Milk flow traits of buffalo cows in intensive farming system

L. Bava, A. Sandrucci, A. Tamburini, M. Zucali

Istituto di Zootecnia Generale. Università di Milano, Italy

Corresponding author: Luciana Bava. Istituto di Zootecnia Generale. Facoltà di Agraria, Università di Milano. Via Celoria 2, Milano - Tel. +39 02 50316453 - Fax +39 02 50316434 - Email: luciana.bava@unimi.it

ABSTRACT: The particular morphology of buffalo udder is associated to milking difficulties. To better understand the characteristics of milk ejection in buffaloes, a study was conducted in an intensive farm in Lombardy, Italy. A total of 184 milk flow profiles were measured with an electronic flow meter. The results showed that during the first 3 minutes of milking 73% of total milk yield was milked; lag time of milk ejection (1.94 min ± 1.57) was very long and increased significantly with the increasing of lactation stage (33% of total milking time, on average). Administration of oxytocin before milking did not significantly affect milk flow parameters and machine on-time. The results suggested that proper pre-milking stimulation and prompt cluster takeoff could improve milking efficiency, ensuring good milk letdown and protecting teat conditions.

Key words: Buffalo, Milk production, Milk ejection, Milk flow.

INTRODUCTION – Milk ejection reflex is similar in buffaloes and in dairy cows (Thomas, 2004): a continuous and complete emptying of the udder is dependent on elevated oxytocin concentrations release during the entire milking (Bruckmaier and Blum, 1998). However morphological differences suggest some peculiarity of milk letdown in buffaloes which have to be considered to improve the efficiency of machine milking. The total cisternal area and milk cisternal fraction in buffalo cows is smaller than in dairy cows, sheeps and goats: cisternal fraction is, on average, only 5% of total milk, decreases during lactation and increases with the age of the animal. The small volume of buffalo cistern suggests that a longer teat stimulation before teat cup attachment is necessary to guarantee a correct oxytocin emission and a good milk letdown. Moreover buffalo teats are longer and thicker and have longer teat canals than those of dairy cows (Thomas, 2004). Buffalo are known to be difficult to milk: lag time between teat stimulation and milk letdown required more time compared to cows, lasting on average 2 minutes (Costa and Reinemann, 2003). Although not documented, it is well known from practice that in large buffalo herds, oxytocin injection before milking is frequently used to achieve milk let down (Thomas, 2004). The aim of the study was to describe buffalo milk flow profile for a better understanding of milk ejection physiology and improving efficiency of machine milking of buffaloes.

MATERIAL AND METHODS – A total of 184 individual milk flow profiles were measured with electronic mobile milk flow meters (Lactocorder, WMB) in an intensive farm in Lombardy, Italy. Monitorings were performed during afternoon machine milking in 8 farm visits in the course of a year. Milk flow parameters were previously described by Sandrucci et al. (2007). None udder preparation was applied before milking; about a third of buffaloes were treated with an injection of oxytocin before teat cup attachment to improve milk letdown. Milk production and SCC were obtained from the database of AIA (Italian Breeders Association) and corresponded to the results of the test day nearest to the date of the milk flow monitoring. SCC were expressed as Linear Score (LS). All the data were analyzed by GLM procedure (SAS, Inst. Inc., Cary, N.C.) with the following fixed effects: number of parity stage (1, 2, >2), stage of lactation (DIM; < 90, 90–180, > 180 d) and their interaction.

RESULTS AND CONCLUSIONS – Lactation number of monitored buffalo cows varied from 1 to 12. Average DIM were 151 ± 91 d, daily milk yield was 8,86 ± 3.46 kg/d, milk fat and milk protein percentages were 8.58 ± 1.22 % and 4.76 ± 0.55 %, respectively. Average LS was 3.79 ± 1.62, higher than LS values reported by other authors on buffaloes (Cerón-Muñoz et al., 2002; Moroni et al., 2006). Milk yield per milking significantly decreased during lactation while fat and protein percentages significantly increased: fat percentage changed from 8.29% to 9.14% (P
<0.05) and protein percentage from 4.61% to 5.04% (\(P < 0.05\)) from < 90 DIM class to > 180 DIM class, respectively. These results are in agreement with data reported by Ceròn-Muñoz et al. (2002).

Table 1. Main milk flow parameters as a function of lactation stages (Least-Squares Means).

|                | DIM     |              |              | SEM  |
|----------------|---------|--------------|--------------|------|
|                | < 90 d  | 90-180 d     | > 180 d      |      |
| n.             | 37      | 53           | 43           |      |
| Total milk yield | kg/milking | 5.23\(^A\)   | 3.57\(^B\)   | 2.73\(^C\) | 0.252 |
| Milk yield first 3 min | kg     | 3.56\(^A\)   | 2.73\(^B\)   | 2.03\(^C\) | 0.220 |
| Period of milk ejection| min     | 7.71\(^\text{a}\) | 6.61\(^\text{b}\) | 6.21\(^\text{b}\) | 0.414 |
| Lag time before milk ejection | min     | 1.64         | 1.86         | 2.44 | 0.315 |
| Time of incline phase | min     | 0.61         | 0.55         | 0.65 | 0.127 |
| Bimodality | %       | 15.0         | 11.3         | 9.80 | 5.86 |
| Time of plateau phase | min     | 2.02\(^\text{A}\) | 1.65\(^\text{A}\) | 1.27\(^\text{B}\) | 0.226 |
| Time of decline phase | min     | 2.15         | 1.70         | 1.62 | 0.224 |
| Time of overmilking phase | min     | 2.77         | 3.07         | 2.91 | 0.370 |
| Average milk flow | kg/min  | 1.11\(^\text{a}\) | 0.93\(^\text{b}\) | 0.74\(^\text{c}\) | 0.072 |
| Maximum milk flow | kg/min  | 1.80\(^\text{a}\) | 1.42\(^\text{b}\) | 1.14\(^\text{c}\) | 0.114 |
| Peak milk conductivity | mS/cm | 5.41         | 5.20         | 5.33 | 0.143 |

\(^1\)Period of milk ejection= period of time between milk flow > 0.5 kg/min and cluster removal;

Means within a row with small (\(P < 0.05\)) or capital (\(P < 0.01\)) letters are different.

Data reported in table 1 showed that during the first 3 minutes of milking 73% of total milk yield was milked which is higher than the percentage reported for cows (67% of total milk; Sandrucci et al., unpublished data). Time of milk ejection (period of time between milk flow > 0.5 kg/min and cluster removal) significantly decreased during lactation because of the reduction of milk production. Similar data are reported for cows (Sandrucci et al., 2007). Lag time before milk ejection (period of time between teat cup attachment and the start of milk ejection) was very long (1.94 \(\pm\) 1.57) and it was due to the lack of teat stimulation before milking that induced a delay in milk ejection reflex (Bruckmaier and Blum, 1998). Lag time tended to increase with increasing stage of lactation: lag times were 17.5%, 22.0% and 28.3% of total milking time (calculated as the sum of time of milk ejection and lag time) for the three stages of lactation, respectively. This phenomenon is explained by the reduction of cistern size and milk yield as lactation progressed (Thomas et al., 2004) and by the delay of alveolar milk ejection due to the decrease of udder filling (Bruckmaier and Hilger, 2001). Overmilking phase was very long (33% of total milking time, on average) in comparison with data reported for cows (16% of total milking time; Sandrucci et al., 2005) because automatic takeoffs were not used in this farm. The sum of the lag time before milk ejection and the overmilking phase, as a percentages of total milking time, was 47.2%, 58.2% and 61.9% for the three stages of lactation. These results suggest that the milking procedure applied causes an unnecessary increase in machine-on time that could lead to a poor teat conditions (Hillerton et al., 2002). Percentage of bimodal curves was lower for buffaloes (9%) in comparison with cows (Sandrucci et al., 2005). Average and maximum milk flow rates were 0.92 \(\pm\) 0.37 and 1.42 \(\pm\) 0.60, respectively and these value are very low in comparison with cows (Sandrucci et al., 2007). Milk flow rates significantly decreased during lactation as a consequence of the reduction of milk yield.

Treatment with oxytocin before milking did not affect significantly milk yield and milk flow parameters (table 2) although time of milk ejection, lag time before milk ejection and bimodality were slightly lower in the oxytocin group than in the control one. From these results the efficacy of chronic treatment with exogenous oxytocin for improving milk ejection in buffaloes seems questionable. Moreover, Bruckmaier (2003) indicated that chronic administration of oxytocin before milking could caused a reduced milk ejection in cows. Further investigations are
needed to study the effect of chronic administration of oxytocin in buffaloes. Results from the present study confirmed that buffalo have a species-specific requirements for milk ejection: proper pre-milking stimulation and prompt cluster removal are necessary in order to ensure optimal milk letdown and to guarantee good teat conditions.

Table 2. Effects of oxytocin administration before milking on milk flow parameters.

| Treatment                           | Control | Oxytocin | SEM  |
|-------------------------------------|---------|----------|------|
| n.                                  | 125     | 62       |      |
| Total milk yield kg/milking         | 3.89    | 3.66     | 0.202|
| Milk yield first 3 min kg           | 2.70    | 2.79     | 0.173|
| Period of milk ejection min         | 6.86    | 6.58     | 0.304|
| Lag time before milk ejection min   | 2.13    | 1.85     | 0.299|
| Time of incline phase min           | 0.64    | 0.53     | 0.105|
| Bimodality %                        | 12.4    | 8.90     | 4.75 |
| Time of plateau phase min           | 1.68    | 1.55     | 0.175|
| Time of decline phase min           | 1.92    | 1.72     | 0.183|
| Time of overmilking phase min       | 2.78    | 2.90     | 0.291|
| Average milk flow kg/min            | 0.91    | 0.93     | 0.057|
| Maximum milk flow kg/min            | 1.43    | 1.44     | 0.092|
| Peak milk conductivity mS/cm         | 5.33    | 5.31     | 0.122|

1Period of milk ejection = period of time between milk flow > 0.5 kg/min and cluster removal.

The Authors want to thank Mr. Vitali, owner of the buffalo farm.

REFERENCES – Bruckmaier, R.M., Blum, J.W., 1998. Oxytocin release and milk removal in ruminants. J. Dairy Sci. 81:939-949. Bruckmaier R. M., Hilger, M., 2001. Milk ejection in dairy cows at different degrees of udder filling. J. Dairy Res. 68:369-376. Bruckmaier, R., 2003. Chronic oxytocin treatment causes reduced milk ejection in dairy cows. J. Dairy Res. 70:123-126. Cerón-Muñoz, H., Tonhati, H., Duarte, J., Oliveira, J., Muñoz-Berrocal, M., Jurado-Gámez, H., 2002. Factors affecting somatic cell counts and their relations with milk and milk constituent yield in buffaloes. J. Dairy Sci. 85:2885-2889. Costa, D.A., Reinemann, D.J., The need for stimulation in various bovine breeds and other species. 100th Centenary Int. Dairy Fed., World Dairy Summit Special Conference: 100 Years with Liners and Pulsation, Sept. 2003, Bruges, Belgium Hillerton, J. E., J. W. Pankey, and P. Pankey. 2002. Effect of over-milking on teat condition. J. Dairy Res. 69:81-84. Moroni, P., Sgoifo Rossi, C., Pisoni, G., Castiglioni, B., Boettcher, P.J., 2006. Relationships between somatic cells count and intrammary infection in buffaloes. J. Dairy Sci. 89:998-1003. Sandrucci, A., Bava L., Tamburini A., Zanini L., 2005. Milking procedures, milk flow curves and somatic cell count in dairy cows. Italian J. Anim. Sci. 4 (Suppl. 2):215-217. Sandrucci, A., Tamburini, A., Bava, L., Zucali, M., 2007. Factors affecting milk flow traits in dairy cows: results of a field study. J. Dairy Sci. 90:1159-1167. Thomas, C.S. 2004. Milking management of dairy buffaloes. Ph.D. Diss. Swedish Univ. Agric. Sci., Uppsala, Sweden. Thomas, C. S., Svennersten-Sjaunja, K., Bhosrekar, R., Bruckmaier, R., 2004. Mammary cistern size, cisternal milk and milk ejection in Murrah buffaloes. J. Dairy Res. 71 :162-168.