Agronomy Research Biosystem Engineering Special Issue 1, 135-141, 2011

Variability of milking frequency and intervals between milkings in milking robots

A. Laurs and J. Priekulis

Institute of Agricultural Engineering, Latvia University of Agriculture, J. Čakstes bulv. 5, Jelgava, LV-3001, Latvia;
e-mail: armins.laurs@promedia.lv; Juris.Priekulis@llu.lv

Abstract. The aim of the research is to state in what way the voluntary visiting principle of milking robots implements robots with milking cows. The research was performed on the training and research farm of the Latvia University of Agriculture 'Vecauce' where the cows are milked in two company 'DeLaval' milking robots VMS; for guiding the cows to the robots the selectively guided cow traffic feed first system is applied. In order to ensure milking of the cows that are not milked during the planned time they are driven to the robot waiting box by the cattle breeder on duty in his leisure hours. All the data necessary for the research were obtained during seven days from the robot management system. There were 87 cows in the research group with the average milk yield of the herd 7,000kg/year. The research results showed that while milking in robots the programmed milking frequencies and intervals between milking did not materialize. The milking frequency reduces but the intervals between milking increase. The intervals between milking vary in a very wide range and their variations have irregular character. Milking delays in 50% of cases do not exceed two hours, but there are cases when they last for eight hours and more. On analyzing the research results it can be concluded that to ensure a successful milking process an important role is played by the person who drives the cows that are not milked in the planned time to the robot. The question what influence on the productivity of animals do the variable intervals between milking that often considerably exceed the set values have remains open.

Key words: Automatic milking systems, milking robots, milking frequency, milking interval.

INTRODUCTION

Due to purposeful selection work and wholesome feeding of animals in the countries with highly developed agriculture during the last 30 years considerable improvement of cow productivity has been achieved. If in the eighties of the last century the milk yield 5,000–6,000kg/year was considered to be a good result, then today farms with the milk yield 10,000kg are common. Together with the increase in the number of productive herds, the inadequacy of the milk production technologies used till now showed up. It became necessary to develop them in compliance with the new reality.

At first the approach to the milking frequency was revised. Till now it was proved in practice that at the milk yield 5,000kg/year the milking of cows twice a day was enough and their productivity potential was used completely. But in case of milking cows with higher productivity such a milking frequency turned out to be insufficient. The research showed that 3×daily milking of high productivity cows compared

to 2×daily milking increases the milk yield by 10–15%, but 4×daily milking increases it even up to 22% (Meinhold & Rosegger, 1977; Phillipps et al., 1980; Poole, 1982; Hogeven et al., 2000). At the same time it was stated that further increase in milking frequency is not advisable as at very short milking intervals (less than 4–5 hours) it is not possible to provoke full value milk ejection reflex, as a result of which milk ejection process will be disturbed (Hamman & Dodd, 1992).

Therefore, it was concluded that cows with low milk yield can be milked twice a day but high productivity cows should be milked three or four times.

Unfortunately, on applying the traditional milking technologies, it is problematic to milk cows three or four times a day as it would make the situation caused by the continuous rise in the price of the labour force and dissatisfaction of the milkers with hard working conditions and inconvenient working time even worse.

For solving these problems, the milking robots were developed.

With the application of milking robots the procedure of milking cows differs significantly from milking with the traditional milking equipment. Milking robots are completely automated milking equipment that can be visited by cows at any time during 24 hours. The milking process itself takes place without direct participation of people.

In order to stimulate the cows to enter the robot they are fed concentrated feed in the robot. Besides, an opinion exists that with milk being accumulated in the udder the cows have a desire to be milked; therefore they themselves go to the milking robots. The milking frequency advisable for every cow is programmed individually depending on the lactation phase and daily milk yield. If the lactation phase and daily milk yield changes, the milking frequency adjustment is also changed. The desirable milking frequency is adjusted setting the minimal admissible interval between milking, i.e., the cows can enter the robot during this time but they are not milked. To milk the cows that considerably hesitate to visit the robots they should be from time to time driven by people.

With the introduction of the milking robots into practice several questions arise:

- if applying the voluntary milking robot visiting principle, adjusted milking frequency is implemented;
- what is the dynamics of the milking frequency.

These questions have been partly considered in the research of Koning & Ouweljts (2000); Bohlsen & Artmann (2000), and Artmann (2005); nevertheless, we have not found any detailed research results.

Based on the above mentioned problems, the research aim was set: how is the voluntary visiting principle of milking robots implemented in practice.

According to the research aim two research tasks were set:

- to state how the milking frequency deviates from the adjusted values and what is the dynamics of these deviations;
- to state milking frequency deviations from the adjusted values and the character of these deviations.

MATERIALS AND METHODS

The research was carried out on the training and research farm of the Latvia University of Agriculture 'Vecauce' where the cows are milked with two milking robots VMS of the company 'DeLaval'. In order to drive the cows to the robots, the selectively guided cow traffic feed first system was applied.

The milking procedure was supervised by the cattle-breeder on duty. The duties of the cattle-breeder include encouraging of the 'lazy' cows to go to milking if their between milking interval according to the reading of the computer management system considerably exceeds the adjusted value. Driving the cows is not his main job, though. At first he should carry out the duties of the cattle breeder on duty as well as every day four hours in the morning and in the evening serve another milking equipment.

All the necessary data for the research have been taken from the robot management system. The data have been summarized about a period of seven days. The researched group of animals included 87 cows and the average milk yield of the herd was 7,000kg/year.

RESULTS AND DISCUSSION

The research was performed in two series. At first the milking frequency, after that the milking frequency variations at different adjustments were investigated.

The results of the first series research are summarized in Figures 1 and 2 and in Table 1.

Figure 1 shows the actual average milking frequency per cow per day for the groups of cows with different milking frequency adjustment.

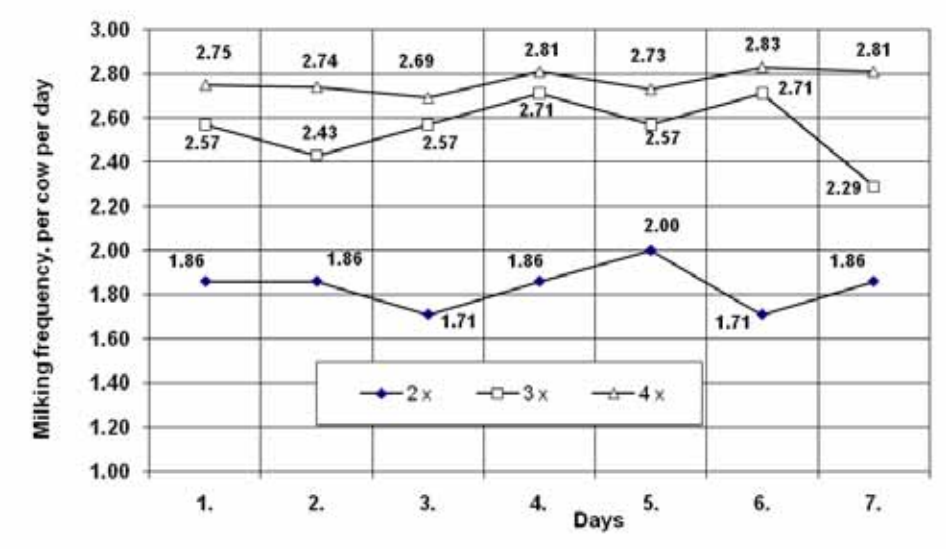

Figure 1. The actual milking frequency for the cow groups with the adjustment 2 ×, 3 ×, and 4 × daily milking.

Figure 1 shows that during the whole period of the research only in one day in the group of cows with 2 × daily milking adjustment all cows were milked two times. In the other groups the milking frequency adjustment has not implemented any day not a single time.

The distribution of cows according to the actual milking frequency for the groups of cows with the adjustment 2 ×, 3 ×, and 4 × daily milking is shown in Table 1.

Table 1. Distribution of cows according to the actual milking frequency.

		Group with milking adjustment 2 × per day	Group with milking adjustment 3 × per day	Group with milking adjustment 4 × per day
Number of cows in the group		7	7	62
Average milking frequency per cow per day		1.8 ± 0,11	2.55 ± 0,15	2.77 ± 0.05
Distribution of cows, % ± δ, according to the actual milking frequency	1 x	8.2 ± 4.3	0.0	0.9 ± 0,0
	2 x	91.8 ± 12.1	44.9 ± 15.3	39.6 ± 5.0
	3 x	0.0	55.1 ± 10.6	41.5 ± 7.4
	4 x	0.0	0.0	18.0 ± 3.6

The research results show that milking in robots does not go according to the plan, that is, the cows are not milked so many times a day as it has been adjusted. As it can be seen in Table 1, the cows that were planned to be milked four times a day have been milked only 2.77 times, but the cows with the adjustment 3x daily milking have been milked 2.55 times. The situation is better in the group of two adjustments where the cows were milked 1.80 times on average. If the adjustment is 4x daily milking, actually in 0.9% of cases the cows have been milked only once per day, 39.6% of cows twice a day, 41.5% of cows three times a day and only 18% of cows four times a day.

Figure 2 shows the distribution of the cows according to the actual milking frequency for the group with the adjustment 4x daily milking.

On analyzing the data shown in Figure 2 it can be concluded that during the period of the experiment in the group of 62 cows with the adjusted frequency four times a day only 13–21% cows were milked, 31–52% cows were milked three times but 33–48% two times a day.

From the results of the first series of research it can be concluded that even periodical participation of people in driving the cows to the robot does not ensure complete compliance of the milking frequency with the adjusted values. The incompliance is greater if the adjusted frequency is higher.

The research results on deviation of the intervals between milking from the adjusted values are summarised in Figure 3.

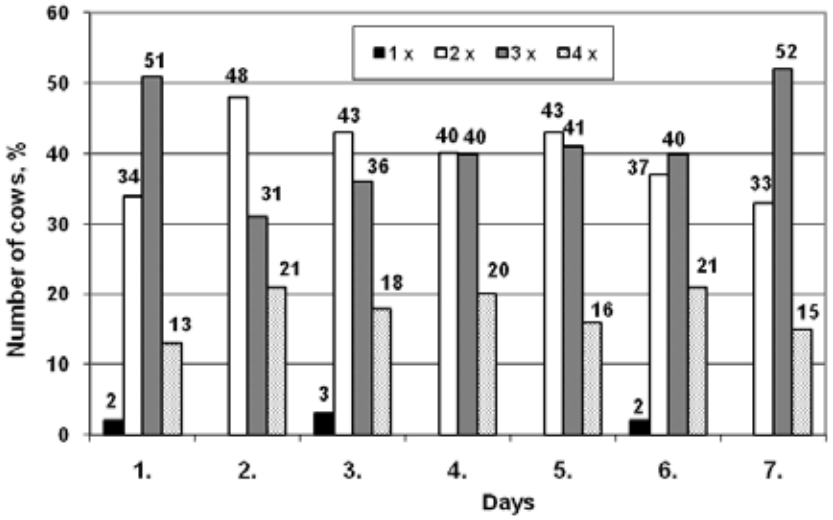

Figure 2. Distribution of the cows according to the actual milking frequency per cow per day for the group with the adjustment 4x daily milking.

As it can be seen in Figure 3, on milking with robots the adjusted intervals between milking are exceeded, that is, the cows are milked later than planned, but in 50% of cases the delay does not exceed two hours, in 75% of cases five hours, but in 95% of cases seven hours. In separate cases the delay is even longer but does not occur often.

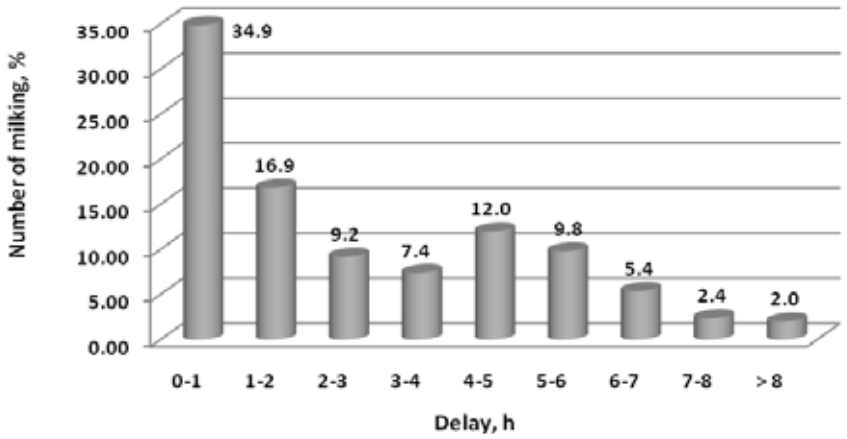

Figure 3. Milking interval deviations from the adjusted values.

It has been proved by many investigations that milk secretion and accumulation of milk in the udder are related processes. For continuous ensuring of milk secretion regular emptying of the udder is necessary as at reaching a definite stage of milk

accumulation in the udder the intensity of milk secretion considerably decreases (Hamman & Dodd, 1992). In practice, it is considered the determining factor of the daily milking routine. As it was mentioned in the introduction of the article, in order to completely use the productivity potential of highly productive cows they have to be milked three and four times per day, but on condition that intervals between milking are equal.

As it can be seen from the research results of milking with robots, considerable delay from the adjusted milking time is observed and the intervals between milking are not of equal length. It means that the daily routine of milking with robots is not close to the one desired. Together with this a question arises if on milking with milking robots and programming of the intervals between milking 8 and 6 hours corresponding to 3× and 4× milkings per day it is possible to get the same milk yield as on milking 3× and 4×times per day with the traditional milking equipment. It could be the object of future research.

Obviously, for ensuring the best possible approach to the adjusted milking frequencies and intervals between milking, today active participation of people in driving the cows to the milking robots is needed.

CONCLUSIONS

In practice on milking cows in milking robots the milking frequencies and intervals between milking deviate from the adjusted values:

1. The milking frequencies are shorter than the adjusted ones and they vary irregularly during the time;
2. The higher the adjusted milking frequency, the more difficult it is to implement it;
3. The adjustment 2× per day implements best, the worst is 4× per day;
4. Milking compared to the adjusted interval between milking is always delayed;
5. The delay varies in a wide range (from several minutes to 8 and more hours), and it has irregular character;
6. In 34.9% cases the delay does not exceed 1h, in 51.3% cases 2h, but in 89.8% cases 8h.

In order to ensure the best possible approach to the adjusted milking frequency and intervals, active participation of people is necessary who would drive the cows to the milking robots.

REFERENCES

Meinhold, K. & Rosegger, S. 1977. Die Bedeutung der Melk- und Fütterungsfrequenz für die Wirtschaftlichkeit der Milcherzeugung. Tierzüchter **10**, pp. 44–445 (in German).

Phillipps, D. S. M., Woolford, M. W., Copeman, P. J. A. 1980.The Implications of Milking Management Strategies Involving Variations of Milking Frequency in the Immediate Post-partum Period. In: *Proceedings of the New Zealand Society of Animal Production* **40**, Hamilton, New Zealand**,** pp. 166–174.

Poole, D. A. 1982. The Effects of Milking Cows Three Times Daily. Animal Production **2**, pp. 197–121.

Hamann, J. & Dodd, F. H. 1992. Milking Routines. In: Bramley A.J. (ed.) Machine Milking and Lactation. Insight Books, Berkshire – Vermont, pp. 69–96.

Koning de, K. & Ouweltjs W. 2000. Maximising the Milking Capacity of an Automatic Milking System. In: Hogeveen, H. & Meijering, A. (eds): *Robotic Milking. The International Symposium*, Wageningen Pers, Lelystad, Netherland, pp. 38–46.

Hogeveen, H., Miltenburg, J. D., Hollander den, S. & Frankena, K. A. 2000. Longitudinal Study on the Influence of Milking Three Times a Day on Udder Health and Milk Production. In: Hogeveen, H. & Meijering, A. (eds): *Robotic Milking. The International Symposium*, Wageningen Pers, Lelystad, Netherland, pp. 297–298.

Bohlsen, E. & Artmann, R. 2000. Research in Multybox Equipment Usage. In: Schön, H. (ed.) Automatic Milking Systems, KTBL, Darmstadt, pp. 101–107 (in German).

Artmann, R. 2005. Results of Long-term Application of Milking Robots. In: Hoch, Ch. (ed.): *Construction, Engineering and Envirorment in Livestock Farming.The 7th Conference.* KTBL, Darmstadt, Germany , pp. 145–150 (in German).