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Research Article

Effects of Teat Shape on Milk Yield and Milking Traits in Brown Swiss Cows*

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Abstract: Effects of teat measurement and teat shape on milking time, milk flow rate and milk yield in Brown Swiss cows were evaluated. The means of 305-day milk yield for cylindrical, funnel and bottle teat shape groups were 3156, 3169 and 2377 kg, respectively. The mean values for the milking time in 1st, 2nd and 3rd milk yield groups were 6.54, 6.56 and 6.20 min and the differences were not statistically significant.

Length and diameter of front and rear teats were negatively correlated with milk flow rate. Milk flow rate showed significant correlations with 305-day milk yield and milk yield per milking ($P < 0.001$). There was a significant negative correlation between milking time and milk flow rate ($P < 0.001$). In conclusion, 305-day milk yield of bottle teat shape cows was lower than that of cylindrical and funnel teat shape cows.

Key Words: Brown Swiss cow, milk yield, milking time, milk flow rate, teat shape

İsviçre Esmeri İneklerde Sağım Özellikleri ve Süt Verimi Üzerine Meme Başı Şeklinin Etkileri

Özet: Çalışma, İsviçre Esmeri ineklerin meme ve meme başı şekli, sağım süresi, süt akış hızı ve süt verimi arasındaki ilişkileri ortaya koymak amacıyla yapılmıştır. Silindir, huni ve şişe meme başı şekillerine göre 305 günlük süt verimi ortalamaları sırasıyla 3156, 3169 ve 2377 kg olarak bulunmuştur. Sağım süresinin 1, 2 ve 3. süt verim gruplarında genel ortalamaları sırasıyla 6,54, 6,56 ve 6,20 kg/dakika olarak belirlenmiştir.

Ön ve arka meme başı uzunlukları ve çapları ile süt akış hızı arasında negatif fenotipik korelasyonlar bulunmuştur. Süt akış hızı ile 305 günlük süt verimi ve sağım süt verimi arasında yüksek derecede önemli pozitif korelasyon katsayıları tespit edilmiştir ($P < 0,001$). Yine süt akış hızı ile sağım süresi arasında yüksek derecede önemli negatif korelasyon katsayıları belirlenmiştir ($P < 0,001$). Sonuç olarak, şişe meme başına sahip ineklerin süt verimi silindirik ve huni meme başına sahip ineklerin süt veriminden daha az bulunmuştur.

Anahtar Sözcükler: İsviçre Esmeri, süt verimi, sağım süresi, süt akış hızı, meme başı şekli

Introduction

Milk yield is the most important trait in dairy cattle. It is also important for dairy cattle to have the shortest secretion time. In productivity evaluation of dairy cattle, udder measurements are important factors. In addition, teat shape and teat measurements also have equal importance (1). Relationships between teat shape and measurements with milk yield, milking and mammary diseases might be regarded as criteria for selection of dairy cattle.

Many studies show that cows with funnel shape teats produced 10.9-15.4% more milk than cows with cylindrical shape teats, at a similar lactation stage and age. In addition, cows with cylindrical shape teats showed a higher incidence of mastitis (2-5). However, differences between teat shapes were not found significant by Özbeyaz et al. (6) for Brown Swiss cows.

Miller et al. (7) reported that cows with high milk yield have high milk flow rate and more susceptibility to mastitis. They also reported that cylindrical teat shape reduces the milk flow rate.

* This study was carried out in the Bahri Dağdaş International Agricultural Research Institute.

In the process of manual milking, teat length has an effect on milk amount and flow rate and the most successful manual milking can be applied on short teats (8). The same researcher additionally stated that there is no effect of teat diameter on milk flow rate.

This study aimed to determine the effects of teat shape and teat measurements on milking time, milk flow rate and milk yield in Brown Swiss cows.

Materials and Methods

The research was conducted in Bahri Dağdaş International Agricultural Research Institute. Data were obtained from 94 Brown Swiss cows.

Milk yields of cows were recorded monthly. Measurements of udders and teats were taken in the morning just before milking. Traits of relating milking were determined in the lactation. During the control period of morning milking, total milk yield and milking time were recorded. Udder and teat measurements were taken from each cow five times, in the 2^{nd}, 4^{th}, 6^{th}, 8^{th} and 10^{th} months of lactation. Months of lactation were grouped 1, 2, 3, 4 and 5.

Cows were divided into 3 groups according to teat shape as cylindrical, funnel and bottle type.

Milk yield groups were divided into 3 groups according to 305-day milk yield: milk yield <3000 kg was group 1, milk yield between 3001-4000 kg was group 2 and milk yield >4001 kg was group 3.

Data were analysed by the following general linear model:

Y_{ijklm} : $m+ a_i + b_j + c_k + d_l + e_{ijklm}$

Y_{ijklm} : Milking time and milk flow rate to investigate in a cow,

μ : is the overall mean,

a_i : is the effect of lactation number (i: 1, 2, 3, 4, 5, 6+);

b_j : is the effect of milk yield groups (j: 1, 2 and 3);

c_k : is the effect of lactation stage (k: 1, 2, 3, 4 and 5 day);

d_l : is the effect of teat shape (l: cylindrical, funnel, bottle)

e_{ijklm} : is the random error.

In addition, one-way ANOVA was used to determine the statistical significance for actual and 305-day milk yield according to teat shape. Comparisons between the groups were made by Duncan's test. The phenotypic correlations between milk flow rate and milking time with different teat measurements and milking properties were determined by SPSS.

Results

The means of actual and 305-day milk yield with their standard errors according to teat shape are given in Table 1. Teat shape significantly affected 305-day milk yield ($P < 0.05$) but did not affect actual milk yield ($P > 0.05$).

Means with their standard errors for milking time and milk flow rate are presented in Table 2. Means of milking time and milk flow rate were 6.44 min and 1.34 kg/min, respectively.

Milk yield groups and lactation stages affected milk flow rate ($P < 0.01$-0.001) but milk flow rate was not affected by lactation number or teat shape.

Phenotypic correlations between milk flow rate and milking time with different teat measurements and milking properties are given in Table 3.

Discussion

Bottle teat shape milk yield was lower than cylindrical and funnel teat shape milk yield ($P < 0.05$). Milk yields were found similar for cylindrical and funnel teat shape.

Table 1. The means of actual and 305-day milk yield with their standard errors according to teat shape.

Teat shape	n	Actual milk yield, kg		305-day milk yield, kg	
		$\bar{X} \pm S\bar{x}$		$\bar{X} \pm S\bar{x}$	
Mean	94	3062	140.6	2968	88.3
Cylindrical	45	3156[a]	209.5	3027	132.5
Funnel	37	3169[a]	216.4	3039	129.4
Bottle	12	2377[b]	358.5	2525	252.6
Probability		*		NS	

NS: Non significant ($P > 0.05$), *: $P < 0.05$

[a, b]: Means with different superscripts within a column indicate significantly different values ($P < 0.05$).

Table 2. Means with their standard errors for milking time and milk flow rate.

Properties	n	Milking time, min		Milk flow rate, min/kg	
		$\bar{X} \pm S\bar{x}$		$\bar{X} \pm S\bar{x}$	
Mean	94	6.44	0.15	1.34	0.05
Lactation number		NS		NS	
1	18	6.50	0.27	1.31	0.08
2	21	6.50	0.26	1.38	0.08
3	15	6.50	0.32	1.32	0.09
4	13	6.08	0.32	1.48	0.09
5	10	6.34	0.36	1.33	0.10
6+	17	6.71	0.30	1.25	0.09
Milk yield groups		NS		***	
1	54	6.54	0.19	1.02c	0.06
2	28	6.56	0.23	1.38^{b}	0.07
3	12	6.20	0.29	1.63^{a}	0.09
Lactation stages		NS		**	
1	94	6.57	0.24	1.52^{a}	0.07
2	91	6.42	0.25	1.42^{ab}	0.07
3	81	6.69	0.26	1.33^{bc}	0.08
4	69	6.54	0.28	1.18^{d}	0.08
5	42	5.96	0.34	1.28^{cd}	0.10
Teat shape		NS		NS	
Cylindrical	45	6.41	0.17	1.30	0.05
Funnel	37	6.47	0.19	1.40	0.06
Bottle	12	6.43	0.36	1.33	0.10

NS: Non significant (P > 0.05), **: P < 0.01, ***: P < 0.001

$^{a-d}$: Means with different superscripts within a column indicate significantly different values (P < 0.05).

Table 3. Phenotypic correlations between milk flow rate and milking time with different teat measurements and milking properties.

Properties	Milk flow rate	Milking time
Front teat length	-0.061	-0.020
Rear teat length	-0.137*	0.010
Front teat diameter	-0.025	0.088
Rear teat diameter	-0.001	0.042
305-day milk yield	0.340***	
Milk yield per milking	0.687***	
Milking time	-0.659***	

*: P < 0.05, ***: P < 0.001

These findings were similar to those reported by Özbeyaz et al. (6) for Brown Swiss cows. However, the results do not agree with the data reported by Rathore (2,3) for Friesian cows, Gonzalez (4) for Holstein cows or Prajapati et al. (5) for Kankrej cows. They reported that funnel shape teats produced more milk than cylindrical shape teats.

Milking time was not affected by lactation number, milk yield groups, lactation stage or teat shape and milking time displayed irregular distribution. Our findings for milking time were lower than those reported by Grin et al. (9) and Şekerden and Kuran (10) for Holstein cows. Similar findings to the present study were reported by Özbeyaz et al. (6) for Brown Swiss, and by Denisova (11) for Jersey x Holstein, Holstein x Jersey and Jersey cows.

According to the rise in the milk yield groups, milk flow rate increased and milk flow rate for the 1st, 2nd and 3rd milk yield groups were 1.02, 1.38 and 1.63 kg/min, respectively. However, effect of teat shape was not significant on milk flow rate. These findings were similar with those reported by Özbeyaz et al. (6), Grin et al. (9) and Şekerden and Kuran (10). However, our findings were lower than those reported by Weber (12,13) and Anonymous (14) for Brown Swiss cows. The results of the present study were higher than that reported by Suntsova (15), and Şekerden et al. (16) for Simmental cows.

The correlation of milk flow rate with 305-day milk yield (0.340) and milk yield per milking (0.687) was highly significantly positive ($P < 0.001$). Length and diameter of front and rear teats were negatively correlated with milk flow rate (between -0.001 and -0.137). Rear teat length affected milk flow rate significantly ($P < 0.05$). The result for Brown Swiss cows was similar to that reported by Özbeyaz et al. (6).

There was a significant negative correlation (-0.659) of milking time with milk flow rate ($P < 0.001$). It can be said that milk flow rate increased with milk yield and extended milking time. Phenotypic correlations between milk flow rate with milking time were similar to those reported by Özbeyaz et al. (6) for Brown Swiss cows, by Şekerden and Kuran (10) for Holstein cows, by Şekerden et al. (16) for Simmental cows, by Kuran and Şekerden (17) for Jersey cows, and by Brzozowski and Kawezynska (18) for Polish Black and White Lowland cows.

Consequently, milk flow rate increased with the increasing in milk yield. However, advancing lactation stage caused a significant decrease in milk flow rate. In addition, increasing length and diameter of front and rear teats decreased the milk flow rate. 305-day milk yield of bottle teat shape cows was lower than that of the cylindrical and funnel teat shape cows. Therefore, cows with cylindrical and funnel teat shape might be recommended to breeders to get higher milk yield.

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