Journal of Animal and Veterinary Advances 7 (10): 1218-1222, 2008
ISSN: 1680-5593


# Study on Milkability Traits in Brown Swiss Cows Reared Eastern Region of Turkey

[1]Recep Aydin, [1]Mete Yanar, [2]Olcay Güler, [3]Sadrettin Yüksel, [4]Feyzi Ugur and [1]Leyla Turgut
[1]Department of Animal Science, College of Agriculture,
Atatürk University, 25240, Erzurum, Turkey
[2]Department of Animal Breeding and Health, Hinis Vocational Training School,
Atatürk University, Hinis, 25600, Erzurum, Turkey
[3]Eastern Anatolian Agricultural Research Institute, 25250, Erzurum, Turkey
[4]Department of Animal Science, College of Agriculture, 18 Mart University, Canakkale, Turkey

**Abstract:** The study was carried out to determine the effect of environmental factors on milkability traits and to estimate genetic parameters and relationships among milk yields, milk flow rate (MFR) and milking time (MT) of Brown Swiss cows reared in Eastern Region of Turkey. The data used in this study consisted of 2051 observations of milking time and milking flow rate on 315 lactations of 163 cows. The averages for MFR, MT and total test day milk yield (TTDMY) were 0.972 kg $min^{-1}$, 5.46 min and 11.35 kg, respectively. Stage of lactation and parity had significant ($p<0.01$) effect on the MFR, MT and TTDMY. Multiparous cows had higher MT and TTDMY ($p<0.01$) than primiparous cows. Calving season only significantly ($p<0.01$) affected on TTDMY. The heritability estimates for MFR, MT and TTDMY were 0.37, 0.37 and 0.21, respectively. The positive genetic correlations of MFR with actual milk yield, 305 days milk yield, TTDMY were 0.423, 0.585 and 0.735, respectively, while negative genetic correlations between MT and milk yield traits were calculated. The higher heritability values for MFR and MT suggested that selection of a good milkability seems to be promising and genetic improvement in MFR and MT might be achieved through selection for milk production.

**Key words:** Milkability, genetic parameters, milk flow rate, milking time, Brown Swiss

## INTRODUCTION

Milkability can be considered an important functional trait in dairy cattle for udder health and labour efficiency (Povinelli *et al*., 2003). Increased Milk Flow Rate (MFR) and reduced milking time (MT) indicate a decrease in milking labour time which accounts for a large part of the total cost of milk production. The reduction of milking time per milking per cow means an increase in the capacity of the automatic milking systems. On the other hand, Boettcher *et al*. (1998) and Zwald *et al*. (2005) reported that cows which had higher milk flow also had wider teat canal and sphincter on average. The greater diameter of the teat canal might facilitate the access of pathogen microorganisms and therefore, the higher milk flow can be related with an increase of udder health problems. Regarding with the results of the literature, a moderate milk flow could be considered as optimum in terms of udder health (Gade *et al*., 2006).

Milkability is sufficiently heritable as to make breeding sensible. Many researchers have obtained moderate to high estimates of heritability for milkability traits which range from $h^2 = 0.17$ up to $h^2 = 0.49$ for average milk flow rate, from $h^2 = 0.16$ up to $h^2 = 0.38$ for milking time, from $h^2 = 0.21$ up to $h^2 = 0.55$ for maximum milk flow (Sekerden and Kuran, 1991; Bahr *et al*., 1995; Boettcher *et al*., 1998; Rupp and Boichard, 1999; Gade *et al*., 2006). Others have reported positive correlations of milkability traits and milk yield (Singh, *et al*., 1999; Mijic *et al*., 2003; Cho *et al*., 2004; Juozaitiene *et al*., 2006). The results have led to speculation that selection for milk yield might improve average milk flow rate and milking time.

The present study was undertaken to investigate the effect of environmental factors on milkability characteristics and to estimate genetic parameters and relationships among milk yields, milk flow rate and milking time of Brown Swiss cows reared in Eastern Region of Turkey.

## MATERIALS AND METHODS

The data for this study consisted of 2051 observations of milking time and milking flow rate on 315

**Corresponding Author:** Recep Aydin, Department of Animal Science, College of Agriculture, Atatürk University, 25240, Erzurum, Turkey

lactations of 163 Brown Swiss cows reared in Research Farm of College of Agriculture at Atatürk University, Erzurum, Turkey. All cows were milked in the same stall of 6 stall, in a milking parlour in order to collect the data. On each sampling day, before recording the data, the milking and pulsation vacuum was set 50 kPa and pulsation ratio was 60:40 at a rate of 60 cycles $min^{-1}$. Each stall in the milking parlour was equipped with a milk-o-meter. Observations were made once a month throughout the lactation period and the data were collected over three consecutive years.

All observations on milking times and rates were taken by the same researcher team at evening control milking. The observers stationed around the milking parlour recorded milking time of each cow by using chronometers. MT was measured as the interval from the attachment of the milking unit to the udder until it was completely removed. MFR was calculated as the ratio between milk yield and MT. Percentage of milk fat was also determined from milk samples taken at each test day milking and analysed in the laboratory by a milk fat analyzer (Milkotester). Amounts of milk from morning and evening milkings were also measured and recorded. Total test day milk yield (TTDMY) resulted from adding up the respective milk yields from all single milking per day. Total 305 days milk and actual milk yields were also calculated for each cow.

Statistical analysis was by a least squares and maximum likelihood general programme for mixed models. A general linear model with fixed effects of parity, calving season, stage of lactation and their interactions with each other was used to identify the main sources of variation for studied traits in preliminary statistical analyses. Since, the interactions were not statistically significant, they were excluded from final mathematical model.
The mathematical model was following as:

$$Y_{ijkl} = \mu + S_i + F_j + H_k + e_{ijkl}$$

Where,

- $Y_{ijkl}$ : The measurement of a particular trait.
- $\mu$ : The population mean.
- $S_i$ : Fixed effect of parity (i = 1, 2, 3, 4, 5, 6, 7).
- $F_j$ : Fixed effect of stage of lactation (j = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10).
- $H_k$ : Fixed effect of calving season (k = Winter, Spring, Summer, Fall).
- $e_{ijkl}$ : Random error with a mean of 0 and variance $\sigma_e$.

Significant differences between the levels within effect were tested by Duncan's multiple range test. Heritability estimates as well as genetic and phenotypic correlations were also calculated (Harvey, 1987).

## RESULTS AND DISCUSSION

Least square means with standard error for Milk Flow Rate (MFR), Milking Time (MT), Milk Yield (MY) from morning and evening milkings and Total Test Day Milk Yield (TTDMY) are presented in Table 1. The average MFR for Brown Swiss cows reared in Eastern region of Turkey was 0.972 kg $min^{-1}$. The finding is in accordance with results of Pandey *et al.* (1990) and Kuran and Sekerden (1992). On the other hand, the mean MFR found out in the present study was lower than 2.78 kg $min^{-1}$ for Brown Swiss (Anonymous, 1998), 2.2 kg $min^{-1}$ for Italian Brown (Povinelli *et al.*, 2003), 2.30 kg $min^{-1}$ for Holstein Friesian cows (Lee and Choudhary, 2006). However, Bhivasankar *et al.* (2003) reported that the average MFR in crossbred and Shavial cows were 0.467 and 0.597 kg $min^{-1}$, respectively. Corresponding values were 0.57 and 0.81 kg $min^{-1}$ for Desi and crossbred cows in mid lactation (Tripathi *et al.*, 1991). Similarly, Singh *et al.* (1999) stated that mean MFR in crossbred cows varied from 0.691-0.920 kg $min^{-1}$ and all these results were smaller than our finding.

The average MT determined in this study was 5.46 min (Table 1). The result is in agreement with findings of Petersen *et al.* (1986), Kuran and Sekerden (1992), Povinelli *et al.* (2003) and Gade *et al.* (2006). In literature, shorter total MT values (1.54 min, 3.304 min) were obtained,, respectively by Triphati *et al.* (1991) and Bhivasankar *et al.* (2003), while the average MT reported by other researchers (Lee and Choudhary, 2006; Maltz *et al.*, 2000) were greater (8.23 min, 6.58-6.70 min) than results of the present study. Major factors which contribute to MT reported by other investigators could be differences in the milk production levels, milking plants, age as well as pre-milking preparations.

Stage of lactation significantly influenced all studied parameters (Table 1). Peak milk production was reached at the first month of lactation and thereafter, milk production decreased gradually. The value of MT corresponded to TTDMY changes throughout lactation. Consequently, MT was the longest in first month of the lactation and decreased as lactation proceeded. The decrease in TTDMY was about 30.5% below peak MY, whereas the reduction in MT was only about 27.2% below MT at peak lactation. This supports the finding of Povinelli *et al.* (2003) and Tancin *et al.* (2006) who stated that milk flow traits, or at least some of them, have to vary during lactation. MFR was relatively stabile with slight reduction

Table 1: Least squares means with standard errors for milk flow rate, milking time and total test day milk yield

| | n | MFR[1] (min $kg^{-1}$) X±Sx | MT[2] (min) X±Sx | TTDMY[3] (min) X±Sx |
|---|---|---|---|---|
| Overall mean | 2051 | 0.972±0.013 | 5.46±0.05 | 11.35±0.102 |
| Stage of lactation | | ** | ** | ** |
| 1 | 215 | 1.029±0.027$^{c}$ | 6.07±0.11$^{d}$ | 13.39±0.21$^{e}$ |
| 2 | 250 | 1.093±0.026$^{c}$ | 5.66±0.10$^{c}$ | 12.93±0.20$^{de}$ |
| 3 | 232 | 1.041±0.026$^{c}$ | 5.64±0.10$^{c}$ | 12.33±0.21$^{cd}$ |
| 4 | 222 | 1.066±0.027$^{c}$ | 5.53±0.11$^{bc}$ | 12.31±0.21$^{cd}$ |
| 5 | 226 | 1.020±0.027$^{c}$ | 5.47±0.10$^{abc}$ | 12.02±0.21$^{c}$ |
| 6 | 210 | 0.911±0.028$^{ab}$ | 5.37±0.11$^{abc}$ | 10.61±0.22$^{b}$ |
| 7 | 215 | 0.930±0.028$^{b}$ | 5.28±0.11$^{ab}$ | 10.39±0.21$^{b}$ |
| 8 | 198 | 0.934±0.029$^{b}$ | 5.13±0.11$^{a}$ | 10.26±0.22$^{b}$ |
| 9 | 160 | 0.846±0.031$^{a}$ | 5.27±0.12$^{ab}$ | 9.53±0.25$^{a}$ |
| 10 | 123 | 0.851±0.035$^{a}$ | 5.22±0.14$^{a}$ | 9.75±0.28$^{a}$ |
| Parity | | ** | ** | ** |
| 1 | 759 | 0.873±0.014$^{a}$ | 4.76±0.06$^{a}$ | 8.75±0.11$^{a}$ |
| 2 | 589 | 0.929±0.016$^{a}$ | 5.13±0.06$^{b}$ | 10.15±0.12$^{b}$ |
| 3 | 284 | 0.977±0.023$^{bcd}$ | 5.70±0.09$^{c}$ | 11.81±0.18$^{c}$ |
| 4 | 171 | 1.055±0.029$^{cd}$ | 5.76±0.12$^{c}$ | 12.69±0.23$^{de}$ |
| 5 | 103 | 1.008±0.037$^{bcd}$ | 5.62±0.15$^{c}$ | 11.90±0.29$^{cd}$ |
| 6 | 78 | 0.926±0.044$^{bc}$ | 5.63±0.18$^{c}$ | 11.77±0.35$^{cd}$ |
| 7 | 67 | 1.037±0.047$^{d}$ | 5.66±0.19$^{c}$ | 12.40±0.37$^{e}$ |
| Calving season | | ns | ns | ** |
| Winter | 532 | 1.031±0.017 | 5.53±0.07 | 11.99±0.13$^{b}$ |
| Spring | 498 | 0.962±0.020 | 5.46±0.08 | 11.25±0.15$^{a}$ |
| Summer | 279 | 0.916±0.025 | 5.45±0.10 | 10.83±0.19$^{a}$ |
| Fall | 742 | 0.979±0.019 | 5.42±0.07 | 11.33±0.14$^{a}$ |

**: $p<0.01$, ns: Non-significant, [1] MFR: Milk Flow Rate (kg $min^{-1}$), [2] MT: Milking Time (min), [3] TTDMY: Total Test Day Milk Yield (kg)

Table 2: Heritabilities on diagonal, genetic correlations below diagonal and phenotypic correlations above diagonal of milking and milk yield traits

| | MT[1] | MFR[2] | MY-am[3] | MY-pm[4] | TTDMY[5] | MF[6] | AMY[7] | 305 DMY[8] |
|---|---|---|---|---|---|---|---|---|
| MT | 0.37 (0.10)[9] | -0.420** | 0.688** | 0.297** | 0.294** | -0.088** | 0.134** | 0.180** |
| MFR | -0.713** | 0.37 (0.10) | 0.514** | 0.260** | 0.632** | -0.140** | 0.238** | 0.266** |
| MY-am | 0.784** | 0.604** | 0.15 (0.06) | 0.770** | 0.949** | -0.220** | 0.401** | 0.471** |
| MY-pm | -0.134 | 0.168 | 0.823** | 0.25 (0.08) | 0.932** | -0.195** | 0.364** | 0.424** |
| TTDMY | -0.117 | 0.735** | 0.947** | 0.962** | 0.21 (0.07) | -0.221** | 0.408** | 0.477** |
| Milk Fat (%) | -0.234 | -0.087 | -0.797** | -0.370 | -0.593** | 0.11 (0.05) | -0024 | -0.032 |
| Actual Milk Yield (kg) | -0.235 | 0.423* | 0.588** | 0.427* | 0.524* | -0.539* | 0.28 (0.16) | 0.911** |
| 305 Days Milk Yield (kg) | -0.103 | 0.585** | 0.896** | 0.793** | 0.880** | -0.722** | 0.764** | 0.25 (0.15) |

*: $p<0.05$, **: $p<0.01$, [1] MT: Milking Time, [2] MFR: Milk Flow Rate, [3] MY-am: Milk Yield from Morning Milking, [4] MY-pm: Milk Yield from Evening Milking, [5] TTDMY: Total Test Day Milk Yield, [6] MF: Milk Fat (%), [7] AMY: Actual Milk Yield, [8] 305 DMY: 305 Days Milk Yield, [9] Standard Error of Heritability Estimates

after 2nd month of lactation (Table 1). Similar result was already reported by Tancin *et al*. (2006). Gade *et al*. (2006) also noted that lactation curve for MFR for dairy cows showed a descending pattern throughout the lactation.

Multiparous cows had significantly ($p<0.01$) higher MT and TTDMY than primiparous cows (Table 1). Increased MFR with parity corroborates previous studies (Maltz *et al*., 2000; Firk *et al*., 2002; Cho *et al*., 2004; McCarthy *et al*., 2007). Petersen *et al*. (1986) reported that increasing parity is associated with rising average MT. Akbulut *et al*. (1992) also stated that TTDMY increases with ascending lactation number.

The influence of calving season on the MT and MFR traits were not significant, but TTDMY was significantly ($p<0.01$) affected by the treatment. TTDMY of the cows calved in winterspring was the highest amount compared with others. Significant effect of the calving season on the TTDMY of cows was also reported by Kurt *et al*. (2005), Gader *et al*. (2007) and Nagawade *et al*. (2008).

Heritability estimates for both of MFR and MT were 0.37 (Table 2) and the values were similar to results of Gade *et al*. (2006). On the other hand, heritability estimates of the present study were higher than results of Williams *et al*. (1984), Sekerden and Kuran (1991) and Povinelli *et al*. (2003). Higher heritability values could be explained by standardised environmental conditions existing in the research farm.

Genetic and phenotypic correlations are presented in Table 2. Negative genetic correlations between MT and actual milk yield, 305 days milk yield, TTDMY were calculated. The negative correlation looks obscure and means that cows with high milk yield show at the same time the tendency for less MT. However, phenotypic correlation between these two parameters is positive and significant. Similar finding is also reported by Gade *et al*. (2006).

The positive genetic correlations of MFR with actual milk yield, 305 days milk yield, TTDMY were 0.423, 0.585 and 0.735, respectively. Similar relationships ($r_g$ = 0.63, $r_g$ = 0.51, $r_g$ = 0.51) were reported by Trede *et al.* (1987), Santus and Bagnato (1998) and Gade *et al.* (2006), respectively. Phenotypic correlations between MFR and milk yield traits were also positive and statistically significant. The finding is in accordance with results of Cho *et al.* (2004), Lee and Choudhary (2006) and Juozaitiene *et al.* (2006) who reported that MFR rises accordingly with increasing actual and 305 days milk yield as well as TTDMY. The significant genetic correlation coefficients between milk yield traits and MFR are positive indicating that further selection for higher milk yield might result in a deterioration of udder health, as a higher MFR is associated with increased problems concerning udder health (Boettcher *et al*., 1998; Lacky-Hulbert and Hillerton, 1995; Zwald *et al*., 2005). Thus, it should be tried to exclude cows with extremely low or high MFR from breeding because of the interrelation to labour efficiency and udder health to achieve more uniform milking duration among cows and to avoid a deterioration of the udder health simultaneously.

## CONCLUSION

The results of the study show that there are significant influences of environmental factors on the MFR, MT and TTDMY parameters. The higher heritability values for MFR and MT suggest that selection of a good milkability seems to be promising and genetic improvement in MFR and MT might be achieved through selection for milk production of Brown Swiss cows. However, cows with moderate MFR could be considered as optimum in terms of udder health and more uniform milking duration among cows, since further selection for higher milk yield might cause problems concerning udder health.

## REFERENCES


Akbulut, Ö., N. Tuzemen and M. Yanar, 1992. Erzurum sartlarinda Siyah Alaca sigirlarin verimi, 1: Döl ve süt verim özellikleri. Turk. J. Vet. Anim. Sci., 16: 523-533.

Anonymous, 1998. Ease of milking test in 1997. CAB Abstracts, Accession Number: 19980105196.

Bahr, T., R. Preisinger and E. Kalm, 1995. Untersuchungen zur zellzahl und melkbarkeit beim rind: 2. Mitteilung: Genetische parameter der melkbarkeit. Züchtungskunde, 67: 105-116.

Bhivasankar, A.K., J.M. Chahande and S.Z. Ali, 2003. Studies on milkability traits in Sahiwal and crossbred cows. Indian Vet. J., 80: 76-77.

Boettcher, P.J., J.C.M. Dekkers and B.W. Kolstad, 1998. Development of udder health index for sire selection based on somatic cell score, udder conformation and milking speed. J. Dairy Sci., 81: 1157-1168.

Cho, Y.M., B.H. Park and B.S. Ahn, 2004. A study on estimation of factors affecting duration of milk flow and milk flow rate and their relationships with milk yields of dairy cattle. J. Anim. Sci. Technol., 46: 517-524.

Firk, R., E. Stamer, Junge, W. and J. Krieter, 2002. Systematic effects on activity, milk yield, milk flow rate and electrical conductivity. Arch. Tierz. Dummerstorf, 45: 213-222.

Gade, S., E. Stamer, W. Junge and E. Kalm, 2006. Estimates of genetic parameters for milkability from automatic milking. Livest. Sci., 104: 135-146.

Gader, A.Z.A., M.K.A. Ahmed, L.M.A. Musa and K.J. Petersen, 2007. Milk yield and reproductive performance of friesian cows under Sudan tropical conditions. Arch. Tierzucht, 50: 155-164.

Harvey, W., 1987. User's Quide for LSMLMNN., PC-1 Version. The Ohio State University, Columbus, Oh., USA.

Juozaitiene, V., R. Japertiene and S. Japertas, 2006. Influence of milkability traits on milksomatic cell count in Lithuanian Red and Red and White cattle. Vet. Zoot., 35: 62-66.

Kuran, M. and O. Sekerden, 1992. Jersey sigirlarinda makina ile sagim sartlarinda süt verimi ile süt akis hizi ve sagim süresi arasindaki iliskiler. 19 Mayis Üniv. Ziraat Fak. Derg., 7: 41-49.

Kurt, S., F. Ugur, T. Savas and M. Saglam, 2005. Milk production characteristics of Holstein Friesian cattle reared in Tahirova State Farm located in Western Anatolia. Indian J. Dairy Sci., 58: 62-64.

Lacky-Hulbert, S.J. and J.E. Hillerton, 1995. Physical characteristics of the bovine teat canal and their influence on susceptibility to streptococcal infection. J. Dairy Res., 62: 395-404.

Lee, D.H. and V. Choudhary, 2006. Study on milkability traits in Holstein cows. Asian Aust. J. Anim., 19: 309-314.

Maltz, E., D.J. Reneman and M.A. Davis, 2000. A study of blood flow and oxygen concentration of teat end tissue before and after machine milking. ASAE Annual International Meeting, Milwaukee, Wisconsin, Number: 003012.

McCarthy, S., D.P. Berry, P. Dillon, M. Rath and B. Horan, 2007. Effect of strain of Holstein Friesian and feeding system on udder health and milking characteristics. Livest. Sci., 107: 19-28.

Mijic, P., I. Knezevic, M. Baban, M. Domacinovic and D. Rimac, 2003. Investigation of correlations and milking parameter distribution on cattle farms in eastern Croatia. Acta Agron. Hung., 51: 191-198.

Nagawade, P.P., D.Z. Jagtap and S.S. Kamble, 2008. Effect of non-genetic factors on colostrum and production traits of Phule Triveni (triple crossbred) cattle. Indian J. Anim. Sci., 78: 215-217.

Pandey, H.S., M.M. Saxena, D.N. Jana, H.N. Pandey and L.P. Nautial, 1990. Milkability in crosbred and Holstein-Friesian cows under hand and machine milking. Indian J. Anim. Sci., 60: 732-734.

Petersen, M.L., L.B. Hansen, C.W. Young and K.P. Miller, 1986. Rates of milk flow and milking times resulting from selection for milk yield. J. Dairy Sci., 69: 556-563.

Povinelli, M., C. Romani, L. Degano, M. Cassandro, R. Dal Zotto and G. Bittante, 2003. Sources of variation and heritability estimates for milking speed in Italian Brown cows. Italian J. Anim. Sci., 2 (Suppl. 1): 70-72.

Rupp, R. and D. Biochard, 1999. Genetic parameters for clinical mastitis, somatic cell score, production, udder type traits and milking ease in first lactation cows. J. Dairy Sci., 82: 2198-2204.

Santus, E. and A. Bagnato, 1998. Genetic parameters estimation for milkability traits recorded with flowmeters in Italian Brown Swiss. Proceedings of the 6th World Congress on Genetics Applied to Livestock Production, Armidale, NSW, Australia, pp: 19-22.

Sekerden, O. and M. Kuran, 1991. Karaköy Tarim Isletmesi Jersey sigirlarinda süt akis hizi, sagim süresi ve süt verimine ait kalitim derecelerinin tahmini. Turk. J. Vet. Anim. Sci., 16: 86-92.

Singh, S.K., H.P.S. Arya and H.S. Pandey, 1999. Type of udder and teat shape in cros-bred cows and their association with milkability. Indian J. Anim. Res., 33: 70-72.

Tancin, V., B. Ipema, P. Hogewerf and J. Macuhova, 2006. Sources of variation in milk flow characteristics at udder and quarter levels. J. Dairy Sci., 89: 978-988.

Trede, J., 1987. Genetische analyse der parameter der eutergesundheit und der melkbarkeit. Schrreihe Inst. Tierzucht Tierhalt. Christian-Albrechts-Univ. Kiel, Bd. 44.

Tripathi, S., S. Pan and S.K. Halder, 1991. Performance of deshi cattle as dairy animal. Milkability and dairy temperament. Indian J. Anim. Prod. Man., 7: 225-229.

Williams, C.B., Burnside, E.B. and L.R. Schaeffer, 1984. Genetic and environmental parameters of two field measures of milking speed. J. Dairy Sci., 67: 1273-1280.

Zwald, N.R., K.A. Weigel, Y.M. Chang, R.D. Welper and J.S. Clay, 2005. Genetic evaluation of dairy sires for milking duration using electronically recorded milking times of their daughters. J. Dairy Sci., 88: 1192-1198.