BEHAVIOR OF COWS AND ITS CONSEQUENCES RELATED TO THE USE OF MILKING ROBOTS

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Abstract. Efficiency of utilization of a single-stall DeLaval milking robot was evaluated on a herd of 59 first calvings. The study was conducted at the turn of the second and the third month of the robot's operation over the period A of 30 days, and in the fifth and sixth months: during the period B of 27 days. The total number of milkings was similar in both periods and came to 153 per day in the period A and 139 in the period B. The herd milked fairly consistently during the day, the hourly total ranging from 5 to 7 milkings. The average daily amount of the collected milk in both analyzed periods was about 1700 kg. The single cow's milkings averaged 2.5. Almost 95 % of cows milked 2 and 3 times per day and about 4 % – 4 times. The daily yield for cows milked twice per day averaged 25 kg, and for cows milked 3 times – 35 kg. The difference in productivity between 2-times-per-day and 3-times-per-day milked animals was statistically significant during the both studied periods. The results of the study confirmed that the single-stall DeLaval VMS can be accepted and intensively used by the cows and that it meets the requirements of their well-being.

Key words: cow, milking, milking robot, VMS.

Introduction

A milking robot was for the first time used in 1992 in Holland. It was a Lely Industries unit called Lely Astronaut [1]. Since November, 2009 about 9000 machines of this make have been put to work throughout the world [2]. In Poland, not long ago a single milking unit of this kind was three times more expensive than a whole milking parlor of similar efficiency [3]. Recently however, with the changing market, two robots were introduced in 2008, and as many as 23 units of the DeLaval brand alone were working in Poland in 2010.

The subject of the study was the analysis of the behavior of cows and its consequences related to the use of DeLaval VMS robot. The aim of the study was the evaluation of:

- frequency of milkings and the occurrence of incomplete milkings;
- hourly distribution of twice and three-times-a-day milkings;
- robotic efficiency.

Methods and materials

The study herd of 59 first calvings was milked by a one-stall DeLaval VMS with feed-first cow traffic solution [4]. The system became fully operational in October, 2008. The cows were kept in a free-stall deep-litter barn and fed TMR diet. The entire herd of 287 cows of the Szoldry dairy farm yielded the total of 10 685 kg of milk. The data for the analysis were collected in two periods: A – in the second and third month of the operation (Nov. 20th to Dec. 19th 2008 – total of 30 days), and B – in the fifth and sixth month (Feb. 16th to Mar. 14th 2009 – total of 27 days). The data originated, without exception, from the VMS' on-board computer system.

Results and discussion

Milking robots are still very expensive; they become economically viable with a yearly yield of half a million kilograms [5-8]. Since a one-stall robot can service roughly 60 cows, it follows that a single cow's productivity should exceed 8 thousand kg per year; though it is claimed that as little as 7 thousand kilograms could be the profitability threshold [9]. As the studied herd showed over 10 thousand kg of individual yearly yield this condition was fulfilled.

The cows adapted to the robot very quickly, which similar distributions of milking parameters and the yields in the respective days of the A and B periods testified to. The results confirmed the earlier observations presented in [10-12].

The number of milkings per day varied from 1 to 5 milkings (Table 1), but most prevalent were twice-a-day and three-times-a-day milkings covering 90 % of all cases. In the A period over 50 % of all milkings were made up by the three-times-a-days while in the B period over 50 % were the twice-a-days. Four-times-a-day milkings stayed below 4 % in either period.

Table 1

Milking frequency percentage distribution

Number of milkings per day	Study period A			Study period B		
	Number of cases	Fraction of the total number of days	Incomplete milkings	Number of cases	Fraction of the total number of days	Incomplete milkings
1	31	1.8	0.0 %	79	5.1	0.0 %
2	723	40.8	0.2 %	835	53.5	0.2 %
3	951	53.7	0.7 %	583	37.3	1.0 %
4	65	3.7	8.8 %	60	3.8	11.7 %
5	0	0.0	0.0 %	4	0.3	50.0 %
Total number of days	1770	100.0	1.0 %	1561	100.0	1.6 %

Incomplete milkings (Table 1), evidence of the robot's limitations, occurred sporadically and constituted 1 % of cases in the A and 1.6 % in the B period. Differences between groups of the herd were observed depending on the number of milkings per day. For cows milked twice or three times a day the incomplete milkings fell under 1 % while for cows milked four or five times the percentages were substantially higher.

The number of milkings per day averaged 2.6 for the A, and 2.4 for the B period – the values that match the findings in [13, 14]. Due to the prevalence of double and triple milkings, their comparison was drawn with respect to daily milk yield (Table 2). In both periods the cows milked three times a day gave approximately 10 kg more milk per day than the cows milked two times. The difference, statistically significant for p-value < 0.01, confirms the results of many researches such as [15], or [16]. Conversely, in [13] it is observed that with voluntary milking systems high yielding animals milked more frequently. The average yield per milking was similar for twice-a-days and three-times-a-days.

Table 2

Daily yield and milking yield characteristics against the number of milkings per day

Number of milkings per day	Study period A		Study period B	
	average daily yield ± standard deviation	average milking yield ± standard deviation	average daily yield ± standard deviation	average milking yield ± standard deviation
2	24.3±4.9	12.2±3.1	25.4±5.7	12.7±3.6
3	33.3±5.9	11.1±2.5	36.0±7.1	12.0±3.2
p-value	p<0.01	p>0.05	p<0.01	p>0.05

The records of the average daily yield for cows milked twice and three times a day during the A and B periods looked very much alike (Figure 1), which suggests early adaptation of the animals to the new milking system.

The daily yield of the herd averaged 1756 kg for the A period, and 1710 kg for the B period.

The robot carried out an average of 153 milkings a day during the A and only 140 during the B period. Moderate performance during the latter resulted from higher frequency of twice-a-day milkings in that period. Besides, most of the time the herd count was two cows less than in the A period.

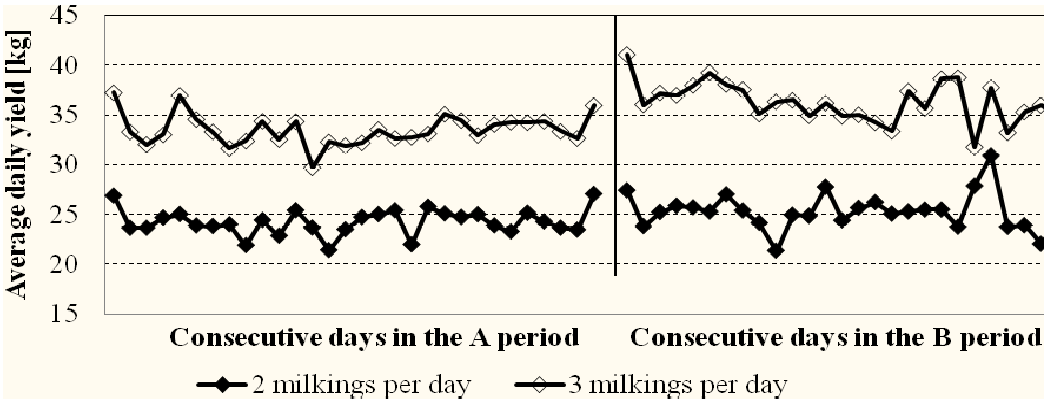

Fig. 1. **Average daily milk yield for 2-times-a-day and 3-times-a-day milkings**

The cows entered the milking area at different times of the day (Figure 2), but with different regularity. Infrequent milkings in the early hours were related to the sanitization schedule of the milking appliances and unloading of the milk container.

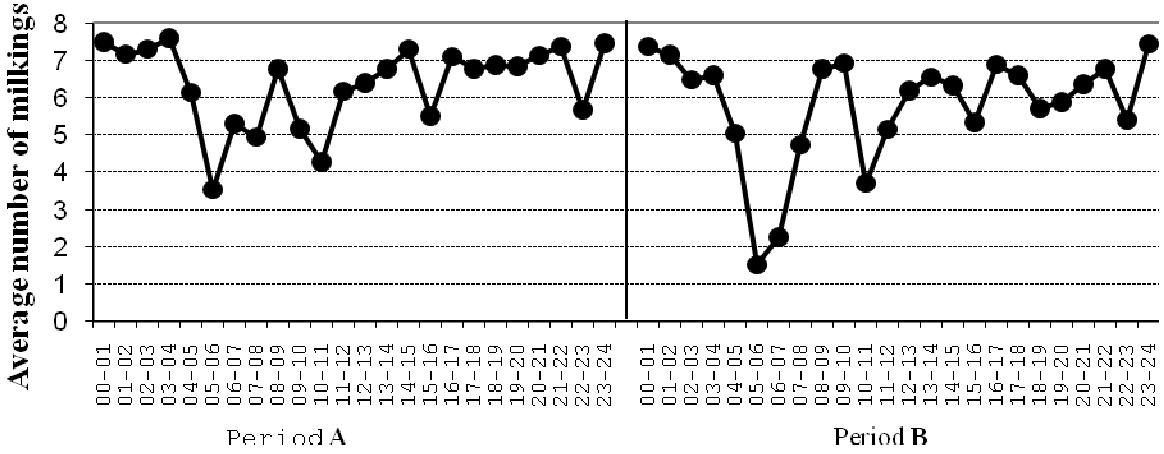

Fig. 2. **Hourly distribution of the number of milkings**

Across the hourly distribution chart of the robot utilization two strikingly dissimilar lines run for the twice-a-day and three-times-a-day milkings (Figure 3). The cows that milked twice a day preferred morning and evening hours while the cows that milked three times – afternoon and night. What is more, this happened in the both studied periods. The authors find no explanation for this phenomenon, nor could they discover such in the literature.

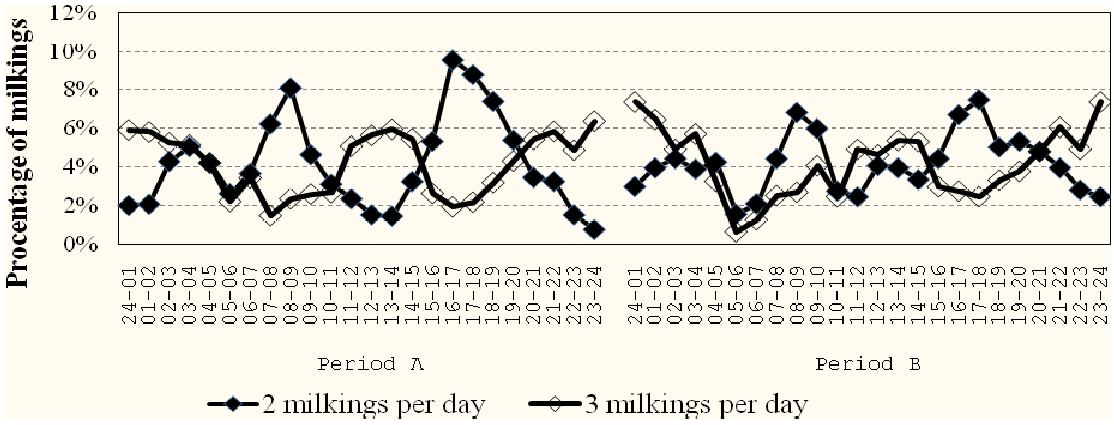

Fig. 3. **Hourly distribution of the averaged number of 2-times-a-day and 3-times-a-day milkings**

Conclusions

1. The herd's productivity level fulfilled the profitability condition for the milking robot.
2. Daily milking frequency was acceptable from the zootechnical point of view.
3. Daily distribution of the number of milkings indicates intensive use of the robot.
4. Negligible percentage of incomplete milkings testifies both to the adaptation of the animals to the robot and its technical capability.

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