

Milking: How Much Milk Can Remain in the Udder?

Too much milk remaining in the udder after milking has a negative influence on milk production and udder health. This problem can be avoided with correct milking routine and milking technique.

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Opinions are divided about the degree to which an udder should be empty after milking. While many farmers, based on their experience, try to empty the udder as completely as possible, their colleagues as well as some representatives of the milking industry and some milking consultants have a more relaxed attitude. They argue that it is completely normal that milk remains in the udder after milking. „A little bit of milk remaining in the udder can't be harmful,“ they claim, since the milk will come out the next time the cow is milked. So, who is right?

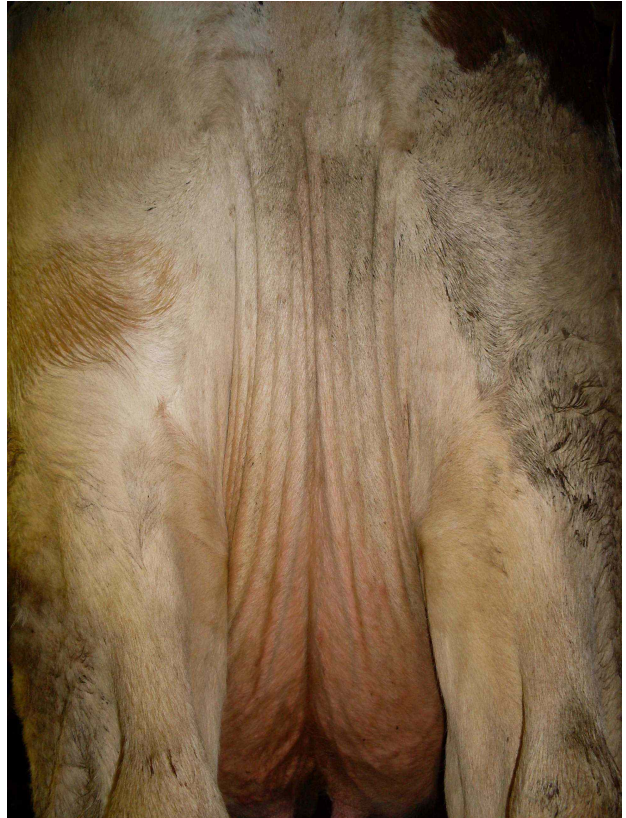
Before answering this question, we should discuss where and why there is milk left in the udder after teatcups are removed, and what the effects of this milk are on the udder tissue.

Stripping yields still exist

Everybody is probably familiar with stripping yields. This is the „freely available milk“ that collects at the end of milking in the ducts or udder cisterns. This milk can only be extracted by cluster stripping.

Since this takes time and effort, many dairy farmers readily believe that the stripping yields of „modern high-yield cows“ are negligible. Exhaustive surveys of the University of technology and economy Dresden (Saxony) from 2006 show, however, that this is only true for cows with compact, healthy udders. For those cows the stripping yield is indeed only 100 – 200 g. This is quite different when the udders are big and wrinkly, as they usually are in old cows or in meat breeds. These udders have stripping yields of up to 1kg and more. (You can read about why this is the case in the box on page 2.) In some cases, e.g. in cows with udder tissue damaged by mastitis, a stripping yield of over 2 kg can be expected.

The studies from Saxony show furthermore that the distribution and the amount of stripping yields are roughly the same as they were 16 years ago. The average stripping yield of over



An empty udder after milking is flaccid and soft. An exception are very big, hard or swollen udders (e.g. after calving).

4,000 cows was 370 g. 38 % of the udders contained more than 500 g of freely available milk. In almost half of these cases the stripping yield even rose to between 1 and 2 kg. Other studies show similar results with average amounts of generally 300 to 500 g and a range of 0 to 1.5 kg.

It is thus not true that modern cows have a negligible stripping yield. It is also not true that the stripping yield is reduced or becomes less important by milking three times a day. There is no correlation between milking frequency and stripping yield. This has been well documented in studies from Saxony.

Often the alveolar tissue is not completely emptied as well

After milking, not only the cisterns but also the alveolar tissue can contain significant amounts of milk. This is also called "bound residual milk" since milk can not be extracted from the alveoli and the narrow milk ducts, not even with an extremely high vacuum. This milk can only be released and moved to the udder cisterns through rhythmical movements of the muscle cells of the alveolar tissue. These myoepithelial cells are activated by the hormone oxytocin.

And here is the problem: As is generally known, the milk flow is drastically reduced after a few minutes and completely ceases after about 8 - 10 minutes. This happens even if large amounts of milk remain in the udder. According to recent findings, the reason for the cessation of the milk flow is not so much the sinking oxytocin level but rather fatigue of the udder muscle cells and/or a saturation of the oxytocin receptors of the udder. No matter the reason, it has been proven that the effect of oxytocin only lasts for a limited time!

This means that the time for emptying the alveolar tissue completely is limited and that rapid milking is important, especially for plump (full) udders. Scientific studies as well as the experience in numerous dairy farms have proven: With slow milking, significant amounts of „bound residual milk“ remain, especially in

plump udders, while quick milking allows for these udders to be completely emptied.

Incomplete milk ejection due to slow milking

It has been repeatedly shown that avoidable flaws in milking equipment and milking routine are the cause of too slow and incomplete milking. Causes worth noting are besides insufficient pre-milking stimulation, clusters that do not hang evenly on the udder, defects in the pulsator, and liners that are either of the wrong size or of bad quality. Another common and unnecessary reason is the so-called „milk flow dependent vacuum drop“, that is the disproportionately high reduction of vacuum in the liner when milk flow increases.

If the so-called liner vacuum during the suction phases is reduced to significantly below 38 kPa, the milking speed for cows with normal milkability is greatly reduced which prevents the achievement of the highest biologically possible milk flow rate. Due to the limited duration of the effect of oxytocin, the slow milking speed causes an incomplete milk ejection and thus an incomplete emptying of the alveolar tissue. This can often be seen when the udders do not collapse (completely) after milking and when milk drips from the udder shortly after milking.

This is aggravated by the fact that the working vacuum which is generally raised to 44 kPa,

Where do stripping yields come from and what should be done about them?

Contrary to popular belief, high stripping yields are not primarily due to „teatcup crawling“. This is only the end of a long process. The process begins with the formation of skin folds at the inside of the udder when the udder begins to empty. These skin folds prevent the complete drainage of the diminishing milk flow. Subsequently, the teats are emptied and slacken. At this point, the teatcups crawl up and completely clog the teat base which, anyway, had been partially obstructed before by the skin folds.

In order to open the clogged drainage passages the slackened udder tissue has to be stretched by pushing the cluster down. Unfortunately, a heavy cluster cannot replace this process. The teatcups adhere much

more firmly to a slackened udder than to a firm udder at the beginning of milking. An extremely heavy cluster would thus lead to even more liner slip during main milking than is already the case because of missing milk tube supports or inadequate liners.

In the interest of a high milk yield and good udder health, stripping yields of more than 300 ml should be removed from the udder. You can strip the cluster either manually or automatically without fear of the habituation effect. It is true that the stripping yields increase over time, but this is not due to habituation but rather because udders become bigger and slacker with increasing age. The above mentioned skin folds at the inside of the udder form earlier in the

milking process and get bigger in older cows than is the case for younger cows with more compact udders. The problem is not an alleged additional release of oxytocin during stripping. This oxytocin release has been proven not to take place.

It is thus the anatomy of the udder that has a significant influence on the stripping yield. The milking process is also important. Any deficiencies (such as inadequate stimulation, clusters that do not hang evenly on the udder, a too low or too high teat vacuum, inadequate pulsation or liners) inevitably lead to stripping yields that are higher than anatomically necessary.

or respectively 50 kPa, (conventional milking parlours, or respectively swing-over-parlours or stanchion barns) almost unabated acts on the udder when milk flow decreases. This not only damages the teat tissue but also raises the stripping yield. It is thus not possible to „compensate for the drop in vacuum at the teat“ by raising the working vacuum of the installation!

If you are upset about too high stripping yields or if you notice that the alveolar tissue of your cows is not emptied completely, you should have an independent expert check your milking equipment. The equipment should conform to the milking machine installation standard, and should above all be checked during milking.

Long term declining yield

No matter where milk remains in the udder after milking, it has a negative effect on the milk producing cells. Contrary to popular opinion, the reason for this is not excessive udder pressure. The problem is rather that, together with the remaining milk, a so-called „alveoli inhibitor“ remains in the udder. On the one hand, this chemical substance directly inhibits the new production of milk. On the other hand, this substance causes an premature and excessive regression of milk production tissue. This is especially the case for cows with a high milk yield. („The best cows suffer the most“).

This was already proved in the 1980s in large scale, long term studies. These studies demonstrated that even during the first lactation period, the loss in yield was higher in the udder half that was not stripped than in the control udder half that was stripped. It was also observed that the udder halves that were not stripped became prematurely smaller and lighter. On average, not stripping led over the course of four lactation periods to a statistically significant loss of yield of 10%. The yield was not only reduced during the individual lactation period but also from year to year. Further studies even showed a loss in yield of up to 15 % for incomplete milking.

Although these results are dismissed by some people as obsolete, they are still up-to-date and relevant. This has been substantiated by several more recent studies. These studies also showed a reduced milk secretion and persistence as a result of incomplete milking.

Complete and frequent removal of milk and the alveoli inhibitor, in turn, leads to increased milk secretion and persistence. This can be seen among other things if milking takes place not every 12 but rather every 8 hours. (see box).

Threats to udder health

Milk remaining in the udder after milking not only has a negative impact on milk yield but also on udder health. Most dairy farmers experienced more than once that the cell count quickly rises and that their cows develop acute mastitis when they leave the milking parlour with incompletely emptied udders.

The reason for this is that together with the remaining milk, nutrients and in the case of infected udders also pathogens and their metabolites remain in the udder. The latter are toxic for the udder. Numerous scientific studies also confirm the observations from practical experience that milk remaining in the udder promotes new cases of mastitis and interferes with the healing process of existing udder diseases. Sometimes there are no other forms of therapy besides frequent and complete milking, e.g. in the case of yeast infections. Accordingly, the researchers from Saxony, quoted previously, note that „the complete emptying of the udder is a basis for good udder health and a high milk yield“.

Milk-out rates versus milking time

This does not mean, however, that the last drop of milk needs to be removed from the udder. Once a disproportionate amount of time is needed to extract very low amounts of milk, the damage done with intensive stripping becomes greater than the benefit because of the added stress on the teat tissue. It is important to find the least harmful compromise between milking time and milk-out rate. Taking this requirement into consideration, most experts recommend that not more than approx. 300 ml of milk should remain in the udder after removal of the teatcups.

Summary

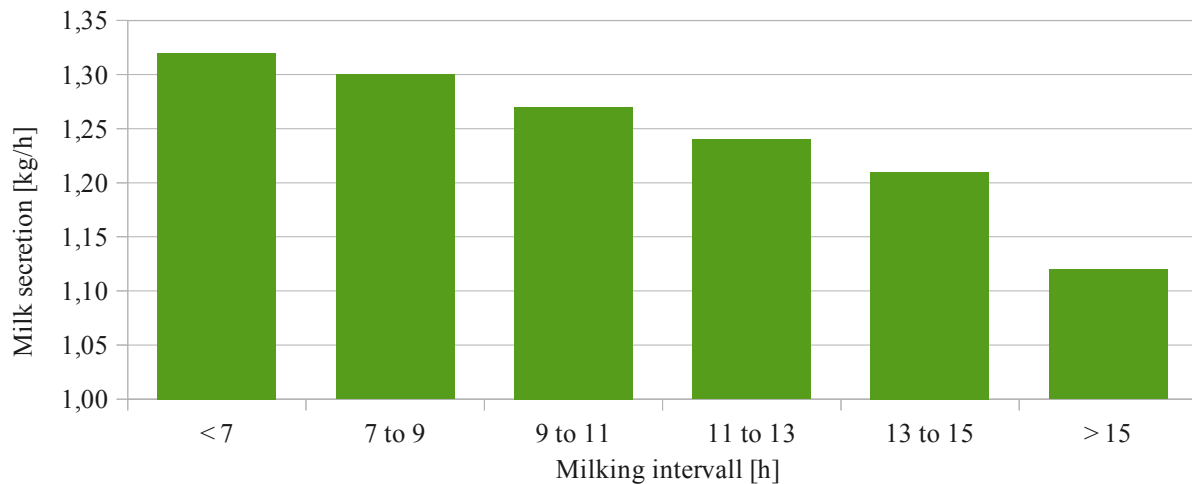
After milking, a significant amount of milk can remain in the udders of modern high-yielding cows. Their stripping yields amount in almost 40 % of the cases to more than 0.5 kg and

Is it not that bad if we simply milk three times a day?

It is often claimed that one does not need to milk completely, if the cow is milked three times a day. This leads, after all, to an increase in milk yield. This is only true if the cow is milked every 8 hours. The opposite is true, however, if the milking intervals are irregular, as is the case with many farms with milking robots. In

that case, the milk yield does not increase, as was hoped, but rather decreases. German studies at the end of the 1990s, among others, found a yield reduced by 4 % when milking intervals were not 12 hours but fluctuated between 9 and 16 hours.

Even if cows are milked every 8 hours, this does not automatically lead to an increased yield if the udders are not completely emptied. If one wants to achieve the highest yield and maintain udder health, one has to milk not only more often but also milk completely every single time.



Milking three times a day leads to a higher yield. However, this is only true for regular milking intervals and if the udders are always completely emptied. (Data source: Ipema et.al., 1997 in "Robotic milking of dairy cows", Conference proceedings, p.294)

in more than 10 % of the cases to between 1 and 2 kg. Often a significant amount of milk remains in the udder cisterns and in the alveolar tissue because of inadequate milking.

The immediate effect of this milk is reduced milk secretion. The long term effect is a premature deactivation of the productive udder tissue,

and thus diminishing persistence. In addition, incomplete milking poses a significant threat to udder health. The nutrients and pathogens left behind usually lead to a real increase in cell count and in udder diseases. This is why the amount of residual milk per cow and milking should not be more than approx. 300 ml.