CONSUMPTION OF CONCENTRATED FEED FOR MILK COWS IN CONDITIONS OF ROBOTIZED TECHNOLOGY

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Abstract. The research was performed on the milk farm "Līgotnes" of the Latvia University of Agriculture research and training farm "Vecauce" where robotized milking is introduced. On the farm concentrated feed was fed in three places: at the feeding table, i.e., together with the feed mix, in the milking stand and at feeding stations. In the research the amount of concentrated feed that the cows received at every feeding place was stated. For this purpose the cows were divided in four milk yield groups with 10-20, 20-30, 30-40 and more than 40 kg of milk per day. It was stated that the consumption of concentrated feed varies proportionally to the milk yield but its proportion for lower productivity cows is too high according to physiological requirements, but for cows with the milk yield 30-40 kg and more it can be insufficient. Several versions of concentrated feed consumption control are described.

Key words: cows, robotized technology, milk yield, concentrated feed limit.

Introduction

In dairy farming modern technologies that are characterized by automation of the operation processes, high productivity and high quality of milk are introduced very fast. One of such technologies is loose handling of milk cows using robotized milking stands and automated distribution of concentrated feed.

Nevertheless, together with the successful solutions of introduction of the new technologies also several problems arise. For instance, in feeding cows there are difficulties with ensuring the nutrients in compliance with the normative requirements. It is very topical in the conditions of application of the modern technologies when the cows have free access to the basic feed mixture and get concentrated feed from the distribution automatic machines or feeding stations. Then it becomes possible that the less productive animals get more nutrients and energy than they should causing fatness and metabolic disturbance. Therefore, the farms are forced to reject these animals as defective too soon.

If, in turn, there are unsounded limits for consumption of feed the potentially more productive animals will not receive adequate amount of nutrients and energy appropriate to their genetic productivity. Their milk yield will be inadequately low. In the result the amount of milk will reduce and the farm will incur losses. Therefore, it is important to have the content of the basic feed that is fed to cows in the conditions of loose handling and robotized milking suitable for animals of all productivity levels but concentrated feed should be correctly limited adequate for the milk yield of every cow.

Materials and methods

For the research the milk farm „Līgotnes" of the Latvia University of Agriculture research and training farm "Vecauce" where loose handling of cows is introduced was chosen. A group of cows milked in robotized stands with using the management system for serving the animals was used in the research. In this group 80-100 cows with the average live weight 600 kg and the average milk yield 6500 kg were included. The basic feed (feed mix) was fed at the feeding table, but concentrated feed – in the milking stands and feeding stations.

The basic feed included 83 % of silage, 5.5 % hay, 11 % concentrated feed mixture prepared on the farm and 0.5 % vitamins and mineral admix. Concentrated feed was purchased and prepared in a shape of granules.

The research was carried out from January, 2009 to March, 2010. The herd during this period was varying as the cows with the milk yield less than 10 kg per day were periodically moved to the breeding room or rejected. Therefore, the cows were divided in four milk yield level groups: with 10-20 kg, 20-30 kg, 30-40 kg and more than 40 kg per day.

Using the data accumulated in the management system the average milk yield and the amount of the consumed feed in the corresponding feeding places was determined for each group.

Results and discussion

It was stated in the experiments that for all four productivity groups of cows great differences in individual consumption of concentrated feed were ob served, i.e., essential deviations from the average indices of the group. So, for instance, the amount of concentrated feed received at the milking stand for separate individuals varied from 0.1 to 3.5 kg per day, but at the feeding stations – from 0.1 to 8.0 kg. Besides, it can be prognosticated that the amplitude of these individual variations can be even larger if there would not be limits for distribution of concentrated feed: at the milking stand 3.5 kg per day and at the feeding stations 8.0 kg per day.

According to our calculations the relative standard error $S_{\bar{x}\,\%}$ of the data obtained in our research was in the range 3.0-4.5 % that corresponds to the assessment "completely satisfactory" [1]. Therefore, scientifically valuable regularities can be seen in the average figures of concentrated feed consumption.

The results of the research show that if the productivity of cows rises, the consumption of concentrated feed increases in all machines of concentrated feed distribution. If these variations are not so large at the milking stand, the amount of concentrated feed at the feeding stations is exactly proportional to the level of the milk yield. It can be clearly seen in Table 1.

Table 1

Amount of concentrated feed fed at the milking stands and feeding stations

Milk yield group, kg	Average milk yield, kg	Concentrated feed for one cow, kg·day^{-1}		
		At the milking stand	At feeding stations	Total
10-20	16.8	1.9	1.8	3.7
20-30	24.2	2.2	3.2	5.4
30-40	33.9	2.4	5.1	7.5
>40	42.3	2.5	6.4	8.9
Average	23.5	2.1	3.1	5.2

If, for instance, the average milk yield increases from 16.8 kg to 42.3 kg per day, i.e., approximately 2.5 times, the amount of concentrated feed consumed at the milking stand has increased approximately 1.3 times but at the feeding stations – 3.6 times. In turn, the total consumption of concentrated feed (at the milking stand and feeding stations) has in creased 2.4 times and already approximately corresponds to the milk yield proportion.

Determining the concentrated feed distribution limits it is essential to consider the amount of concentrated feed in the feed mixture. During the research the cows consumed in the average 43 kg (40-46 kg) of the feed mixture per day. Considering that it included 11 % of concentrated feed it can be concluded that every cow consumed in the average 4.7 kg (4.4-5.0 kg) of concentrated feed per day together with concentrated feed and hay. Besides, the cows with higher milk yield used to consume a larger amount of feed mixture than the less productive (two to three kg). Therefore, it is possible to assume that they will also consume proportionally more concentrated feed (200-300 grams).

The summary amount of concentrated feed consumed by the cows of the corresponding groups per day can be seen in Figure 1.

The obtained data prove that cows of different milk yield levels have consumed quite different total amounts of concentrated feed. If the milk yield has been in the range 10 to 20 kg per day, the consumed amount of concentrated feed is 8.1 kg, but if more than 40 kg per day – 13.9 kg·day^{-1}. Nevertheless, these data do not allow to judge about the sufficiency of the consumed amount of concentrated feed. Therefore, the consumption of concentrated feed was determined calculating per one kg of the obtained milk (Table 2).

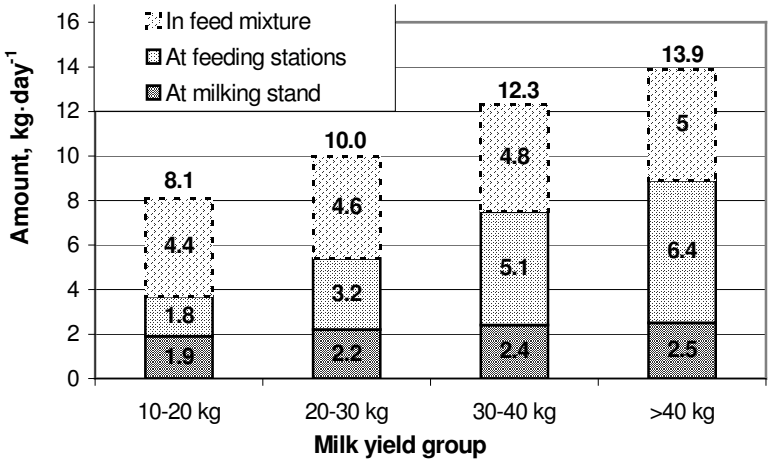

Fig. 1. **Amount of concentrated feed, kg·day^{-1}, consumed by cows together with feed mixture, at feeding stations and at robotizes milking stand depending on milk yield group**

According to the data in literature [2-4] for the cows with the milk yield 20 kg per day 300 g of concentrated feed would be enough calculating per kilogram of milk. For the cows with higher productivity the need for concentrated feed is bigger, but also then, not to cause indigestion and metabolic disturbances, the consumption of concentrated feed should not exceed 400 g per kg of milk or 50-55 % of the feed dry matter energetic value. In turn, the data of Table 2 show that the feed rations used on farms for lower productivity cows are with too high proportion of concentrated feed, but for the cows with the milk yield 30-40 kg and more the amount of concentrated feed can be insufficient.

Table 2

Total and specific consmption of concentrated feed

Milk yield group, kg	Average milk yield, kg	Total consumed concentrated feed	
		kg·cow^{-1} per day	g·kg^{-1} milk
10-20	16.8	8.1	482
20-30	24.2	10.0	413
30-40	33.9	12.3	363
>40	42.3	13.9	329

This condition can be improved if the amount of concentrated feed is reduced in the feed mixture or it is excluded from this mixture at the same time readjusting the concentrated feed distribution limits in the feeding stations and milking stands.

Such version was tested in one of our previous investigations [5] (See Fig. 2).

In these investigations it was stated that after exclusion of concentrated feed from the feed mixture its consumption at the milking stand increased by 0.6-1.8 kg and in the feeding stations by 1.0-2.4 kg. Still, the total consumed amount of concentrated feed for the more productive cows with the milk yield more than 20 kg was by 0.3-0.8 kg less and at the same time also their milk yield reduced (by 2-3 kg·day^{-1}).

There is also a version possible when all cows get the feed mixture with a small proportion of concentrated feed (about 4 % or 2 kg calculating per cow), but the cows with the milk yield more than 20 kg are fed additionally mixed feed calculating 2 kg per 5 kg of milk that exceeds 20 kg (400 g per kg of milk). Such feeding solution has been investigated by Winnicki and others [6]. But in such case there is a possibility that for the less productive cows the acquired reflex to visit the milking stand and feeding stations can be destroyed. Therefore, it is possible to prognosticate that it would be more rational to include in the feed mixture about 5 % of concentrated feed (per mixture mass) or 2 kg calculating per cow, but at the milking stand and feeding stations the concentrated feed amounts would be limited corresponding to the cow productivity level. However, this hypothesis must be tested in our future research.

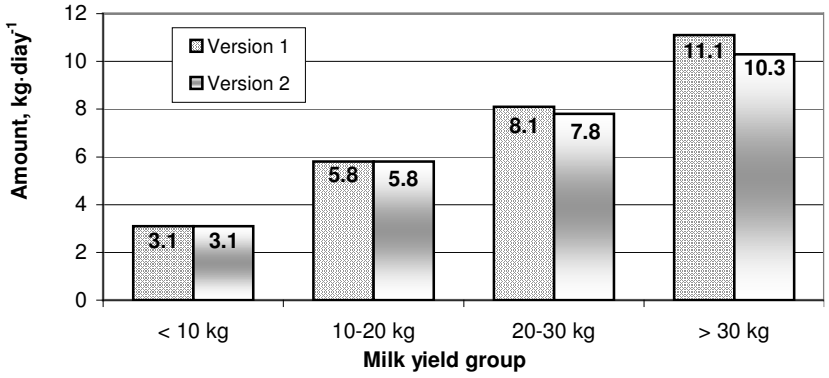

Fig. 2. **Amount of concentrated feed consumed by cows, kg·day^{-1}, in two research h versions; if concentrated feed is included in feed mixture (version 1), if it is fed only in feeding stations and milking stands (version 2)**

Conclusions

1. For all productivity cows there are great differences in the amount of individually consumed concentrated feed. At the milking stand it varied from 0.1 to 3.5 kg per day, but at the feeding stations – from 0.1 to 8.0 kg per day.
2. The amount of concentrated feed consumed by cows varied proportional to the milk yield. The cows with the milk yield 10-20 kg received in the average 8.1 kg of concentrated feed per day, at the milk yield higher than 40 kg per day the received amount of concentrated feed was 13.9 kg, i.e., it increased 1.7 times.
3. In the biggest represented group with the milk yield 20-30 kg 46 % of the total amount of concentrated feed was fed to cows together with the feed mixture, 22 % at the milking stand, 32 % at the feeding stations
4. The feed rations used on farms for lower productivity cows are with too high proportion of concentrated feed, but for the cows with the milk yield 30-40 kg and higher the amount of concentrated feed can be insufficient.
5. Exclusion of concentrates from the feed mixture is not useful as in that case the amount of the consumed concentrated feed for the more productive cows reduced by 0.3-0.8 kg per day causing the decrease in the milk yield by 2-3 kg.

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