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Milking procedures and milk ejection in Italian Brown cows

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ABSTRACT: The aim of the study was to describe, on the basis of field data, the traits of milk flow curves of Italian Brown cows and to investigate some sources of variation. A total of 1,450 milk flow curves of the whole udder were collected in 81 Italian Brown dairy herds in Lombardy, Italy, using electronic mobile milk flow meters. Parity order and days in milk affected most milk flow traits. Milk flow curves showed some defects dependent on milking management practices: very long machine-on time, long duration of overmilking phase, high percentage of stripping and moderate percentage of bimodality.

Key words: Dairy cow, Milk flow, Milking procedure.

INTRODUCTION – Electronic mobile milk flow meters allow to study in details milk flow during milking. A normal milk flow curve is characterized by an incline phase, with increasing milk flow, a plateau phase, with steady milk flow, and a decline phase. The shape of milk flow curve is influenced by many factors as breed, parity order, DIM, milking procedures and milking machine operating characteristics (Sandrucci et al., 2007). Study of milk flow during milking can provide useful information for enhancing the efficiency of milking process, avoiding some common mistakes, and protecting teat integrity and udder health. The aim of the study was to describe, on the basis of field data, the main traits of milk flow curves of Italian Brown cows and to investigate some sources of variation.

MATERIAL AND METHODS – The study was carried out in 81 herds in Lombardy, Italy. Data set consisted of 1,450 observations, obtained from different cows, collected from January 2005 to April 2006 by the technicians of ANARB (Association of Italian Brown Breeders) with electronic mobile milk flow meters (Lactocorder, WMB, Balgach, Switzerland). Lactocorder measured milk flow, milk yield and milk conductivity throughout the milking and determined some parameters, as described in Sandrucci *et al.* (2007). Data from milk flow meters were associated with the information on milking routines and milking machine derived from a questionnaire. All the data were analyzed by GLM procedure (SAS, Inst. Inc., Cary, N.C.); the statistical models always included, as fixed effects, parity order (1, 2, >2), stage of lactation (DIM; <100, 100-200, >200 d) and their interaction.

RESULTS AND CONCLUSIONS – The 81 commercial dairy farms involved in the study had, on average, 33 ± 33 lactating cows. The percentage of monitored cows on each farm was, on average, 57 ± 28%. Milk yield per milking was, on average, 11.7 ± 3.84 kg/d, with peak milk flow rate of 3.15 ± 0.97 kg/min and average milk flow rate of 2.05 ± 0.62 kg/min. Milk flow rates are higher than those registered by Santus and Bagnato (1998) on 724 Italian Brown cows and by Povinelli *et al.* (2003) on 2,071 Italian Brown primiparous cows. Peak and average milk flow rates of Italian Brown cows monitored in the present investigation are lower than those found in previous studies on Italian Holstein-Friesian cows (Sandrucci *et al.*, 2005; Sandrucci *et al.*, 2007). Similar differences in milk flow rates between breeds were reported by Dodenhoff *et al.* (1999) on Braunvieh and German Holstein cows.
Most milk flow parameters were influenced by parity order and DIM (Table 1), mainly as a consequence of different milk production levels. For peak milk flow rate, a significant interaction between parity order and stage of lactation effects was found ($P < 0.001$). Primiparous cows increased their ability to release milk per unit of time at milking as lactation progressed, but multiparous cows decreased peak milk flow rate as DIM increased because of

Table 1. Milk flow parameters as a function of parity order and DIM (least squares means).

		Parity order				DIM			
		1	2	>2	SEM	<100	100-200	>200	SEM
n		505	309	619		534	492	421	
Milk yield	kg/milking	10.5[c]	11.8[b]	12.3[a]	0.19	13.5[A]	11.5[B]	9.6[C]	0.17
Total milking time	min	8.34[c]	8.85[b]	9.28[a]	0.17	9.15[A]	9.08[A]	8.24[B]	0.15
Peak milk flow rate	kg/min	2.90[B]	3.25[A]	3.31[A]	0.05	3.25[A]	3.14A[B]	3.07[B]	0.05
Average milk flow rate	kg/min	1.98[b]	2.08[a]	2.08[a]	0.03	2.16[A]	2.06[A]	1.92[B]	0.03
Bimodality	%	26.1A[B]	31.5[A]	22.3[B]	2.45	23.8[B]	23.2[B]	32.9[A]	2.19
Duration of incline phase	min	0.64[b]	0.75[a]	0.72[a]	0.04	0.67[b]	0.67[b]	0.77[a]	0.03
Duration of plateau phase	min	2.61[a]	2.33[b]	2.25[b]	0.09	2.92[A]	2.47[B]	1.80[C]	0.08
Duration of decline phase	min	2.26[C]	2.71[B]	2.99[A]	0.09	2.85[A]	2.55[B]	2.56[B]	0.08
Peak conductivity of milk	mS/cm	6.16[B]	6.55[A]	6.58[A]	0.04	6.35[B]	6.39[B]	6.56[A]	0.04

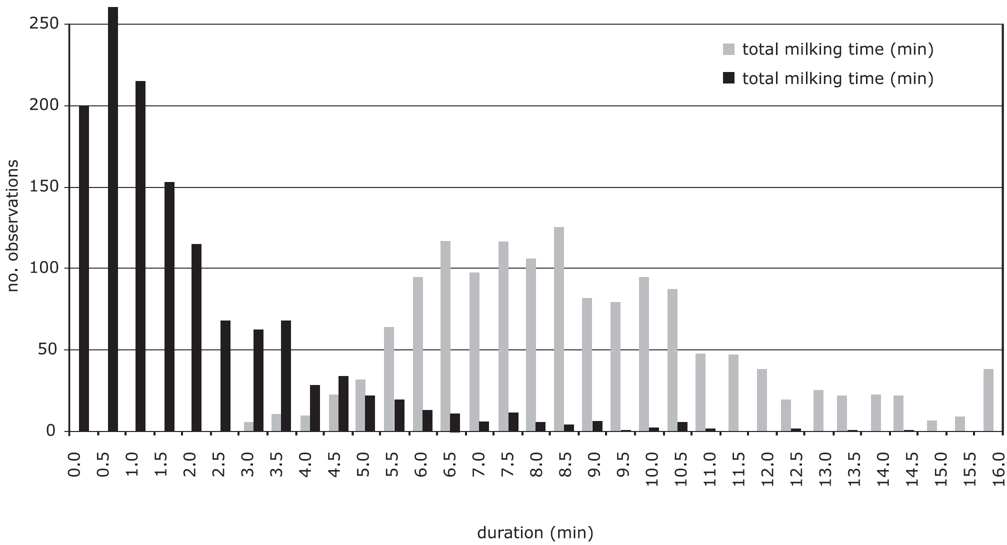
Means within a row, for parity and DIM separately, are different with small ($P < 0.05$) or capital ($P < 0.01$) letters.

reduced milk production, as observed by Bagnato *et al.* (2003). Similar interaction was also found on Italian Holstein-Friesian cows (Sandrucci *et al.*, 2007). Percentage of bimodal milk flow curves was 25.0 ± 43.3%, on average, with a significant increase in the last stage of lactation in respect to the first two stages. In previous studies on Italian Holstein-Friesian cows (Sandrucci *et al.*, 2005; Sandrucci *et al.*, 2007) higher frequencies of bimodality were registered. Dodenhoff *et al.* (1999) observed percentages of bimodality of 15, 17 and 16% for Braunvieh cows in first, second and third lactation, respectively, and found higher values for German Holstein cows. The low percentage of bimodality observed in the present study could partly depend on the moderate values of milk flow rates which reduced the probability of cistern emptying before alveolar milk ejection. Moreover in almost all monitored milkings (about 97%) teat cup attachment was preceded by one or more premilking operations (teat cleaning in 85%, predipping in 17% and forestripping in 72% of the farms) with positive effects on milk letdown. Percentage of bimodal curves dropped from 49.6 to 28.1% ($P < 0.01$) from the group without any preparation to the group with complete teat preparation (cleaning, forestripping and teat predipping). Prolongation of attachment delay, between pre-stimulation and cup attachment, was associated to a significant decrease in bimodality (from 30.4% with attachment delay <60 s to 17.5% with attachment delay >60 s; $P < 0.001$) and a reduction of incline phase time (0.73 *vs* 0.64; $P < 0.02$), which is influenced by bimodality. Total milking time was 8.9 ± 3.0 min with a wide range of variation (Figure 1): about 30% of milkings were longer than 10 min. Total milking time is longer than the values registered in previous studies on Italian Holstein-Friesian cows (Sandrucci *et al.*, 2005; Sandrucci et al., 2007): the long duration of machine-on time can be explained partly by the moderate average milk flow rate of Italian Brown cows, and partly by the long duration of overmilking phase observed in the present investigation (1.90 ± 2.05 min, corresponding to 21% of total milking time). About 32% of the farms were provided with milking parlors and had automatic takeoffs but overmilking time (period of time from milk flow rate < 0.2 kg/min until cluster removal) was very long also in this group (1.96 *vs* 1.79 min in the groups with and without takeoffs, respectively; NS). This result could be justified by improper settings of takeoffs or their discretional switch off.

Stripping phase (period of time at the end of milking, with milk flow rate > 0.2 kg/min for at least 4.2 s) lasted on average 0.96 ± 0.8 min (11% of total milking time) and it was applied in 46% of monitored milkings. Stripping milk was 0.51 ± 0.61 kg (4.7% of total milk yield). About 19% of strippings were automatically effected by milking machine.

In conclusion the study of 1,450 milk flow curves of Italian Brown cows reveals some defects of milk flow curves dependent on milking management practices. Machine-on time was very long, particularly due to excessive overmilking and stripping phases, causing a reduction of milking efficiency and an increase of labour costs and teat stress. Percentage of bimodal curves was moderate because of extensive adoption of pre-milking preparation but it could be further improved.

Figure 1. Frequency of total milking time and overmilking time.



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