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Evaluation of the performance of the first automatic milking system for buffaloes

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ABSTRACT

The objective of this study was to evaluate the response of buffaloes to automatic milking, examining the relationships between milking interval, milk production, and milking time for this species. A total of 7,550 milking records from an average of 40 buffaloes milked by an automatic milking system (AMS) were analyzed during a 3-mo experimental period at a commercial farm with Italian Mediterranean buffaloes in southern Italy. Date and time of animal identification, milk yield, milking duration, milking interval, and average milk flow rate were determined for each milking. The results were also used to predict the maximum number of milkings per day and the optimal number of buffaloes per AMS for different levels of milk production. The average interval period between 2 consecutive milkings was 10.3 h [standard deviation (SD) 3.3]. Overall, 3.4 and 25.7% of the milkings had an interval of ≤6 h or >12 h, respectively. Milking duration averaged 8.3 min per buffalo per milking (SD 2.7). The average milk flow rate was 1.3 kg/min (SD 0.5) at a milk yield of 2.8 kg per milking (SD 1.4). Assuming that the milking station is occupied 80% of the time, the number of milkings ranged from 136 to 152 per day and the optimal number of buffaloes per AMS ranged from 59 to 66 when the production level increased from 2 to 5 kg of milk per milking. Automatic milking systems are suitable for buffalo, opening new options for the management of dairy buffalo farms.
Key words: automatic milking system, dairy buffalo, milking performance

INTRODUCTION

Automatic milking systems (**AMS**) were a revolutionary innovation in dairy cow farming and can be seen not only as replacements for milking parlors but also as a new way of managing dairy farms. The first AMS were installed in the Netherlands in 1992, even though interest in fully automated milking began in the 1970s. This interest was initially due to increasing costs of labor, land, buildings, and machinery, combined with decreasing milk prices (de Koning et al., 2002; de Koning and Rodenburg, 2004). By 2009, about 8,000 farms had adopted AMS (Svennersten-Sjaunja and Pettersson, 2008; de Koning, 2010) and AMS can now be considered a well-established technology. About 90% of AMS are installed in dairy farms in northern Europe, whereas the remainder are located in Canada (9%) and the United States (1%) (de Koning, 2010). The slow adoption of AMS in the United States may be due to farmer uncertainty about using the new technology; the lack of readily available support services in the event of mechanical or technical problems; the availability of less-expensive labor compared with other countries; and a higher proportion of large farms, where installing AMS may be less economically advantageous than in the smaller farms of northern Europe (Rotz et al., 2003; Jacobs and Siegford, 2012).

The main factors promoting the adoption of AMS for dairy cows are better organization of labor, increased milk yields, and improved animal behavior (Hogeveen et al., 2001). Automatic milking systems reduce the heavy workload of milking and enable milking frequency to be controlled on an individual cow basis, according to her production level or stage of lactation, without incurring extra labor costs (Hogeveen et al., 2001; Svennersten-Sjaunja and Pettersson, 2008; Jacobs and Siegford, 2012). All else being equal, cows milked more frequently throughout a lactation usually produce greater amounts of milk compared with cows milked twice a day (Stelwagen et al., 2013; Wright et al., 2013). Some researchers have observed an increase in milk production of up to 12% for cows milked more than twice a day in AMS compared with cows milked twice a day in conventional milking systems (de Koning et al., 2002; Wagner-Storch and Palmer, 2003; Wade et al., 2004), whereas other researchers have reported no increase in milk production in cows milked more

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frequently by AMS (Speroni et al., 2006; Gygax et al., 2007). Although many factors affect the welfare of dairy cows on a farm, cows milked by AMS can manage their daily activities with more freedom and have more opportunities to interact with their environment (Jacobs and Siegford, 2012). Several researchers have compared the behavioral and physiological stress responses of cows during milking in AMS with those being milked in conventional parlor systems. Cows' heart rates in AMS were similar to or lower than those observed in conventional parlors (Hopster et al., 2002; Wenzel et al., 2003; Weiss et al., 2004; Hagen et al., 2005). Lower maximum plasma adrenaline and noradrenaline concentrations were reported in cows milked in AMS compared with cows milked in conventional parlor systems, which indicates that cows experienced less stress during AMS milking (Hopster et al., 2002). Levels of milk cortisol and fecal corticosteroids did not differ between AMS and conventionally milked cows (Weiss et al., 2004; Gygax et al., 2006; Lexer et al., 2009).

In recent years, buffalo dairy farming in Italy has undergone a marked increase. There are currently about 358,000 head of buffalo on 2,500 farms (ISTAT, 2010), mainly in the center and south of the country (Lazio, Campania, and Apulia). In Italy, buffaloes have been successfully milked by machine for over 30 yr, and this was the main means to increase productivity and improve milk quality. However, because cows and buffaloes are similar species, the experience gained and technologies developed for dairy cattle have usually been applied without alteration for buffaloes, even though the anatomy and physiology of the 2 species differ (Caria et al., 2011). Dairy cows store less than 30% of the total milk yield volume in the udder cistern after a normal milking interval (Ayadi et al., 2003). In dairy buffaloes, only about 5% of the milk produced between 2 consecutive milkings (10- to 12-h interval) is stored in the udder cistern, whereas the remaining 95% of the milk is stored in the alveolar compartment. As a result, premilking stimulation is extremely important for the optimal milk ejection response in buffaloes (Thomas et al., 2004). Moreover, dairy buffaloes have longer and thicker teats compared with dairy cows, which is important to consider when milking buffaloes with a machine (Thomas, 2004). Following the same logic, the automatic milking of dairy buffaloes was introduced for the first time on a commercial farm located in southern Italy (Campania) in 2008. As observed in dairy cows, buffaloes can visit the AMS voluntarily. Consequently, one might expect large variation in the frequency of visits to the milking robot and thus large variations in the milking interval (Hogeveen et al., 2001).

The aims of this study were to evaluate the response of buffaloes to automatic milking and, in particular, the relationships between milking interval, milk production, and milking time for this species.

MATERIALS AND METHODS

Data were collected during a 3-mo period (December 2010 to February 2011) at a commercial farm with Italian Mediterranean buffaloes in southern Italy (Campania). The farm had 200 dairy buffaloes that were milked automatically in 4 milking stalls (VMS, DeLaval, Tumba, Sweden), each serving 1 pen of buffaloes. Dairy buffaloes were housed in mat-lined freestalls and were fed ad libitum with a TMR provided once a day (0730 to 0900 h) and pushed into the feeding trough twice daily. Guided cow traffic was achieved by using a preselection gate controlled by the AMS. The buffaloes that were allowed to be milked could enter the waiting area facing each AMS and then move to the milking box; otherwise, they were rejected and directed to the feeding area. However, during the period of the study, we set no minimum time interval between milkings. Thus, buffaloes could access the robot at any time to be milked. The AMS installed (VMS, DeLaval) used the standard configuration for dairy cows. The only modification was the installation of a steel casing to protect the electronic components inside the milking box from damage by the horns of the animals.

Data collection was limited to VMS1 (1 of the 4 VMS installed in the farm). During the experimental period, the herd managed by VMS1 consisted of, on average, 40 buffaloes, with 228 DIM and 3.18 lactations. The working parameters were 42 kPa vacuum, 60 cycles/min pulsator rate, and 60% pulsator ratio. The concentrate feed administered in the milking station to each buffalo ranged between 0.5 and 3.0 kg/d based on daily milk yield.

Data Collection

The following information was collected for each milking, using the VMS herd management software (DeLaval DelPro, DeLaval): buffalo identification number, date and time of buffalo identification, milk yield (kg/milking), milking duration (time between the buffalo identification and the last teat-cup detachment, min), and milking interval (time between the beginning of 2 consecutive milkings for the same buffalo, h). The average milk flow rate (kg/min) was calculated as the sum of the milk flow of each quarter.

Data Selection and Analysis

Before analysis, data were checked for consistency and validity. Data with a milking interval of <1 h or