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# Infrared temperature measurement of teats skin for evaluation of liner-teat interactions during milking in dairy goats

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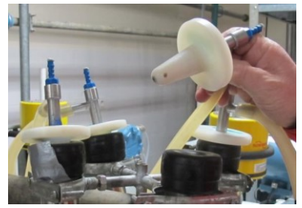
# Introduction/Context

- Goat milking equipment and especially liners, are not designed to fit all the different teat shapes.
- Manufacturers generally test liners on the same ISO 3918 artificial teats(1) that are used for cows or sheep milking equipment's.



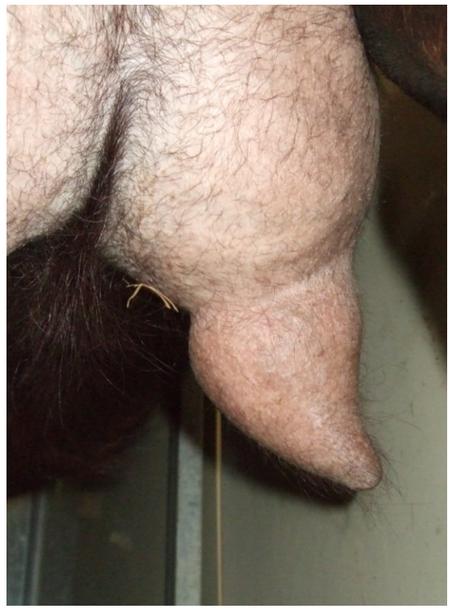



- Consequently, it is frequent to observe different teat reactions in goats (e.g., congestion, compression's rings, redness, pinching etc…).
- This study aims to test Infrared temperature (IRT) technology to evaluate teat tissue reactions of different teat shapes after milking by two different liners.

1: International Standard: ISO 3918- 1977-05-01 Milking Machine Installations, Vocabulary. B—12Q40. Brussels, Belgium.

# Materials and Methods (1)

- 2 groups of 24 multiparous alpine dairy goats were classified in 4 different shapes of teats.



Globular

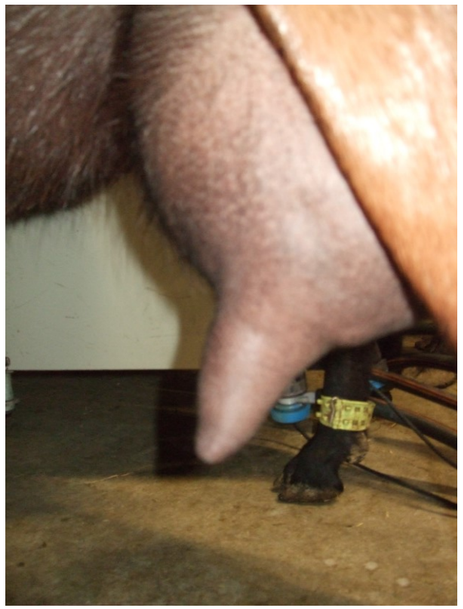
(G)

Conical large

(CL)

Conical medium

(CM)



Conical small

(CS)

# Materials and Methods (2)

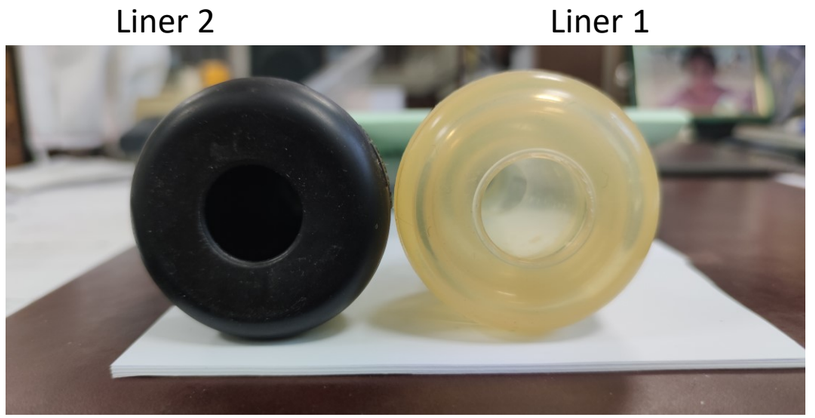
- The two different liners tested were selected among the more frequently encountered in French farms (milking machine control database-Logimat®).
- Measures (on basis of ISO 3918:2007)
  - Liner 1 was in silicon (2.2 cm mouthpiece and between 2.6 and 2.3 cm barrel diameter; 12, cm liner body length with a conical part of 4,5 cm then a tubular part of 7,5 ; Buckling Pressure or Touch Point Pressure Difference [1] (11.44 kPa, n=5).
  - Liner 2 was in rubber (nitrile) (2.1 cm mouthpiece and between 2.5 and 2.1 barrel diameter; 12.1 cm liner body length with a conical part on 3 cm at the top, then a tubular part of 9 cm; Buckling pressure or Touch Point Pressure Difference [1] (13.86 kPa, n=5)

1: International Standard: ISO 3918- 2007 Milking Machine Installations, Vocabulary. B—12Q40. Brussels, Belgium.

# Materials and Methods (2)

- This study experimental plan was a 2*2 cross over design in which each group of goats were milked with these two liners during two periods of 2 weeks (mid lactation) in the same milking parlor:

| Weeks 1-2 | Weeks 3-4 |
| --- | --- |
| Group 1 Liner 1 | Group 1 Liner 2 |
| Group 2 Liner 2 | Group 2 Liner 1 |


# Materials and Methods (3)

- Teat skin temperature (TST) was recorded before milking and just after cluster removal on apex, barrel, base parts of teats and on all teat area using an IRT camera (FLIR E-60®).

Resolution 320 x 240 pixels, tactile screen
Thermal images, normal images and vidéo
Automatic or manual calibration

Precision 0,01°C (+/- 2% of value measured)

Laser illuminator to target specific points

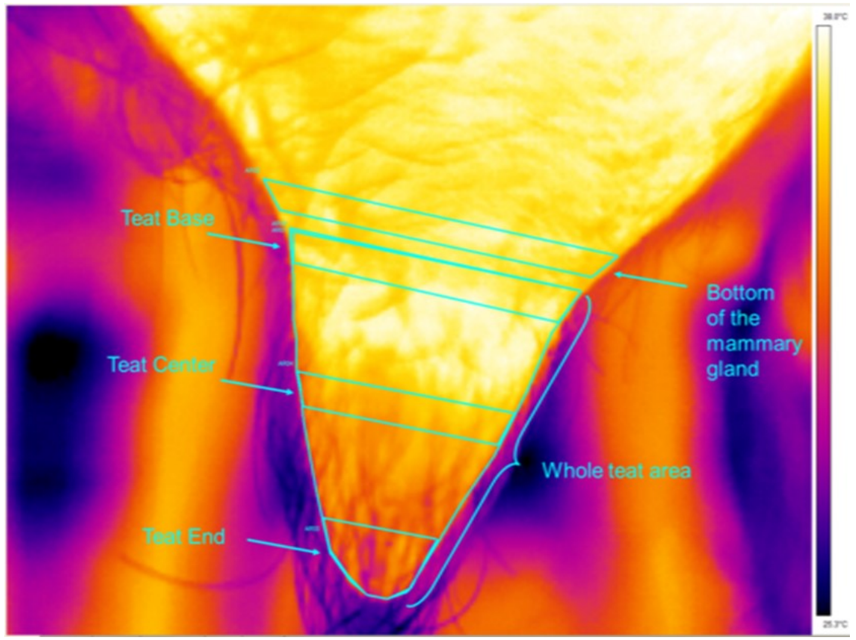
Zoom 1 to 4 fois, manual focus

Storage of multispectral data on SD card

Connection wifi/bluetooth

Autonomie 3-4 heures

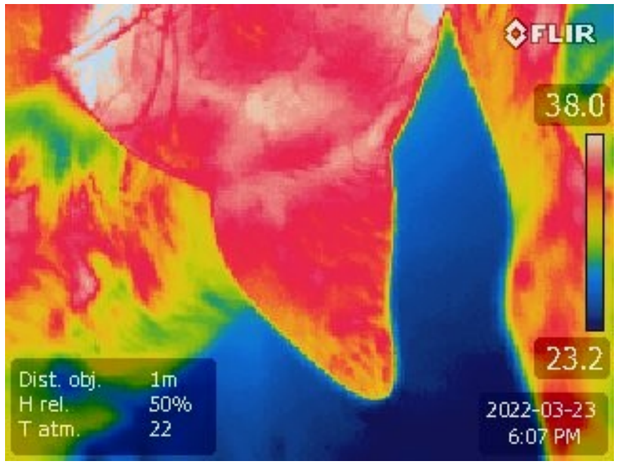
**Thermal Camera FLIR E60**




*Areas were enlarged at 1 cm of height to take in account variation of teat position in liner during milking.*

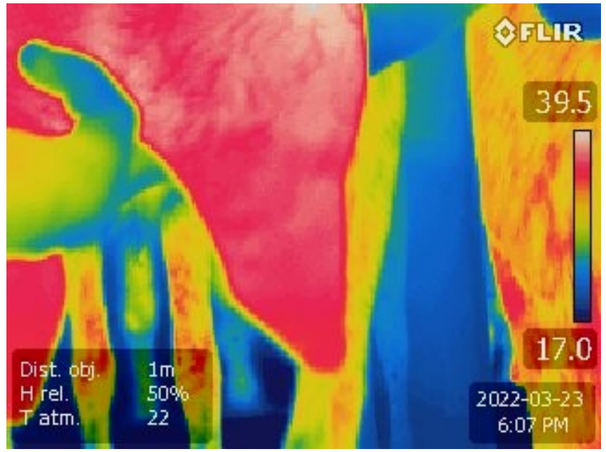
# Results (1)

- The teat surface temperature  differed significantly between base, barrel, and apex before (35.87, 35.42, 35.08°C+/-0.05 respectively) and after (34.82, 34.65, 33.37°C +/- 0.06 respectively) milking.



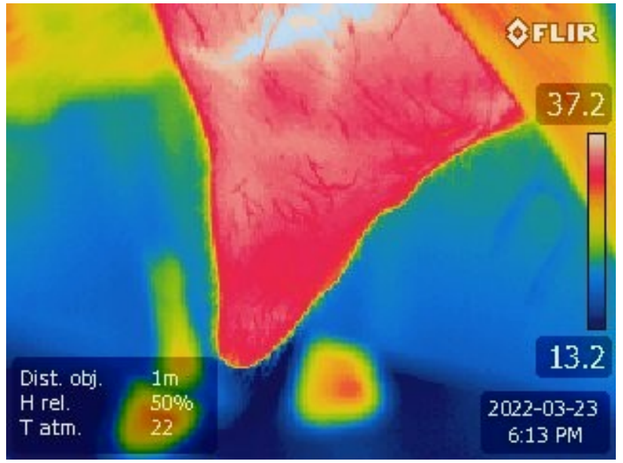

Globular

(G)



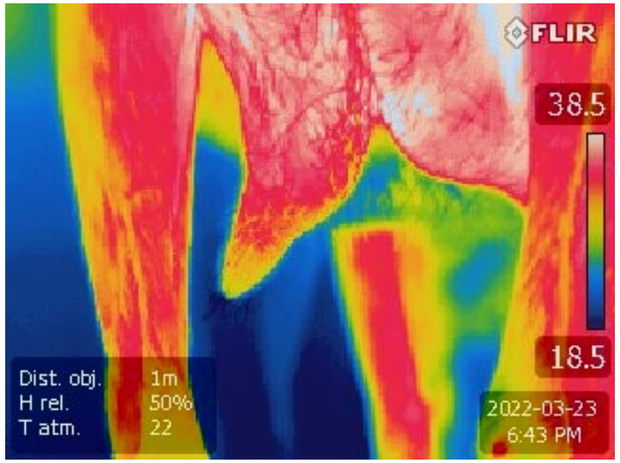

Conical large

(CL)




Conical medium

(CM)




Conical small

(CS)

Some IRT examples before milking of different teat shapes

# Results (2)

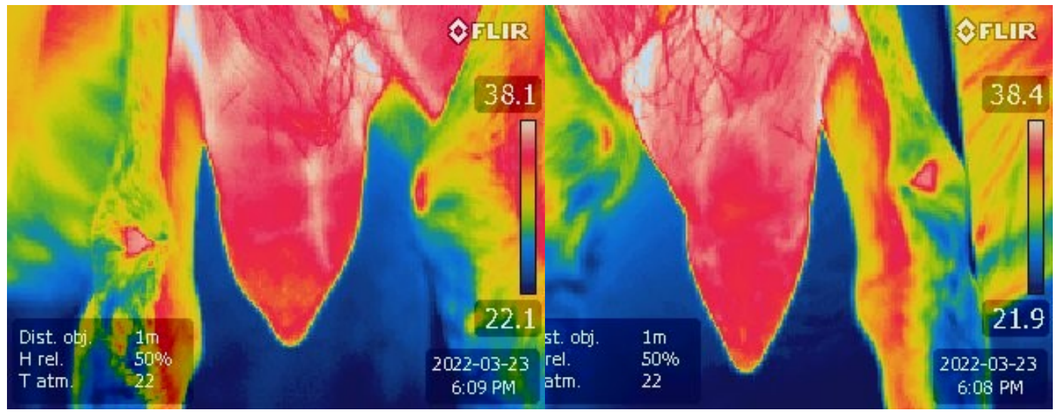
- Teat surface temperature variation on studied teat areas (after – before milking) at each teat level, differed significantly ($P<0.0001$) between teat shapes

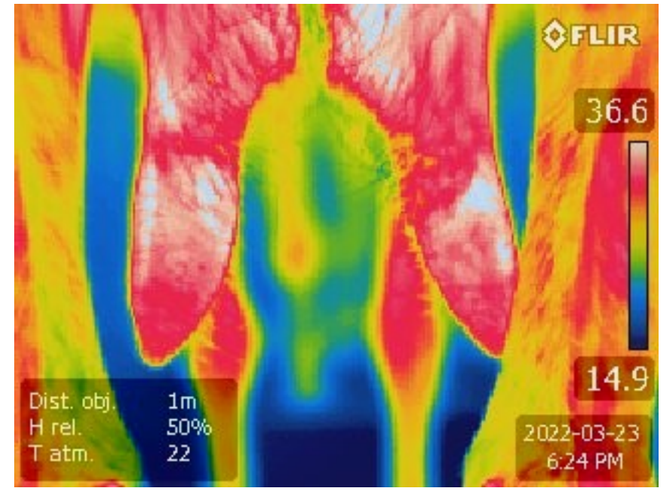
| Teat Shape | G | CL | CM | CS |
|---|---|---|---|---|
| Teat Surface Temperature variation due to milking | -0.72°C a | -0.91°C b | -1.21°C c | -1.77°C d |

# Results (3)

- Teat surface temperature variation was lower on the teat barrel than on base and apex (-0.89°C *vs* -1.04 and -1.67°C respectively).

Before




After

# Results (3)

- Teat surface temperature decrease after milking was significantly affected by the liner type (-1.47°C (Liner 1) *vs* -0.85°C (liner2) +/- 0.043) ($P<0.04$).
- Interaction between liner type and udder shape was significant ($P<0.05$).

# Discussion (1)

- The decrease of Teat Surface Temperature induced by milking confirms our previous observations in this Alpine Breed in other farms but differed of works done in other breed (Alejandro et al, 2014). The reasons could be a combination of theses two factors:
  - Skin and milk temperature interactions because of very low skin wall thickness of udder and teat cistern often between 3 and 1 mm in our breed) .
  - Larger teats at base that could be constricted (frequent compression rings observed) and reduce blood flow in teat skin.
- Nevertheless, the decrease varies between teat parts suggesting a warming due to activation of skin blood flow mainly in the barrel part where properly massaged.

# Discussion (2)

- Thermal temperature of teats differed by liner. That suggests a higher blood flow increase in teat skin with rubber/nitrile (harder wall and smaller diameters) liners than with silicon (softer and larger liners) and thus more interactions with teats.
- Thermal temperature of teats differed also by teat type. The lower TST reductions were observed with the larger teat shapes G and CL suggesting a less good emptying (residual milk having higher impact) and possible higher interactions between teat/liner walls despite very frequent constrictions rings occurrence blocking blood circulation locally.
- This conclusion argue to recommend genetic selection of smaller and more tubular teats as possible in goats to limit tissues and animal stress by milking equipment.

# Conclusions

- IRT technology appears to be a sensitive tool able to evaluate small teat-liner interactions in goats.
- Our results, after test of the different liners available on the markets, could be of value to technician to help farmers when selecting liner type based on the more frequent teat shape encountered in their flock.

# Perspectives

- Effects of liners on teat cup movements on teats (slipping, climbing…), on teat (pinching, compression rings, congestion (calipers))…, on milk flow (Lactocorder®) and on vacuum fluctuations (VaDia®) were also measured and results, still under processing, will complete this first analysis to propose other pertinent indicators.
- Because of importance of liner design ad teat shapes, our Project CAPRIMAM 3D[2], also:
  - Aims to develop a mobile, high rate 3D scanner for goat udder/teats to accelerate the genetic selection of goats on udder/teat shapes (*see poster abstract 158, session S01 genetic traits to enhance goat efficiency*).
  - Aims to develop 3D more realist artificial teats (size-based on 3D scans- and softness) to test and evaluate future liners better adapted to different teat shapes.

2: These researches are supported by CASDAR program, with financial support of MINISTÈRE DE L'AGRICULTURE ET DE L'ALIMENTATION Liberté Égalité Fraternité

# Thanks for your attention

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