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Effects of the working vacuum level on mechanical milking of buffalo

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ABSTRACT

Mechanized milking has become widely used for buffalos in Italy in recent years, thus improving the management and the productivity of farms. The apparent similarities between buffalo and cattle have often resulted in applying the same milking systems and techniques currently used for dairy cows. Considering the effect of mechanical milking on animal health, productivity, and welfare in intensive livestock farming, this study compares the effects of milking at low vacuum (36 kPa) and medium vacuum (42 kPa) on milk emission characteristics and milking system performance. Individual milk flow curves were registered to analyze milk yield, average flow rate, and milking time, and milking operations were recorded to evaluate the system performances. When using 36 kPa vacuum, a significant increase in milking time and in the lag time before milk ejection occurred, as well as a decrease in average flow rate and residual milk. However, the vacuum level did not influence both milk yield and milk ejection time. As a consequence of decreasing the vacuum level to 36 kPa, the milking system throughput was decreased at most by 5 buffalo/h.
Key words: animal welfare, buffalo, milking, working vacuum

INTRODUCTION

In recent years, a marked increase in dairy buffalo farming in Italy has taken place. There are now some 269,000 head of buffalo in Italy (ISTAT, 2008), and they are mainly found in the regions of Campania, Puglia, and Lazio. Mechanized milking is today largely diffused in buffalo farms, because it is the principal way of increasing work productivity and improving milk quality. Because cows and buffalo are apparently similar species, the experience and technology used for dairy cattle are usually employed also for buffalo, but it should be considered that both the anatomy and physiology of the 2 species are different. The udder cistern of buffalo is absent or has a very small volume and, therefore, little or no cisternal milk is available. Considering that buffalo teats are, on average, longer than in cows (Sastry et al., 1988), the effective length of the liner should be accurately chosen because the use of teat cups that are too short can alter the effect of the massage phase of the pulsation cycle. Buffalo are sensitive to changes in the milking parlor (Pathak, 1992), and are considered to be slow and hard milkers (Sastry et al., 1988) because of their slow milk ejection reflex and their sphincter muscle around the streak canal is thicker than in cattle (Ståhl Högberg and Lind, 2003).

For these reasons the working vacuum applied to buffalo is generally higher than the level used in cows so as to shorten the milking time (Table 1). In a recent field survey carried out in 189 installations for buffalo milking in Italy, the working vacuum levels varied from 40 to 53 kPa (Figure 1). The most frequent values (45%) ranged between 44 and 46 kPa, whereas only 4% of the installations were set at ≥50 kPa. A positive relationship between increasing working vacuum and the milk SCC has been found in buffalo (Badran, 1992; Pazzona and Murgia, 1992), which confirms preceding works on cows where raising the vacuum from 33 to over 50 kPa had a negative effect on teat condition (Langlois et al., 1980) and increased mastitis incidence (Galton and Mahle, 1980; Langlois et al., 1980; Østeras and Lund, 1988). By contrast, increase in milking time and increased frequency of the teat cups falling off are the principal negative factors caused by lowering the milking vacuum level (Spencer and Rogers, 1991).

Because little or no cisternal milk is available in buffalos, in the early stage of milking, the animals are often exposed to a long period of vacuum without any ejection of milk. The use of high-working vacuums combined with the absence of milk can cause irritation in the delicate mammary tissues and, thus, stress the animals (Bruckmaier and Blum, 1996). Moreover buffalo are sensitive to the environment and the application of wrong milking technique or a change in milking routines can inhibit milk let-down, thus affecting negatively the milk production (Ståhl Högberg and Lind, 2003).

To deepen the knowledge on the milking dynamics of buffalo and define milking techniques that meet their physiological needs, a study was performed to verify

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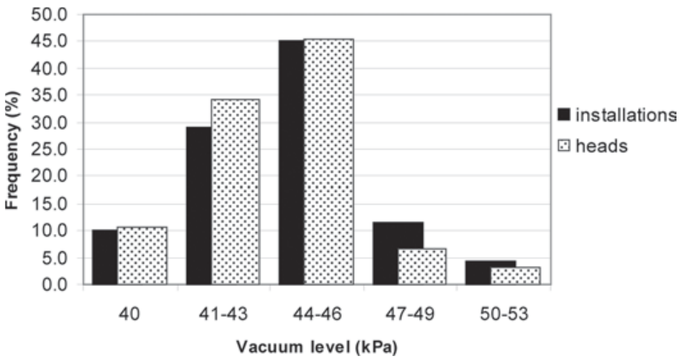

Figure 1. Frequency of vacuum level used for buffalo milking in Italy (189 installations, 21,740 heads). Data were based on field tests of Assaociazione Italiana Allevatori (AIA) in 2009 (S. Grande, AIA, Rome, Italy, personal communication).

the possibility of lowering the level of milking vacuum. Considering that Aliev (1969) reported that a vacuum pressure of over 30 kPa is necessary to relax the teat sphincter in buffalo, we compared what effects using a low vacuum (36 kPa), rather than a medium vacuum (42 kPa), had on the milk flow curve, the throughput of the milking system, and the operator performance.

MATERIALS AND METHODS

This work was carried out on a Mediterranean breed buffalo farm located in Latina, Italy. Four hundred and fifty milking buffalo, in different parity and stage of lactation, were used in the experiment. The milking system was a 2 × 28 parallel parlor with a low-level milking system equipped with a light-weight (1.80 kg) cluster (Harmony Plus, DeLaval, Tumba, Sweden), automatic cluster removers, and electronic herd management system (Alpro system, DeLaval). The cluster was equipped with conic rubber liners (length = 128 mm, diameter of mouthpiece lip = 20 mm, thickness = 2.3 mm) classified by the manufacturer as soft liner (softness rating 1) according to the touch point pressure differential measurement. The claw had a volume of 450 mL, the diameter of the long milk tube was 16 mm, and that of the short milk tube was 12.5 mm. The pulsator rate was 60 cycles/min and the pulsator ratio was 65%. The working vacuum was tested for values of 42 kPa and 36 kPa. Milk flow curves were recorded at 42 kPa and, after 3 wk of adaption to progressively lower vacuum levels, at 36 kPa, from all of the animals in lactation. Milking took place at intervals of 9 h (daytime) and 15 h (overnight).

The milking routine involved the attachment of the milking unit, without any preparation of the udder either by pre-stimulation or pre-dipping, and the manual removal of the teat cups without mechanical or manual stripping. During milking the animals were not given any concentrates.

Milk flow curves (48 curves/milking) were recorded at random during evening milking for 4 d at 36 kPa and 6 d at 42 kPa, using 6 electronic mobile milk flow meters (LactoCorder, WMB, Balgach, Switzerland; Bava et al., 2007; Bava and Zucali, 2007; Borghese et al., 2007).

The variables measured per each milking were milk yield (**MY**; kg/head per milking), the total milk yield from the beginning to the end of the measurement; milking time (**MT**; min), the time from attaching to removing the teat cups; lag time (**LT**) before milk ejection (min), the time from the beginning of measurement until a 0.50 kg/min threshold in the milk flow was reached; milk ejection time (**MET**; min), the time from milk flow rate ≥0.50 kg/min until milk flow decreased below 0.20 kg/min; average milk flow rate (kg/min), the average main milk yield per minute during milk ejection time; effective milking time (**EMT**; min), the time between attaching the teat cup and reaching the value of 0.20 kg/min at the end of milking; and residual milk (**RM**; kg), the quantity of milk extracted in the time between the flow decreasing to less than 0.20 kg/min and removal of the milking unit.

Statistical analysis was carried out by comparing the milk flow curves at 36 and 42 kPa, using a Mann-Whitney U test from the SPSS (ver. 15.0, SPSS, Inc., Chicago, IL).

Table 1. Different levels of working vacuum and the frequency and ratio of pulsations used when milking buffalo in different parts of the world (from Thomas, 2004, rielab.)

Authors and year of publication	Country	Vacuum (kPa)	Pulsator frequency (cycles/min)	Pulsator ratio (%)
Thomas and Anantkrishnan (1949)	India	46	50	—
Marathe and Whittlestone (1958)	India	68	40	50
Aliev (1970)	Azerbaijan	56	60	—
Alim (1977)	Egypt	51	60	50
Pazzona (1989b)	Italy	45	60	60
Badran (1992)	Egypt	56	65	—
Lind et al. (1997)	India	56	70	65
Thomas et al. (2005a)	India	50	70	65