EXPLORING THE ROLE OF LINER DIMENSION, SHAPE, AND VENTING ON MILKING PERFORMANCE

Douglas J. Reinemann, Sonia Maria Ares-Gomez, Paul D. Thompson

University of Wisconsin-Madison, Milking Research and Instruction Lab

Ian Ohnstad

The Dairy Group, Dorset, UK
provide sufficient data to choose the liner for a herd
• data may include teat sizes, liner type or dimensions.
MP Lip and mid barrel Bore Diameters

- **Percentage**
  - Diameter of the mouth piece lip (mm)
  - Bore diameter (mm)

- **Graphs**
  - EU
  - USA
  - USA-special
Measuring MP depth @40kPa Liner Vacuum
Teat Dimensions: A new world?

Teat Length (Blue) or Diameter (Red) and Standard Deviations (mm)

- US1 (n=470)
- US2 (n=3231)
- UK1 (n=870)
- UK2 (n=180)
- NZ (n=16)
Conclusions

- EU liners tend toward larger diameter and deeper mouthpiece than US liners.
  - Liner taper is more common in EU

- This could be to accommodation of large teat sizes in the EU
  - Limited data suggest no difference in teat size for Holstein herds

- Market preferences, history and/or perceived benefits may account for differences
OTHER LINER CHARACTERISTICS

- Liner compression

“Compression applied to the teat-end when the liner is collapsed”
Liner compression applied by four US liners

(Note: 10 kPa = 3 inHg)
LC varies with depth of penetration of teat into the liner

$L$ is defined as ‘Collapse length’ in ISO standard
Dynamic Over-Pressure
A good predictor of liner Compression
Cyclic pressure applied by 7 liners plotted against independent ranking of teat-end condition in USA herds

Mein et al, NMC, 2003
Touch Point Pressure Difference (TPPD)


Touch point for triangular liners was considered to have occurred when all three adjacent sides of the triangle contacted each other.
TPPD is not a good predictor of OP or LC
Other liner characteristics

Liner shape:
- Round
- Triangular
- Tricircle
- Square

Liner material:
- Rubber
- Silicone
User's manual for the milking unit shall state

- for a specified milk flow rate:
  - 5 kg/min for high producing cows

- Desired average liner vacuum
  - 32 kPa to 42 kPa during peak flow

- corresponding milkline vacuum
  - based on a wet test w/specified configuration
    - Length and diameter of the long milk tube and milk lift
Choosing Vacuum Level
Consider
Peak Flow
Low Flow
Real Cows

Distribution of Peak Flow Rates in a herd
Outliers/liner slip?
Milking gently

- Optimal keratin turnover in teat canal
  - Liner Compression

- Manage Congestion in teat tissues to Improve teat closure after milking
  - MPC vacuum, Milking Vacuum, LC

- Health and integrity of teat skin, Rough teat-ends / hyperkeratosis
  - Liner Compression
Teat Tissue Congestion

Teat Barrel Congestion produced by Mouthpiece Chamber Vacuum - cannot be relieved by liner collapse

Teat-End Congestion produced by milking vacuum - can be reduced by Liner Compression (LC also contribute to hyperkeretosis)

Refinement of TCI teat condition evaluation
- Note Size of teats with color/rings
- Note area of color, Barrel v. end
If the teat barrel does not fill the liner cross section - or cannot penetrate the liner

- High mouthpiece vacuum
- Congestion in the teat wall
- Rings at the base of the teat
- Difficult unit removal
Shallower MP = lower MPC vacuum
For “Normal” Teats

![Average of MPC vacuum chart]

- NoVent Narrow Round
- NoVent Narrow Square
- MPCvent Narrow Tri
- NoVent Wide

Legend:
- Green: Low - Med
- Orange: Peak - Med
Associations between teat dimensions and milking-induced changes in teat dimensions and quarter milk somatic cell counts in dairy cows

Zwertvaegher, et al. JDS 2013

Teats with wider barrels had higher quarter SCC.

Teats that became thicker during milking were associated with higher quarter SCC

indicator for incorrect choice of teatcup liner or milking machine settings.
Rønnningen and Postma, NMC 2012.

Herd level mastitis index strongly correlated with proportion of cows with MPC vacuum 10 – 30 kPa.

- of minor importance
  - Machine on time,
  - teat end vacuum during peak flow period

- Not Significant
  - irregular vacuum fluctuations
Visual signs of Teat Barrel Congestion
blue color or ringing
Narrow bore liners on US herd

- MPC vents
- High vacuum
  - 46 v. 38.5 kPa
- Short teats
  - <40 mm
- Duration
  - extra 20 s

1.9 x less likely
1.6 x more likely
1.6 x more likely
1.2 x more likely
The primary machine factors that affect teat condition are (in order of priority):

1. Liner dimensions compared to teat dimensions, or the fit of the liner to the teats
2. Type of liner including shape, material and venting
3. Milking vacuum level, in both the peak and low flow periods of milking
4. Degree of over-milking
5. Pulsation settings

All of these factors are interactive.
Maximising the gentleness of milking

- Small reduction in speed (about 10%)
  - cups-on time
  - Ave/Peak milk flow rate
- Little or no effect on the number of cows milked per hour
  - automatic cup removers
  - maximum milking time

Milking is a compromise: gently, quickly, completely
Take Home Points

笮 Size (Liner Dimensions) Matter!!
  ⚫ Fit of the liner to the teat is an important aspect of gentle milking
笮 Use teat condition to assess the adequacy of the milking vacuum level and the liner
  ⚫ MPC Vacuum can be used to assess liner fit
笮 The most important measurements of milking performance
  ⚫ Average claw vacuum at peak AND low flow
  ⚫ Measure Pulsation phases (a,b,c,d) in ms
     NOT %