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Influences on the Plateau- and Decreasing Phase of Milk Flow Curves

Quick, complete milk withdrawal is indispensable for productive, efficient milk production. In practice, this means that the milk should be withdrawn completely from the udder during the main milking phase. In order to be able to show problems and influences on milk withdrawal, milk flow curves were recorded, and milking samples taken at the beginning of each quarter were evaluated by means of a cytobacteriological analysis. Afterwards, they were examined for their effects on milk withdrawal.

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Keywords

Milk flow, udder health, milking routine

Literature

Literature references can be called up under LT 07413 via internet http://www.landwirtschaftsverlag.com/landtech/local/literatur.htm.

The economic conditions require a significant reduction of the production costs per kg of milk. This also means that more cows must be cared for and the output per worker must increase. The goal is a work time requirement of 35 labour hours per cow and per year. To reach this goal, effective milking is necessary during which the milk is withdrawn from the cows quickly and completely. This can be measured by recording milk flow curves. The optimal milk flow curve is roughly trapezoidal and can be divided into three sections: the main milking phase, the blind milking phase, and the post-milking phase. The main milking phase is the section during which the milking unit works independently at the udder and gains milk. This main milking phase can be divided further into an increasing-, a plateau-, and a decreasing phase. According to the literature, the increase should be uninterrupted. The plateau phase should last four to five minutes, whereas the decreasing phase should not last any longer than one minute [1].

The parameter for an optimal milking process is udder health. Cows with a healthy udder have a physiological cell count of less than 100,000 cells, and microbiological tests do not show any pathogens. If the cell count exceeds 100,000 and if pathogens can be detected, one speaks of mastitis [2]. Below, the correlations between the plateau- and the decreasing phase and udder health will be considered in more detail.

Data Collection

Four farms with 60 to 240 lactating Holstein-Frisian cows were available for the trial. The herd had an average performance of more than 8,000 kg of milk. All farms were free of contagious streptococcus bacteria (*Sc. agalactiae, Sc. canis*), and quarter infections with *Staph. aureus* were below 5%. The distinctive criteria which set the farms apart
were the milking parlours (different manufacturers and models) and their equipment. Using the LactoCorder, the milk flow curves of all animals at all milking places were recorded. In addition, a milking record showed the milking routine, the blind milking times at the quarter level, the udder form, and the orientation of the milking unit. Immediately afterwards, milk samples were taken from all lactating cows at the beginning of each quarter milking under antiseptic conditions and evaluated by means of cytobacteriological tests. Each farm was measured three times at an interval of three months.

The Duration of the Plateau- and Decreasing Phase

In a total of 1,582 measurements, the plateau phase on average lasted 2.32 minutes. Given an average of 2.77 minutes, the decreasing phase took longer than the plateau phase. This means that the desired values mentioned in the literature were not reached by far. These results were also confirmed by other measurements in practice [3]. In order to make the relation of the plateau- and the decreasing phase clearer, a quotient of both parameters is formed in the present study:

$$\frac{\text{Duration of the plateau phase (minutes)}}{\text{Duration of the decreasing phase (minutes)}}$$

Given the target values for the duration of the plateau- and the decreasing phase mentioned in the literature, the quotient would be 4 to 5. In this study, the quotient of all measurements was 0.84, and the quotient in comparable studies ranged between 0,94 and 0,84 [3; 4]. This means that the decreasing phase lasts longer than the plateau phase.

Physiological Influencing Factors

If the duration of the two milking phases is considered as a function of the lactation, it becomes clear that the duration of the plateau phase decreases with a growing number of lactations, whereas the decreasing phase

	1. Lactation	2. Lactation	3. Lactation	> 3 Lactations
Plateau phase				
Duration in min.	2,54	2,25	2,15	2,16
Decreasing phase				
Duration in min.	2,35	2,85	2,97	3,25
Quotient	1,08	0,79	0,72	0,66

Table 1: Duration of the plateau- and the decreasing phase and the quotient in the individual lactations

	< 101 Lt	101 – 200 Lt	201 – 300 Lt	> 300 Lt
Plateau phase				
Duration in min.	3,07	2,52	1,99	1,37
Decreasing phase				
Duration in min.	2,99	2,91	2,58	2,47
Quotient	1,03	0,87	0,77	0,55

Table 2: Duration of the plateau- and the decreasing phase and the quotient in the individual lactation stages

Table 3: Influence of the position of the milking unit on the plateau- and the decreasing phase

	Melkzeug korrekt	Melkzeug verdreht
Plateau phase		
Duration in min.	2,42	2,22
Decreasing phase		
Duration in min.	2,77	2,83
Quotient	0,87	0,79

lasts longer (*Table 1*). Parallel to this, the duration of the main machine milking increases from 5.48 to 6.22 minutes. In addition, average milk quantity grew from 11.73 kg during the first lactation to 14.25 kg during the third lactation. In cows with more than three lactations, average milk quantity dropped to 13.70 kg. As the quotient shows, the longer machine milking period is not caused by the larger milk quantity, but by a longer decreasing phase.

A similar effect can also be discerned as a function of the lactation stage. This quotient is listed in *Table 2*. Since the duration of the main machine milking within the lactation decreases as well (from 6.88 minutes to 4.80 minutes), one also had to expect that the plateau- and the decreasing phase become shorter. However, their length does not diminish equally. Instead, the duration of the plateau phases diminishes far more. Once again, this is shown by the quotient. At the beginning of the lactation, the quotient is 1.03, which means that it is still in the positive range. In the lactation phase which ranges from the 101st to the 200th lactation day, the decreasing phase already lasts longer than the plateau phase, and the quotient is down to 0.87. Over the course of the lactation, this ratio deteriorates. At the end of the lactation, the decreasing phase lasts almost twice as long as the plateau phase, and the quotient drops to 0.55.

Influence of the Position of the Milking Unit

In addition to the physiological influencing factors, the milking process also influences the two phases. Here, in particular the position of the milking unit underneath the udder must be mentioned. In particular in cows with an inclined udder bottom (step udder), the milking units often get twisted. In these animals, the decreasing phase was longer than in cows with a good udder form and in cows with step udders where the milking unit was positioned correctly. The influence of twisted milking units on the quotient is shown in *Table 3*. Due to lever forces, the individual quarters are milked unevenly. This results in a prolonged decreasing phase, and the quotient drops to 0.79, while it is 0.87 if the milking units are positioned correctly.

Longer decreasing phases not only lead to prolonged milking times and longer work time, which is incompatible with the goal of productivity mentioned at the beginning, but they also result in a greater burden on the individual udder quarters because the characteristic step-wise reduction of the milk flow during long decreasing phases is caused by the dwindling milk flow in individual quarters. In some cases, some quarters are therefore milked blindly for several minutes, which results in udder disease. In this study, the cows with a healthy udder had a quotient of 1.03, whereas the cows with diseased udders only reached a quotient of 0.67. This can lead to a vicious cycle because the prolonged decreasing phase damages the teat tissue even more and makes it more susceptible to infections.

Conclusions

Both physiological factors, such as the udder form, the lactation, and the lactation stage as well as factors caused by the milker, such as the position of the milking unit, have an influence on the length of the plateau- and the decreasing phase. These two phases also have a significant influence on the cell content because a prolonged decreasing phase results in poorer under health. This means that the percentage of cows with diseased udders grows significantly.

Literature

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