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Usage of quarter individual milking technique in conventional milking parlours

Milking has an important influence on the udder health of dairy cows. Quarter individual milking systems with a single tube guiding without milking claw and with low working vacuum level, like the MultiLactor®, allow a gentle milk removal. The Leibniz-Institute for Agricultural Engineering Potsdam-Bornim (ATB) has compared the MultiLactor® with a conventional milking system at a farm trial. Milk flow curves, which give diverse information about the milkability of cows, were used to assess the milking technique. Gradual decline phases, which indicate an over-milking of individual quarters, occurred less frequent in quarter individually milked primiparous cows.

Keywords
Milking parlour, quarter individual milking, conventional milking, milk flow curves, MultiLactor®

Abstract
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Milk yield, udder health and milkability of dairy cows have an important impact on the economic efficiency of milk production [1; 2]. Despite the further technical developments in milking technique, diseases of the udder occur frequently. Due to this fact it is essential to improve first of all the milk release itself in addition to the optimization of the herd management and milking routine. Milk release should proceed under optimal technical and hygienic conditions as fast, consistent and gentle to the udder as possible [3], to prolongate the working life of cows. For this purpose a quarter individual milking system, the MultiLactor® (Siliconform GmbH, Türkheim, Germany), was developed. The objective is to harvest the milk as gently as possible, in order to satisfy the physiological requirements of the udder. The MultiLactor® is designed for the use in conventional milking parlours. The quarter individual milking system allows a closer observation of animals and udder health during the milking process [4], compared to automatic milking systems. Furthermore, the milker will be relieved in the arm and shoulder region, because of single tube guiding each milking cup can be attached separately [5]. GEA Farm Technologies (Bönen, Germany) has introduced the „IQ-Vierwege-Melkzeug“ onto the Market, a further new development in the field of quarter individual milking. This system, constructed for conventional milking parlours, is characterized by a milking claw which provided a milk removal separated for each quarter. Furthermore, the vacuum can be interrupted for each milking cup with the help of ball valves in case of air inlets. In this way, the vacuum at the udder remains generally steady and the milk cannot be contaminated with dirt if the cluster falls down.

Evaluation of milking technique by usage of milk flow curves

Milkability of cows in the course of the whole milking process can be represented by milk flow curves. The optimal milk flow curve has a short steep incline and decline phase, an average milking time of five minutes and a trapezium shape (target ideal box shape) [6]. Moreover, it is characterized by a highest milk flow of 3-4.5 kg/min within plateau phase and the lack of bimodality as well as air inlet [7]. Bimodality is often a typical indication of unwillingness for milking because of inadequate stimulation. Bimodality also plays an important role for the evaluation of milk release [8]. Air inlets are characterised by an extreme decrease of milk flow within the milking process. In this case, milk flow is interrupted or rather influenced by atmospheric air. Air inlets can occur in all milk phases and they were mostly caused by ageing or bad dimensioned teat cup liner [9]. Other reasons are the kicking down of the milking unit by the cow caused by ill-fitting milking units and the falling down of individual teat cups because of unfavourable teat shapes [10]. Decline phase can be short or with a steep decre-

asing milk flow. It can also last for long and it can be characterized by a continuous or stepped decline phase (2-3 steps) [9]. Thus, the latter suggests that the individual quarters finished milking unevenly.

Material and methods of practical tests

The ATB tested the MultiLactor® in a practical farm experiment and made a comparative study with a conventional milking system (Westfalia®, GEA Farm Technologies, Bönen, Germany). Both milking systems were installed in comparable auto-tandem milking parlours. Both investigated test groups originated from the same herd and each consisted of 40 Holstein cows. Only animals without clinical evidence, which were until the 120th day in lactation at the beginning of the trial, were considered. Group 1 were milked exclusively with the MultiLactor® and group 2 exclusively with the conventional milking system. Milking routine, feed stuff ration and the keeping conditions were similar in both groups. In each group ten primiparous cows were selected for the present evaluation. After a familiarization period, milk flow curves were recorded every other week over a period of twelve weeks. Six milk flow curves from each cow were collected throughout the evening milking. The LactoCorder® was used for milk flow measurements (WMB AG, Balgach, Switzerland).

Characteristics of the investigated milking technique

The quarter individual milking technique was investigated in an auto-tandem parlour with eight milking places, equipped completely with MultiLactor® units (**figure 1**). The conventional milking parlour had twelve milking places. The MultiLactor® is a quarter-individual milking system with a single tube guiding system without a claw. Single tubes guarantee an equal weight distribution on the udder. Additionally, single tube guiding stops respray between the quarters. After attachment of the single teat cups, mechanical stimulation of the teats (50 s) starts. Therefore, all four teat cups and milk tubes were set in oscillating motion by a mechanical arm (actuator). The machine vacuum is 37 kPa. The system provides periodic air inlet into the teat cups and sequential pulsation which was adjusted with 35 % reduction and 65 % suction phase. As soon as the udder milk flow falls below 800 g/min, the actuator and the intensive stimulation start again. This guarantees an almost completely milking-out of all quarters. All four teat cups will be detached simultaneous if the udder milk flow is less than 200 g/min. After each milking, teat cups will be cleaned and disinfected internally and externally. The Westfalia® auto-tandem as a conventional milking system has a milking unit with a milking claw. The system uses a pulse rate of 300 pulses/min at a vacuum level of 19 kPa for pre-stimulation. Furthermore, the parlour works with a vacuum level of 40 kPa and uses alternating pulsation with 60 % suction and 40 % release phase. The disinfection is carried out with a backflush-system.

Preliminary results of the comparison of the milking systems

The evaluation of milk flow curves of primiparous cows has provided first results for the comparison of both milking systems. The classification of types of milk flow curves is based on [7] and their distribution is shown in **table 1**. Cows which were milked with the MultiLactor® showed most often a slowly milk release. In contrast, curves with a box shape and a gradual or continuous decline phase occurred rarely. Cows milked conventionally had most frequently milk flow curves with a gradual decline phase. Furthermore, the share of bimodality was much higher in this group.

In the analysis of milk flow parameters, means of both milking systems were compared. On average 1.21 kilograms more milk per cow was milked with the MultiLactor®, compared to the conventional milking system. Looking at the total milking time, it became clear that cows milked conventionally had a 2.68 minutes lower milking time per cow as cows in the MultiLactor®-group (**figure 2**). It should be noted that the milking time is very individual for each animal. The greatest differences between both milking systems can be found concerning the incline phase. The study showed that milk flow curves in the MultiLactor®-group had a considerably shorter incline phase with on average 19.2 seconds per cow. Cows reached the plateau phase within 25 seconds in all experimental weeks. In contrast, all cows milked by the conventional milking system, needed to reach plateau phase at least 48.6 seconds per cow throughout the whole experiment. They had an average duration of incline phase of 60 seconds. Concerning the duration of plateau phase, it was detected that quarter individual milked cows had on average a 3.22 minutes longer plateau phase. Looking at the decline phase, the difference between both milking systems were smaller. The average duration was 2.71 minutes for the MultiLactor®-group and 2.45 minutes for the conventionally milked group. Comparing milk flow parameters between

Fig. 1

Usage of MultiLactor® during on farm trial

both milking systems with the help of the Wilcoxon-test, there were significant differences with regard to milk yield, milking time, duration of incline and plateau phase. Only at the duration of decline phase, there was no significant difference between quarter individual and conventional milked cows.

Conclusions

The evaluation of milk flow curves of primiparous cows resulted in the conclusion that the differences between MultiLactor® and conventional milking system were not apparent with the regard to the positive stimulating effect on the incline phase of the milking process. Furthermore, gradual decline phases which are a sign of over-milking of individual quarters were much less likely to occur when cows were milked quarter individual. These positive aspects and the higher number of ideal box shape curves in the MultiLactor® speak for the use of the new system. Milking time of the conventional milked group was shorter in contrast; which minimized the risk of teat tissue damage caused by too long milking.

However, a comprehensive assessment of the new milking system requires consideration of many other aspects. Among other aspects, the results of all cows must be analysed. Cows with stepped udder or with teats set wide apart, so called problem cases, can stay in the herd and can be milked using the single tube guiding. The use of the MultiLactor® is not limited to the usage in auto-tandem milking parlours. Most recently, Impulsa AG (Elsterwerda, Germany) provides the technology for usage in rotary milking parlours. Compared to automatic milking systems (AMS), higher throughput rate in rotary milking parlour makes them interesting for big dairy farms. In addition to the milk flow curves, other parameters were measured to investigate the influence of both milking systems on cows. The aim was to monitor the udder health trend in both test groups. This includes the detection of somatic cell counts, the content of certain milk ingredients of each quarter (fat, protein, lactose) as well as visual rating of the teats with regard to the grade of hyperkeratosis. These results are currently being evaluated and should be published in the near future. Another aim of the project was to develop a quarter individual vacuum steering at teat end. Vacuum conditions, particularly in close proximity to the teats, influence substantially milk release and udder health. For this purpose, parallel experiments were done to develop a steering for quarter individual vacuum application. The healthiest vacuum for several udder types and breeds can be verified by providing of a vacuum steering system.

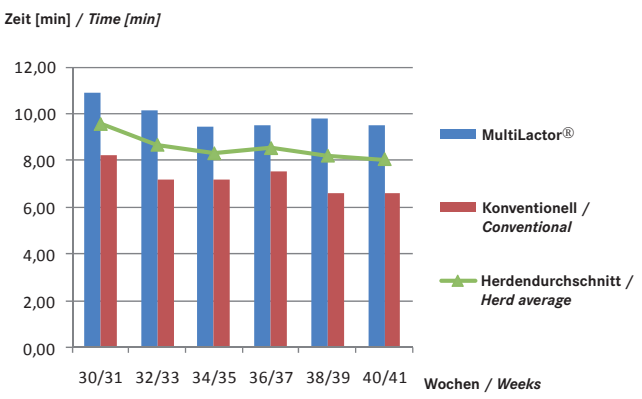
Table 1

Distribution of milk flow curve types for primiparous cows

Kurvenform *Type of curve*	**MUL (n = 60)**	**Anteil [%]** *Percentage [%]*	**KON (n = 58)**	**Anteil [%]** *Percentage [%]*
Kastenform *Trapezian shape*	8	13.3	5	8.62
Bimodalität *Bimodality*	2	3.3	19	32.76
Langsame Milchabgabe *Slow milk removal*	36	60	3	5.17
Stufiger Abstieg *Gradual decline phase*	8	13.3	28	48.28
Gleichmäßiger Abstieg *Continuous decline phase*	6	10	3	5.17

(MUL = MultiLactor®, KON = konventionelles Melksystem/*conventional milking system)*

Fig. 2



Comparison between conventional milking claw and quarter individual milking system (MultiLactor®)

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