STUDIES OF INTERVALS BETWEEN MILKINGS IN AUTOMATIC MILKING SYSTEMS

INTERVALŲ TARP MELŽIMŲ TYRIMAI AUTOMATIZUOTAI MELŽIANT KARVES

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The aim of the research – to state how the voluntary milking principle implements milking cows with automatic milking systems (AMS). The research was performed on a farm where two groups of cows are milked by two company "DeLaval" milking robots VMS and for driving the cows to the robots the selective system "feed first" is applied. There were 76 cows in the research group with the average milk yield of the herd 7000 kg/year. The research results showed that milking in robots the programmed milking frequencies and the 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 that they last for eight hours and more. 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 the animals is left by the variable intervals between milking that often considerably exceed the set values remains open.

Automatic milking system (AMS), milking frequency, interval between milking.

Introduction

Applying the AMS the procedure of milking cows cardinally differs from milking with traditional milking equipment. The AMS 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 AMS 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 AMS. 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 AMS during

this time but they are not milked. To milk the cows that considerably hesitate to visit the AMS they should be from time to time driven by people.

With the introduction of the AMS into practice several questions arise:

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

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

Following the above mentioned the research aim was set – how milking cows in the AMS the voluntary AMS visiting principle implements in practice.

According to the research aim two research tasks were set:

- to state how applying the AMS the milking frequency deviates from the set values and what the character of these deviations is;
- to state how applying the AMS the intervals between milking change and what the character of these changes is.

Materials and methods

The research was performed on the research and training farm „Vecauce" of the Latvia University of Agriculture with 350 cows. On this farm 250 cows are milked with the "parallel" type milking equipment, but one group of cows – with two company "DeLaval" milking robots VMS. There for driving of cows to the robots the selectively guided cow traffic feed first system is applied. An opinion exists that such system of driving cows to the AMS is one of the most efficient (Hermans et al., 2003).

The milking procedure is supervised by the cattle-farm worker on duty. The duties of the cattle-farm worker 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 milk permission starting time. Though, driving of cows is not his basic job. At first he should carry out the duties of the cattle-farm worker on duty as well as every day four hours in the morning and in the evening serve another milking equipment. The cows are not driven also during the night time.

All the necessary data for the research are taken from the robot management system. The data were summarized about a period of seven days. The researched group of animals included 76 cows and the average milk yield of the herd was 7000 kg/year.

Results

The research was performed in two series. At first the milking frequency, after – the milking frequency variations.

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

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.

Tab.1. Distribution of cows according to the actual milking frequency
1 lentelė. Karvių pasiskirstymas priklausomai nuo melžimo dažnumo

		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 3xdaily milking – 2.55 times. The situation is better in the group of two times adjustment where the cows were milked in the average 1.80 times. If the adjustment is 4xdaily 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 1 shows the actual average milking frequency per cow per day for the groups of cows with different milking frequency adjustment.
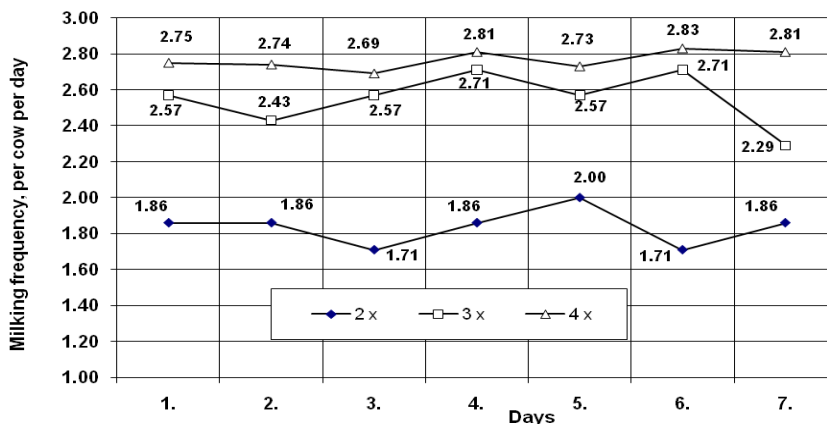

Fig.1. The actual milking frequency for the cow groups with the adjustment 2 ×, 3 × and 4 × daily milking
1 pav. Faktinis karvių grupės melžimo dažnis, melžiant 2, 3 ir 4 kartus per dieną

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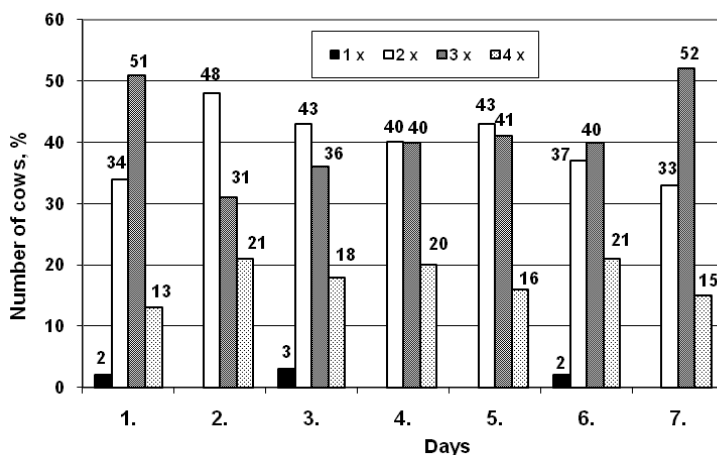

Fig. 2. Distribution of the cows according to the actual milking frequency for the group with the adjustment 4xdaily milking

2 pav. Karvių pasiskirstymas atsižvelgiant į grupės melžimo dažnį, melžiant 4 kartus per dieną

Figure 1 shows that the average milking frequency variations are small. It proves the stability of the technological process during the period of the experiment in total but does not characterise the stability of the process within every adjustment group. It can be seen in Figure 2 that in the largest group of cows (62 animals) with the adjustment 4xdaily most of the cows are milked 3 × (31-52%) and 2× daily (33-48%), but only a small part 4x (8%).

Nevertheless, more than the number of milking per day, the intervals between milking characterize the quality of the milking process. The research results on the variability of the between milking intervals are summarized in Table 2 and shown in Figure 3.

Table 2 shows the distribution of the number of milking on every experimental day every hour after starting the milking permission adjustment. So, for instance, if the milking permission after the last milking is adjusted for 6 hours, then in the interval 0-1 the cows with the between milking interval 6-7 hours will be included, but if the permission is given after 8 hours - the cows with the between milking interval 8-9 hours. This distribution characterizes the variability of the between milking intervals in the experimental group of cows.

Table 2. Distribution of the number of milking every hour after starting the milking permission

1 lentelė. Melžimų skaičiaus pasiskirstymas kas valandą nuo melžimo pradžios

Time after starting the milking permission, h	Number of milkings							
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Average in 7 days
0-1	77	73	75	85	79	92	88	81,3
1-2	42	39	27	37	50	43	37	39,3
2-3	20	19	28	27	15	18	23	21,4
3-4	23	15	12	25	22	11	13	17,3
4-5	26	37	26	21	23	28	35	28,0
5-6	17	22	31	22	25	25	18	22,9
6-7	13	10	13	13	10	13	16	12,6
7-8	4	10	7	6	5	3	4	5,6
8-9	3	1	2	3	4	5	2	2,9
9-10	3		1	2				0,9
10-11					1	1		0,3
11-12					1			0,1
>12			3		1		1	0,7
							Total	233,0

Figure 3 shows the distribution of the average milking times every hour after starting the milking permission during the whole time of the experiment.
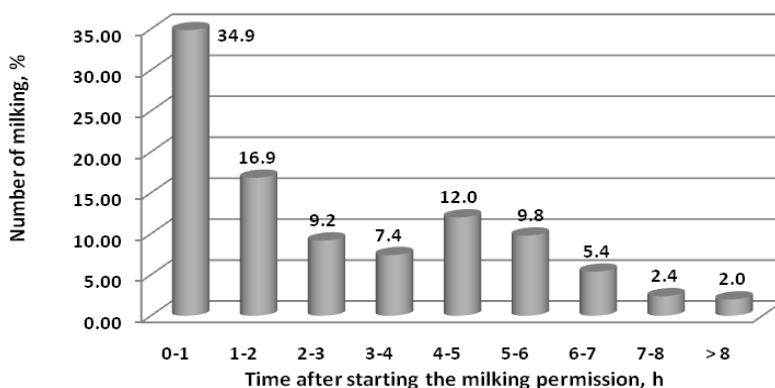

Fig. 3. Distribution of the average milking times every hour after starting the milking permission during the period of the experiment

3 pav. Melžimo kartų vidurkio pasiskirstymas kas valandą po melžimo pradžios

As it can be seen in Table 2 and Figure 3 milking with the AMS the between milking intervals change in a wide range, still in the average in 52% cases they fall within the borders "milking restriction time + 2h", but in 80% cases - "milking restriction time + 5h". In separate cases they are even larger but not often.

Figure 3 attracts attention to the peak of increase of the milking times in

the intervals 4-5h and 5-6h. It can be explained by the participation of the cow driver in the technological process only in separate periods of the day.

Discussion

Previous research has showed that milking highly productive cows with traditional milking equipment three times a day the milk yield increases by 10-15% compared to milking twice a day, but transferring to milking four times a day – even up to 22% (Poole, 1982; Hogeven et al., 2000; Ősterman and Bertilsson, 2003; Sorensen et al., 2008 u.c.). Unfortunately, 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. These problems were tried to be solved with the introduction of the AMS.

If applying the AMS the decrease of the labour force is obvious, the issue of the increase of the productivity is not unambiguous. According to the calculations done tracing the farms after introduction of the AMS, the increase in the milk yield there can be less than 2% (Wade et al., 2004), vai lielākais 7 vai 8% (Svennersten-Sjaunja et al., 2000; Speroni et al., 2006).

May be the results of our research can give the answer to this question.

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 reaching a definite stage of milk accumulation in the udder the intensity of milk secretion considerably decreases. It is considered in practice determining the milking daily routine. As it was mentioned above in 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 with the condition that the intervals between milking are equal.

From the results of our first series research it can be concluded that milking cows with the AMS does not implement according to the plan, i.e., the cows are not milked so many time s per day as it has been adjusted. The nonconformity is larger if the adjusted frequency is higher.

Table 1 shows that in the group of cows with the adjustment 3×daily only 55,1% of cows have been milked 3×daily, but with the adjustment 4× daily only 18% of cows have been milked four times.

Still, not the number of milking per day is the most essential factor, but between milking intervals. The second series research results show that the adjusted, i.e., the desired between milking intervals can be exceeded even up to 8 hours if separate cases are not considered where the milking intervals are still longer. Besides, in our research there are traces (not published) that for every individual cow the between milking intervals change from one milking time to another.

It means that the milking process milking with the AMS with the milking adjustment 3 × or 4×daily does not correspond to the milking process what it is milking as many times per day with the traditional milking equipment. It can be a reason why the increase in productivity milking with the AMS is not as expected.

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ИССЛЕДОВАНИЕ ИНТЕРВАЛОВ ДОЕНИЯ ПРИ ПРИМЕНЕНИИ АВТОМАТИЗИРОВАННЫХ ДОИЛЬНЫХ УСТАНОВОК

Аннотация

Цель исследования – установить, как на практике реализуется принцип добровольного посещения коровами автоматизированных доильных установок (АМС).

Исследования проводились в хозяйстве, в котором коровы доятся двумя автоматизированными доильными установками фирмы «ДеЛавал». Все необходимые данные были получены из системы менеджмента АМС. В группу исследования были включены 76 коровы.

Результаты исследований показали, что при применении АМС не реализуются ранее запрограммированные частоты доения и интервалы между дойками. Частота доений уменьшается, а интервалы между дойками удлиняются. К тому же интервалы между дойками меняются в широких пределах, и эти изменения имеют не регулярный характер. В 50% случаев задержки доения не превышают 2 часа. Однако в отдельных случаях эти задержки длятся более 8 часов.

Анализируя результаты исследования, можно сделать вывод, что для успешной реализации доения коров с помощью АМС большое значение имеют действия человека, который занимается подгоном вовремя не выдоенных коров к АМС. Однако остаётся открытым вопрос, какое влияние на продуктивность коров оказывают непостоянные интервалы доения, которые часто превышают ранее установленные пределы.

Автоматизированная система доения (АМС), частота доения, интервалы между дойками.

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INTERVALŲ TARP MELŽIMŲ TYRIMAI AUTOMATIZUOTAI MELŽIANT KARVES

Santrauka

Tyrimų tikslas – nustatyti kaip savanoriškas melžimo principas įgyvendinamas automatizuotoje melžimo sistemoje (AMS). Tyrimai atlikti ūkyje, kuriame karvės melžiamos dviem firmos "DeLaval" robotais ir taikomas laisvasis karvių bandos valdymas. Tyrimų grupėje buvo 76 karvės, kurių vidutinis produktyvumas apie 7000 kg pieno per metus. Tyrimų duomenys parodė, kad karves melžiant robotais nebuvo realizuotas užprogramuotas melžimo dažnumas ir intervalas tarp melžimų. Melžimo dažnumas sumažėjo ir pailgėjo intervalas tarp melžimų. Intervalas tarp melžimų kito labai plačiose ribose ir turėjo nereguliarų pabūdį. Melžimo vėlavimas 50 % atvejų neviršijo dvi valandas, tačiau buvo atvejų kai viršijo aštuonias ir daugiau valandų. Galima daryti išvadą, kad užtikrinti sėkmingą karvių melžimą robotais svarbus vaidmuo tenka darbuotojams tvarte, kurie nepamelžtas karves suvaro į melžimo robotą. Klausimas koks didelėse ribose kintančių intervalų tarp melžimų poveikis karvių produktyvumui, lieka atviras.

Automatinė melžimo sistema (AMS), melžimo dažnumas, intervalas tarp melžimų.