yield at the beginning of lactation, the cow with higher persistency will have also higher milk yield.

In conclusion, it can be said that RH has kept up the performances and the milk yield of RH found in this study is higher and SCC of it is lower than HF, BS and M breeds reared in the region. The heritabilities for milk yield and for persistency are similar or higher than HF, BS and M breeds, too. On the other hand, because of higher temperature and relative humidity in summer, dairy cows could be affected from heat stress and this revealed that some precautions need to be taken against it.

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