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# Differences in milk conductivity on quarter level induced by milking machine

K. Barth

*Institute of Organic Farming, Federal Agricultural Research Centre,  
Trenthorst 32,  
D-23847 Westerau, Germany  
E-mail: kerstin.barth@fal.de*

Measurement of electrical conductivity (EC) of milk to detect mastitis is now common in most of the milking systems. EC indicates changes of tissue permeability, but does not reveal the causes of these changes. A monitoring of udder health in a herd milked in a rotary parlour showed significant higher EC readings for the right front quarter. The analysis of the data indicated a systematic influence by twisted milking clusters. To review this hypothesis, EC of quarter foremilk was measured monthly in a herd (120 cows) where the milking cluster is usually attached with the long milk tube right angled to the cow. Quarter strippings were gained in the middle and at the end of lactation (n = 19 cows). The forces applied to the teats were measured by a device developed by Deutsche Landwirtschaftsgesellschaft (DLG). 84 cows (55 %) were measured at least 6 times during the investigation. 56 % of them were always milked at the same parlour side: on 21 (25 %) and 26 (31 %) cows the cluster was attached on the left and on the right side of the body, respectively. The preference of one parlour side influenced the EC readings of the quarter. EC of the left front quarter was higher when the cow was always milked from the left side and vice versa. No cases of clinical mastitis on the left front quarter were observed in cows which were milked from the right side and vice versa. The manually gained quarter strippings did not significantly differ. The results indicated a monotonous strain of the teat tissue. A continuous measurement of EC on quarter level might be used for the detection of unequal forces applied to the teats by the milking machine. However, the results also indicated a possible bias of EC readings used for the monitoring of subclinical mastitis.

*Keywords: Electrical conductivity, machine milking, udder health*

To monitor the udder health, EC of foremilk was measured monthly in a herd of 330 cows milked 3 times per day in a rotary parlour. The right front quarters showed significant higher EC readings but not necessarily higher somatic cell counts (SCC) and the incidence of clinical mastitis

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## Summary

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## Introduction

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cases was doubled compared to the left front quarter (BARTH & WORSTORFF, 2003). The observation of the milking routine revealed an unilateral influence: the cup of the right front teat was always slightly twisted. SUTTER (1988) showed, that different cluster positions might cause changed tensile forces on the teats and lead to unequal yields of machine stripping per quarter.

The present study aimed to investigate the influence of a twisted milking cluster on the EC readings in foremilk.

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## **Materials and methods**

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The herd of the research station consisted of 120 cows, which were milked two times per day in a 2x5 tandem parlour. The milking cluster was always attached with the long milk tube right angled to the cow (figure 1).



*Figure 1. Cluster position with the long milk tube right angled to the cow.*

From October 2002 to July 2003, EC was measured monthly with a hand-held conductometer on foremilk prior to udder cleaning to avoid alveolar milk ejection. The cow's position in the milking parlour (right or left side) was registered. In the middle and at the end of lactation strippings were gained after the automatic remove of the cluster. Cows were not used to be stripped manually after machine milking and sampling was difficult. Thus, only a part of the herd (n = 19 cows) was sampled. Teat positions of 41 cows were measured in mid lactation.

The forces applied to the teats were measured by a device, which was developed by the Deutsche Landwirtschaftsgesellschaft (Rose & Klimetschek, 2004). A test stand simulates different udder shapes (normal, unequal teat positions etc.) and data of different forces (torsion, horizontal, vertical, tilt) caused by the cluster were recorded (figure 2).



Figure 2. Test device to measure forces applied to teats developed by Deutsche Landwirtschaftsgesellschaft.

Due to other experiments carried out during the investigation period and due to culling of cows, the number of animals in the herd was not stable. 84 cows (55 %) were recorded at least six times during the experiment. 56 % were always milked at the same parlour side. On 25 % (n = 21) of the cows the cluster was attached on the left side, and 31 % (n = 26) were milked from the right side of the body.

The preference of the parlour side influenced the EC readings of the quarter. EC of the left front quarter was higher when the cow was always milked from the left side and vice versa (figure 3). Torsional forces applied to the teats might offer an explanation. When the cluster was attached from the left, the torsional force measured at the front left position was the highest (figure 4). The shape of the udder might contribute to the strain: the mean distance between the two front and the two rear quarters was 20 and 10 cm, respectively. Thus, the cluster puts more stress on the front quarter of the outside position. The gentler treatment of the inner front quarters might be the reason that no case of clinical mastitis was observed in these quarters. Another explanation would be that the quarters which are better to reach by the milker are healthier (Bothur *et al.*, 1977).

## Results and discussion

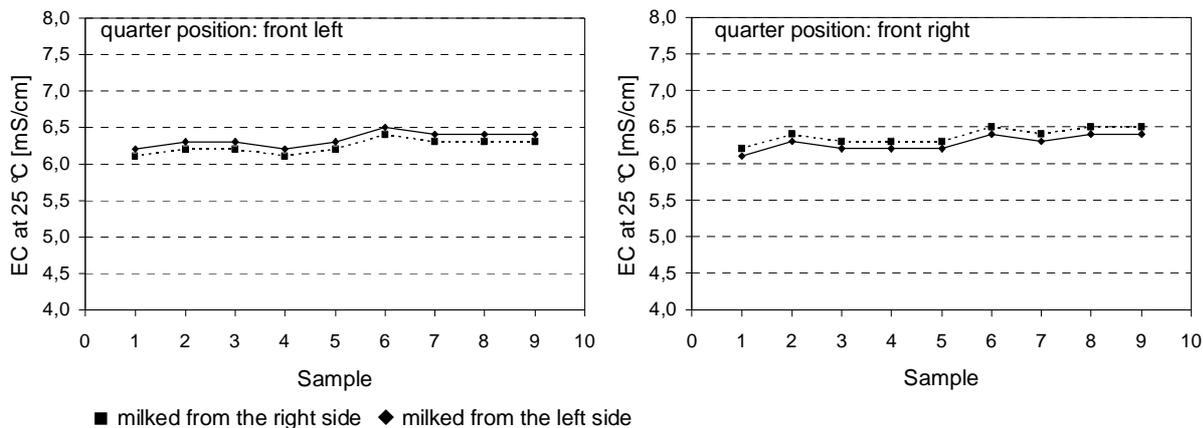


Figure 3. Mean electrical conductivity (EC) of foremilk gained from left and right front quarter of cows milked always from the left or right side of the body.

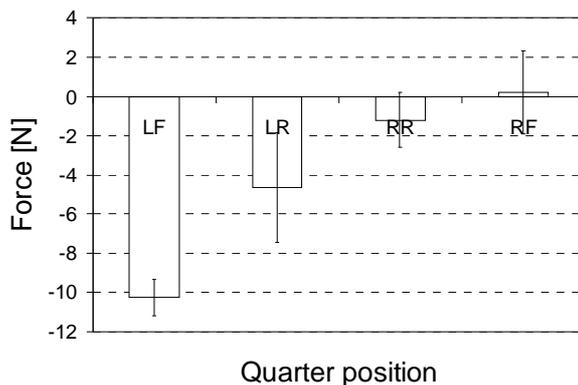


Figure 4. Mean and standard deviation of torsional forces on teats (cluster attached from the left).

Stripping yield per quarter differed only slightly but not significantly at the front left position (figure 5). The results are certainly biased by the method of hand milking. A better solution might be the use of quarter specific milk flow curves.

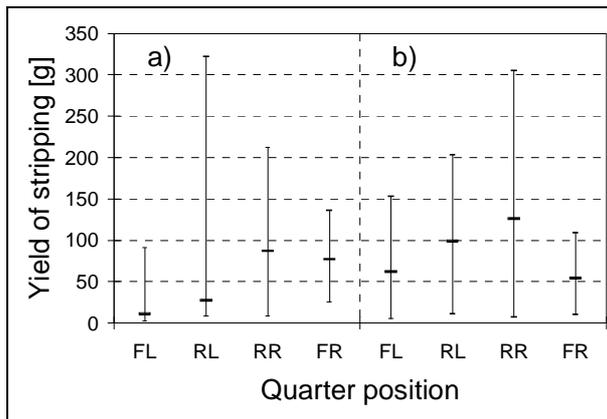


Figure 5. Median and range of stripping yield from cows milked always from the left ( a, n= 8) and the right ( b, n = 11) side.

In cases when cows are milked permanently in the same position (i. e. preference of one parlour side, rotary parlour, automatic milking systems) a monotonous stress might be put on some of the teats. EC is an indicator of a changed permeability of the udder tissue and thus might be used to detect tissue damages caused by the milking machine. On the other hand, these damages might not be accompanied by a bacterial infection or an increase of SCC in milk. This would be another explanation for the often observed low sensitivity of EC to detect subclinical mastitis. However, further investigations should focus on the effect and the relevance of forces applied to the teats by machine milking.

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## Conclusions

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**Barth, K., Worstorff, H., 2003:** Monitoring of quarter health status by periodic milk conductivity measurement: a useful management tool in dairy herds. In K. Janni (Ed.) Proceedings of the 5th Intern. Dairy Housing Conf., Forth Worth, Texas, January 2003, ASAE Publication 701P0203, 84-90.

**Bothur, D., Schulz, J., Mielke, H., 1977:** Untersuchungen über die Verteilung von Eutererkrankungen auf einzelne Eutervierviertel bei Milchkühen in Milchviehgroßanlagen. Mh. Vet.-med. 33, 205-209.

**Rose, S., Klimetschek, J., 2004:** Euterprobleme durch Servicearme. Elite 1, 46-49.

**Sutter, F., 1988:** Über den Zusammenhang zwischen der Gewichtsverteilung des Melkzeuges am Euter und der Entstehung von Maschinennachgemelken. Diplomarbeit, University of Hohenheim, Germany.

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## References

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