Effect of liner characteristics on teat apex condition and milk flow traits

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ABSTRACT - Milking machine characteristics, as liner type, can influence milk flow trait and teat apex condition. The aim of the study was to investigate the effects of liner type on milk flow traits and teat apex condition. In addition, the age of the liner was taken into account. Four commercial farms were visited three times in order to monitor milk flow traits and teat apex condition. Electronic milk flow meters were used. Teat apex condition was assessed following Teat Club International guidelines. Results of the multiple correspondence analysis showed that the farms with triangular liner, percentage of teats rough and very rough less than 20% of the total teats and overmilking less than 0.5min were clustered in the same space and showed a positive correlation. In contrast, they had a negative correlation with farms having higher percentages of teats with hyperkeratosis, longer overmilking phase and with farms using round liners.

Key words: Liner, Milk flow, Teat apex condition.

Introduction - Many factors influence milk flow trait, some of them depend on animal characteristics and some on management choices. Milking machine characteristics (vacuum level, pulsation rate, type of liners) can affect milk flow trait. Different liner types apply different Liner Compression (LC), which is a critical factor in reducing teat tissue congestion during milking. At the same time excessive LC contributes to the development of teat-end Hyperkeratosis (HK) (Capuco et al., 1994). The teat canal is lined with keratin, a material derived from epidermal cells and consisting of fatty acids with bacteriostatic or bactericidal properties (Dzidic et al., 2004). Excessive LC may also remove a great amount of keratin from the teat canal making teats more susceptible to infections. The aim of the study was to investigate the effects of liner type on milk flow traits and teat-end condition. In addition, the age of the liner was taken into account.

Material and methods - Data collection took place between May and October 2008. Four commercial farms were visited three times during this period. Round rubber liners were used by 2 farms, whereas triangular rubber liners were used by the others. Liner age was from 165 to 2091 milkings. During farm visits 487 milk flow traits, from 310 cows, were measured using Lactocorder on 46.4±19.8% of cows of total herd. Milk characteristics, days in milk and number of lactation were obtained from AIA database. Teat apex score was assigned following Teat Club International guidelines (Mein et al., 2001). Data were analyzed using analysis of variance (proc GLM), considering as effects type of liner, age of liner, farm, stage of lactation. Multiple correspondence analysis was also conducted (proc CORRESP; SAS Institute, 2001).

Results and conclusions – All farms had herringbone parlour, herd size was between 122 and 76 Holstein-Friesian lactating cows. Automatic cluster removal was not used constantly in all farms. All farms milked twice a day. Teat preparation before milking was different in each farm. Farm A used scummy pre-dipping, paper towel and stripping before claw attachment and post-dipping liquid barrier was used after cluster removal, milker wore gloves all the time. Farm B used no pre-dipping chemical solution, milker massaged and stripped each cow by gloved hand before claw attachment, after cluster removal liquid post-
dipping were used. Farm C did not use any type of preparation and milker did not wear gloves, automatic cluster removal was not routinely used. After milking, no post-dipping product was applied on the teat. Milker in farm D used gloves during whole milking, no pre-dipping product was used, udder was washed by water and was not dried and stripped before claw attachment. Milk production was 31.1±9.9 kg. Average value of Somatic Cell Count (SCC), expressed as Log 10, was 4.80±0.20. Average of milk flow parameters, teat condition and SCC for cows recorded using electronic milk meter is shown in table 1.

Machine on-time was on average 7.70±1.90min, which is longer than the value of machine-on time reported by Bruckmaier et al. (1995) for Holstein-Friesian cows. Time of plateau phase was 2.64±1.60 min, in according to Dodenhoff et al. (1999). Time of plateau phase, expressed as percentage of the total milking time, had value of 38.7% with a minimum value of 0.82% and a maximum value of 87.6%, showing high variability among farms. Stimulation time was 1.19±0.56 min. The shortest stimulation time corresponded to the highest frequency of bimodal curve. Stimulation time shorter than 1 min appears not to be sufficient; on the other hand long stimulation time did not come out advisable, because it did not reduce bimodality and it slowed down milking routine. Overmilking time was extremely different between farms, it was on average 1.12±1.33 min, with a minimum of 0 min and a maximum of 13.6 min. It was probably due to the not steady use of automatic cluster removal. This device can usually avoid long overmilking phase because it is supposed to take the cluster off when the milk flow decreases below a certain value (about 400 g/min). Teat condition scores characterized by HK (Rough-R and Very Rough-VR scores) were, on average, 19.8 % of the total teats. In according to Mein et al. (2001) the aim for the herd should be 20% so that the teat condition of these herds was quite good, farms C and D had higher values than the others. Milk flow parameters were influenced by stage of lactation in according to Sandrucci et al. (2007). Milk production changed over stage of lactation. Peak milk production occurred around 100 days in milk, and then it decreased linearly (21.2; 17.7; 15.9; 13.3 kg/milking respectively for stages of lactation <100d; 100-200d; 200-300d; >300d; P<0.001). Similar pattern was recorder for duration of plateau phase

### Table 1. Milk flow parameters, teat condition and SCC for each farm.

|                | A     | B     | C     | D     |
|----------------|-------|-------|-------|-------|
| Milk production | kg/milking | 15.3<sup>a</sup> | 18.2<sup>b</sup> | 18.0<sup>a</sup> | 12.2<sup>c</sup> |
| stimulation time | min   | 1.12<sup>a</sup> | 0.60<sup>c</sup> | 0.71<sup>c</sup> | 0.42<sup>c</sup> |
| machine on-time | min   | 7.08<sup>b</sup> | 1.35<sup>c</sup> | 1.94<sup>c</sup> | 2.13<sup>a</sup> |
| time of incline phase | min | 1.00<sup>abc</sup> | 0.26<sup>abc</sup> | 0.42<sup>abc</sup> | 1.11<sup>a</sup> |
| time of plateau phase | min | 3.00<sup>abc</sup> | 1.56<sup>abc</sup> | 2.27<sup>ac</sup> | 1.42<sup>c</sup> |
| time of decline phase | min | 2.57<sup>a</sup> | 1.01<sup>a</sup> | 3.17<sup>a</sup> | 1.54<sup>a</sup> |
| plateau phase/machine on time | % | 44.0<sup>a</sup> | 33.0<sup>a</sup> | 32.2<sup>a</sup> | 18.2<sup>c</sup> |
| overmilking time | min | 0.51<sup>a</sup> | 0.32<sup>a</sup> | 0.36<sup>a</sup> | 1.27<sup>b</sup> |
| average milk flow | kg/min | 2.37<sup>bc</sup> | 3.59<sup>a</sup> | 4.52<sup>a</sup> | 3.74<sup>a</sup> |
| peak milk conductivity | kg/min | 0.6 | 1.06 | 0.8 | 1.28 |
| peak milk conductivity | mS/cm | 6.35 | 4.52 | 6.24 | 3.92 |
| bimodality | % | 18.8<sup>a</sup> | 45.8<sup>a</sup> | 45.0<sup>a</sup> | 45.7<sup>a</sup> |
| somatic cell count | Log<sub>10</sub> | 4.61<sup>a</sup> | 5.03 | 5.50<sup>a</sup> | 4.96<sup>a</sup> |
| R+VR /total teats | % | 12.9 | 5.28 | 20.3 | 11.4 |

<sup>a,b,c</sup>=Means within a row with different superscripts differ (P<0.05), Scheffe’s test.
milking time (50.7; 43.0; 33.5; 15.9% respectively for increasing stage of lactation; \(P<0.001\)). Frequency of bimodal curve had a great change during lactation, after the first 100 days in milk, an increasing value was recorded (9.85; 41.1; 56.8; 37.4% respectively for increasing stage of lactation). It was probably due to the decreased milk production and, as a consequence, the rapid cistern emptying. SCC pattern during lactation was similar to frequency of bimodal curve: an increased SCC level was recorded as days in milk increased (4.68 vs 5.19 log_{10}) respectively for <100 and >300 stage of lactation; \(P<0.05\). A multiple correspondence analysis evaluated the relationships among average farm values converted in categories for a contingency table (Figure 1). Results showed that farms with triangular liner, percentage of R and VR less than 20% of the total teats and overmilking less than 0.5min were clustered in the same space and showed a positive correlation. In contrast, they had a negative correlation with farms having percentage of teats R and VR more than 20% of the total teats and overmilking more than 0.5min and with farms using round liners. Overmilking is a stressful agent (Reid and Johnson, 2003), it made teat apex produce an excess of keratin. In conclusion teat apex condition and milk flow traits can be influenced by many factors like liner types and detachment threshold.

Figure 1. Multiple correspondence analysis.

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