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To cite this article: Angela Gabriella D'Alessandro, Rosanna De Petro, Salvatore Claps, Michele Pizzillo & Giovanni Martemucci (2009) Yield and quality of milk and udder health in Martina Franca ass: effects of daily interval and time of machine milking, Italian Journal of Animal Science, 8:sup2, 697-699, DOI: [10.4081/ijas.2009.s2.697](https://doi.org/10.4081/ijas.2009.s2.697)

To link to this article: <https://doi.org/10.4081/ijas.2009.s2.697>



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Published online: 07 Mar 2016.



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Yield and quality of milk and udder health in Martina Franca ass: effects of daily interval and time of machine milking

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ABSTRACT - Twenty asses of Martina Franca breed, machine milked twice a day, were used to assess the influence of milking interval (3-h, 5-h, and 8-h; N=5) and time (700, 1200 and 1900) on milk yield and udder health. Individual milk samples were taken to determine fat, protein and lactose content. Sensory analysis profile was also assessed. Milk's total bacterial count (TBC), somatic cell content (SCC) and udder's skin temperature were considered to assess udder health. Milk yield increases by 28.4% (P<0.01) with a milking interval from 3-h to 8-h and is higher (P<0.01) at morning milking. The maximum milk yield per milking corresponds to 700 milking (1416.9 mL) thus indicating a circadian rhythm in milk secretion processes. Milking intervals of 5 and 8 hours cause a decrease (P<0.01) in milk fat and lactose content. The 8-h interval leads to an increase (P<0.01) in SCC but without any significance for the health udder. No alterations about CBT, clinical evaluation and temperature of udder were observed. Milk organoleptic characteristics were better in the 3-h interval milking.

Key words: Ass milk, Machine milking, Yield, Quality.

Introduction - The structure of mammary gland in Equidae affects the need for a greater number of daily milkings, due to the small cisternal size (Doreau and Boulot, 1986). The increase in the number of daily milkings up to 8 does not improve milk yield per milking in ass and increases the somatic cell number (D'Alessandro and Martemucci, 2007; Alabiso *et al.*, 2008). Milking interval and time are not well defined in ass. In order to improve milking efficiency in ass, our study was aimed at assessing the influence of the interval and time of daily milkings on milk quantitative-qualitative yield and ass' udder health.

Material and methods - A total number of twenty adult asses of Martina Franca breed, at 4th-5th lactation month were considered (Southern Italy). Daily milking was performed in the presence of foals, by machine. The animals were subdivided into the following four homogeneous experimental groups (N=5) (Table 1). The study lasted twenty days. Individual ass milk yield per milking was measured by infrared lactometer. Individual milk samples from morning and evening milking were collected over the last three trial days, pooled and analyzed as for the main qualitative parameters

Table 1. Experimental design.

Group	Animals N.	Milking interval (h)	Times of daily milkings	
			a.m.	p.m.
A	5	3	12.00	19.00
B	5	5	12.00	19.00
C	5	8	12.00	22.00
D	5	8	7.00	19.00

(protein, fat, lactose; FIL-IDF 141 C:2000; Milkoscan 6000). In relation to milking intervals of 3, 5 and 8 hours, we assessed the milk organoleptic characteristics through a panel test. On D0 and D20 of the trial, the ass' udder condition in terms of: total bacteria count (TBC), somatic cell count (SCC; Fossomatic 360) of milk samples; clinical evaluation of the asses' udder aimed at detecting possible alterations of the organ, and measuring of the udder's temperature, in four sites, as an index of inflammatory processes was also evaluated. Statistical analysis of data was performed by a SAS GLM procedure (SAS, 1999-2000) with means compared by Students' t test.

Results and conclusions - Milk yield is affected by milking interval ($P < 0.01$). Yield per milking significantly increases ($P < 0.01$) with the increase in the milking interval by resulting averagely higher with the 8-h interval (1153.9 mL) (Table 2). This phenomenon was already shown in an our previous work (D'Alessandro and Martemucci, 2007) and in the Ragusana breed (Alabiso *et al.*, 2008). The average daily milk yield per head increases by 28% with the 8-h interval compared to the 3-h interval, and equals 2307.8 mL ($P < 0.01$). This increase however corresponds to a decrease in the secretive ability of the mammary gland, expressed in terms of milk yield per hour with the 8-h interval, equal to 47.6% (data not shown), ascribable to the negative effect wielded by the increase in intramammary pressure (Aguggini *et al.*, 2002). This seems to indicate that the ass' cistern has a certain ability to dilate which compensates the loss in milk synthesis due to the filling of the udder up to 8-h, though making us hypothesize that 8-h is not the maximum limit for increasing milk yield. Milk production obtained in this study was higher compared to that reported by Alabiso *et al.*, 2008. Milking time affects ($P < 0.01$) milk yield. Significantly higher ($P < 0.01$) yield values are found in morning milkings compared to the evening ones (+10.5%, +15.6%, +18.6%, with 3, 5 and 8-h milking intervals respectively) (Table 2). The milking performed at 7:00 (Group D) shows the maximum milk yield per milking ($0.01 > P < 0.05$). This phenomenon can be ascribed to a circadian rhythm of the milk synthesis process, with the highest secretory activity over the night, as shown in rats (+50%; Murray *et al.*, 1986). In Ragusana asses we noticed a circadian rhythm in the synthesis of milk constituents, with a peak of fat and lactose at night and a peak of proteins during the day (Piccione *et al.*, 2008). The milking interval considerably affects ($P < 0.01$) milk fat and lactose content. Milk fat percentage was high at 3-h milking interval and decreased significantly at 5-h interval, value that remained constant until the 8-h interval. Also lactose content followed the same trend (Table 3). This indicates that the fat and lactose synthesis in ass occurs during early udder filling and is not affected by the increase in the milking interval from 5 to 8-h. Also ewes show a reduction in the fat synthesis with the increase in the milking interval (McKusick *et al.*, 2006). Milk protein percentage did not differ ($P > 0.05$) in relation to milking interval, as observed in ewes (Castillo *et al.*, 2008). The number of somatic cells is affected by the milking interval ($P < 0.05$). SCC was similar in 3-h and 5-h milking intervals ($P > 0.05$) while with the 8-h interval it significantly increased compared to 3-h (9.05; $P < 0.01$) (Table 3). In ewes, the increased SCC associated with a longer milking

Table 2. Effect of milking interval and time on asses' milk yield.

Group (milking interval)	Milk yield per milking (mL)		Daily milk yield per milking (mL)		Milk yield per day (mL)	
	a.m.milking	p.m.milking	Mean	SE	Mean	SE
A (3h)	908.5 ^A **	739.1 ^A	823.8 ^A	647.00	1652.1 ^A	548.08
B (5h)	987.1 ^A **	833.0 ^A	910.4 ^A		1816.7 ^A	
C (8h)	1218.0 ^{Ba} **	1089.8 ^B	1153.9 ^{Ba}		2307.8 ^B	
D (8h)	1416.9 ^{Bb} *	1155.4 ^B	1286.1 ^{Bb}		2572.3 ^B	

On the column: ^{A,B,C} = $P < 0.01$; ^{a,b} = $P < 0.05$. On the row: ** = $P < 0.01$; * = $P < 0.05$.

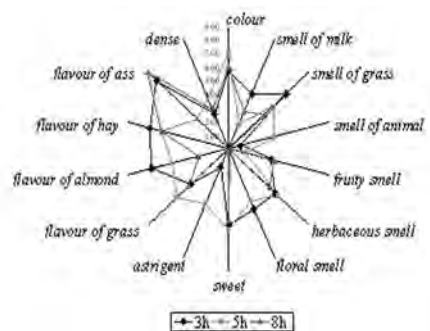
Table 3. Effect of milking interval on asses' milk composition (g/100 g) and SCC (X ±SE).

Group	Milk fat	Milk protein	Lactose	SCC (x 1000 cells/mL)
A	0.97 ± 0.09 ^A	1.67 ± 0.04	6.87 ± 0.06 ^A	6.05 ± 0.79 ^A
B	0.54 ± 0.09 ^B	1.59 ± 0.04	6.57 ± 0.06 ^B	7.39 ± 0.79
C	0.53 ± 0.09 ^B	1.66 ± 0.04	6.44 ± 0.06 ^B	9.05 ± 0.79 ^B

On the column: ^{A,B}= P<0.01.

interval was attributed to a leaky tight junction between mammary epithelial cells. However, tight junctions appear to resume their original state immediately upon milk removal (Stelwagen *et al.*, 1997). Sensory analysis profiles in ass' milk in experimental groups are reported in Figure 1. Milking interval affects milk organoleptic characteristics which are better in the 3-h interval milking. The differences with respect to longer intervals can be attributable to spontaneous lipolysis due to the stagnation of the milk in the mammary gland. In conclusion, the results achieved show that the maximum milk yield is obtained in an 8-h interval milking system and milkings at 7.00. We should however highlight the need for assessing the yielding ability of asses with an 8-h milking interval for longer periods during lactation, and with milking intervals longer than 8 hours. A better milk quality in terms of fat and lactose content and organoleptic characteristics corresponds to the 3-h interval milking systems. Although the 8-h interval increased the SCC number, this value is not worthy of significance for the health udder conditions. No alterations about CBT, clinical evaluation and temperature of udder were observed.

Figure 1. Organoleptic characteristics of ass' milk



The Authors wish to thank Dr. Marianna La Guardia for her collaboration.

The research was supported by Interreg Greece-Italy (Project Code I 2101030), Paper N. 18

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