Design and development of a pilot milking machine: monitoring fouling and cleaning under real conditions

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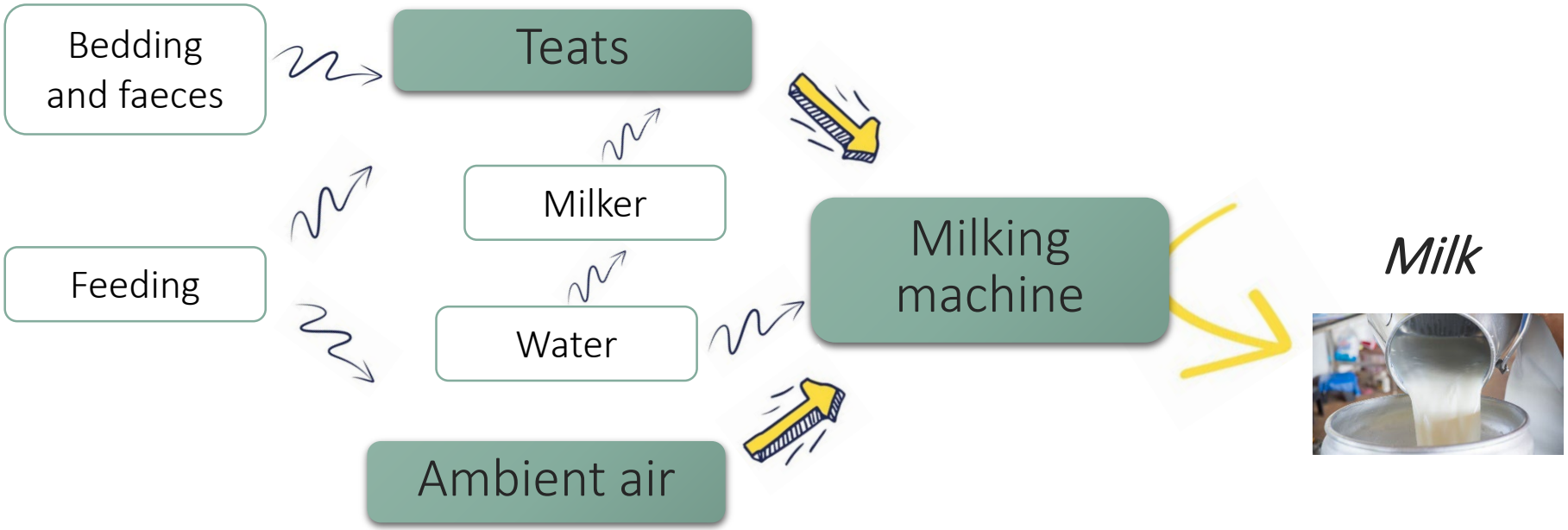
Funded by :

PiLoTraite

Context and presentation

Milking machine and microbiological quality

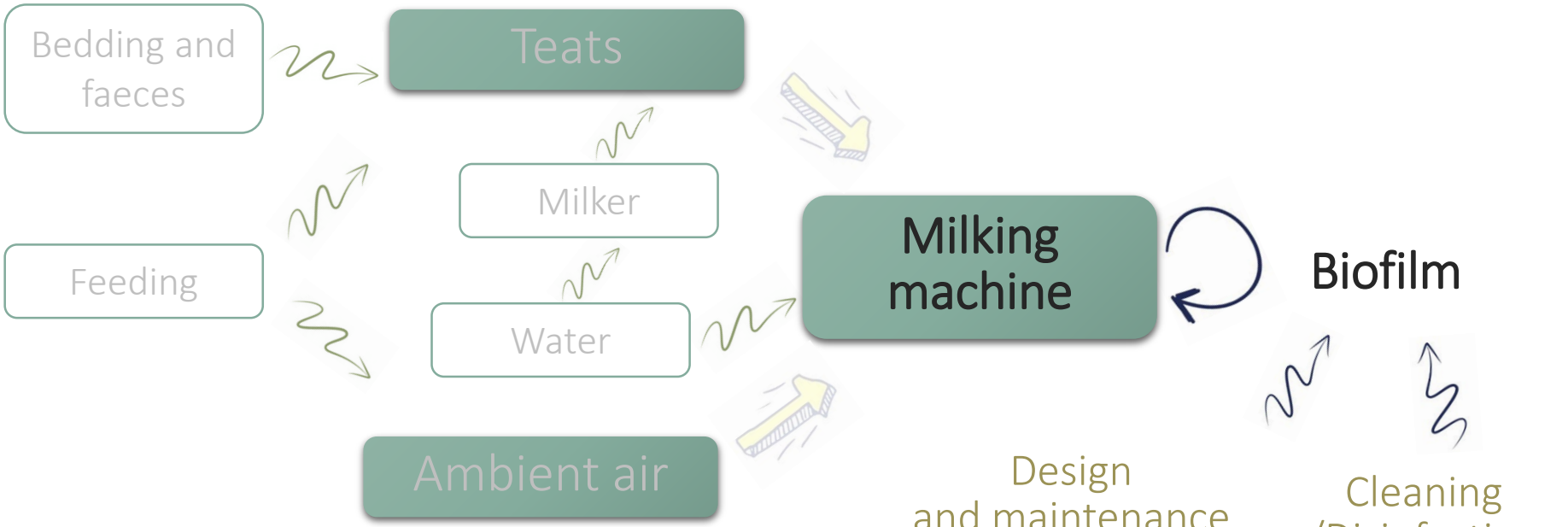


Milking machine : essential impact on microbiological quality of milk

Sanitary Quality

Technological and Sensory Quality

Biofilms in milking machine : inoculation of milk



Intermediary scale
between farm and laboratory

PiloTraite

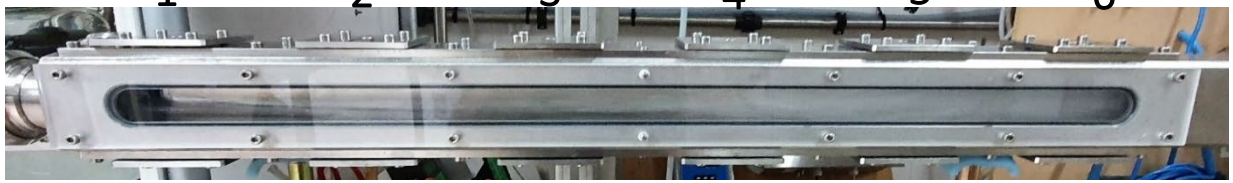
Pulsator line

Artificial udders

Milkline

Cleaning line

« Coupon holding section » with 12 removable coupons to study biofilms



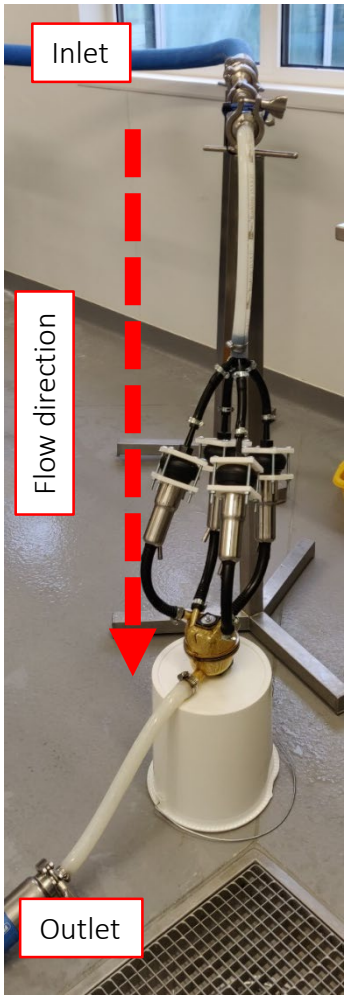
Conditions to study biofilms in the pilot

Eliminating biofilms between each testing		Cleaning/disinfection procedures
Implanting complex biofilms in PiloTraite		Implantation procedures
Sampling biofilms in order to characterize them		Methods for biofilm sampling and analysis (not presented here)

Focus on cleaning/disinfection procedures

Focus on cleaning/disinfection procedures

Cleanability tests on CIP pilot plant (ACTALIA):

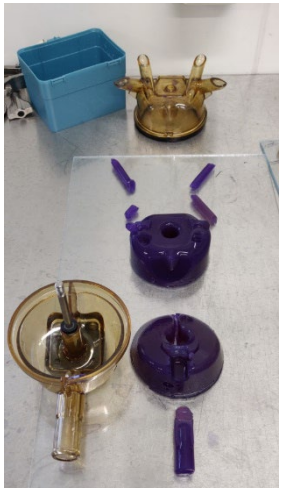


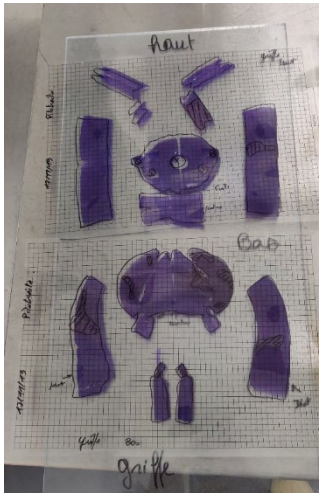
Milking machine components

Cleanability evaluation according to EHEDG test method (Doc.2) with different CIP procedures

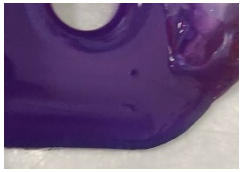
Fouling

CIP

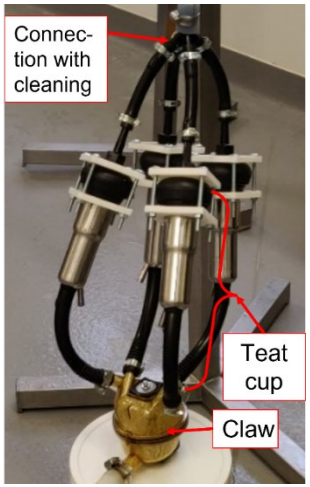

Gelose casting


Mapping


Color changed ➔ still soiled


Color unchanged ➔ clean

Focus on cleaning/disinfection procedures



P3 procedure

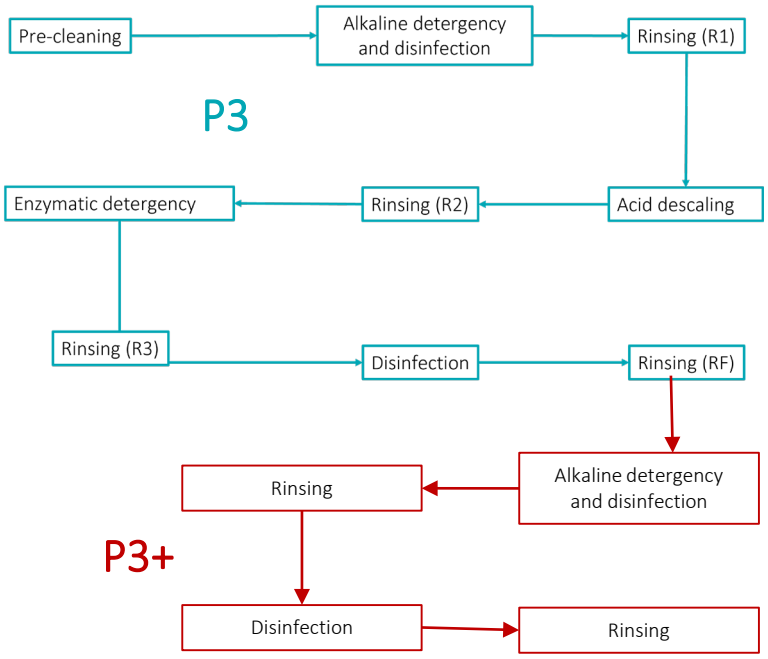
Residual contamination on:
- Connection with cleaning
- Claw

P3 + procedure

Residual contamination on the claw

P3 procedure

No residual contamination



Recommendation: P3 procedure + disassembly and manual cleaning of problematic areas

Perspectives: redesign of the equipment according to hygienic design standards

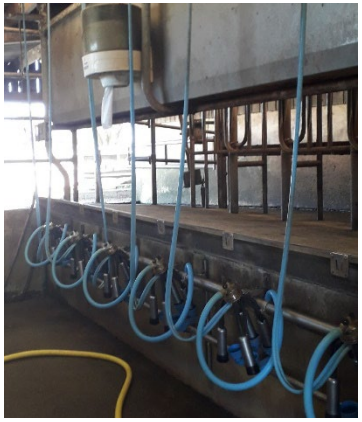
PiLoTraite

Focus on biofilms implantation

Methodology

1. Resident biofilm characterization → Study of the resident biofilm after:
   1/ Cleaning/disinfection procedure

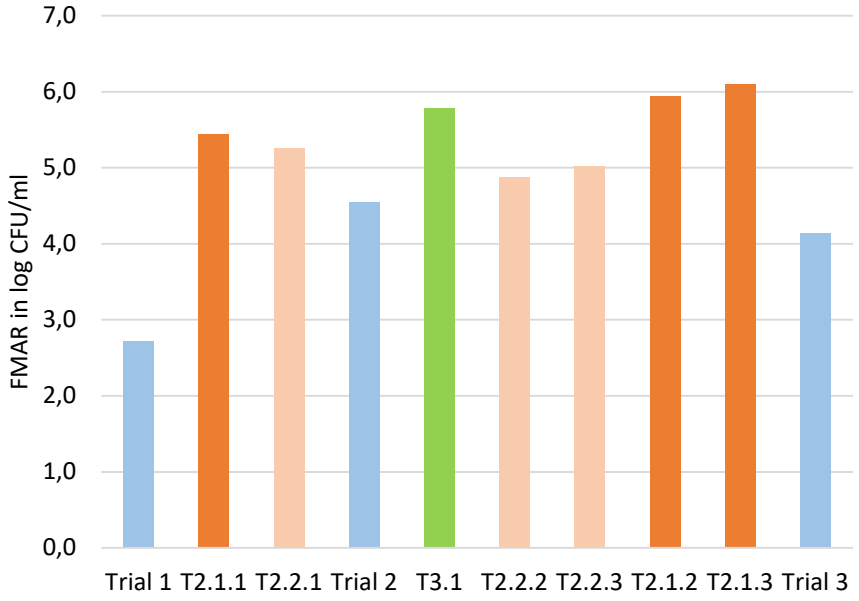
2. Complex biofilm implantation through milk - 1 day / 2 days → Study of the biofilm in the pilot after :
   1/ Cleaning/disinfection procedure
   2/ **Circulation of UHT milk inoculated by circulation in a real milking machine** (1 day/ 2 days)



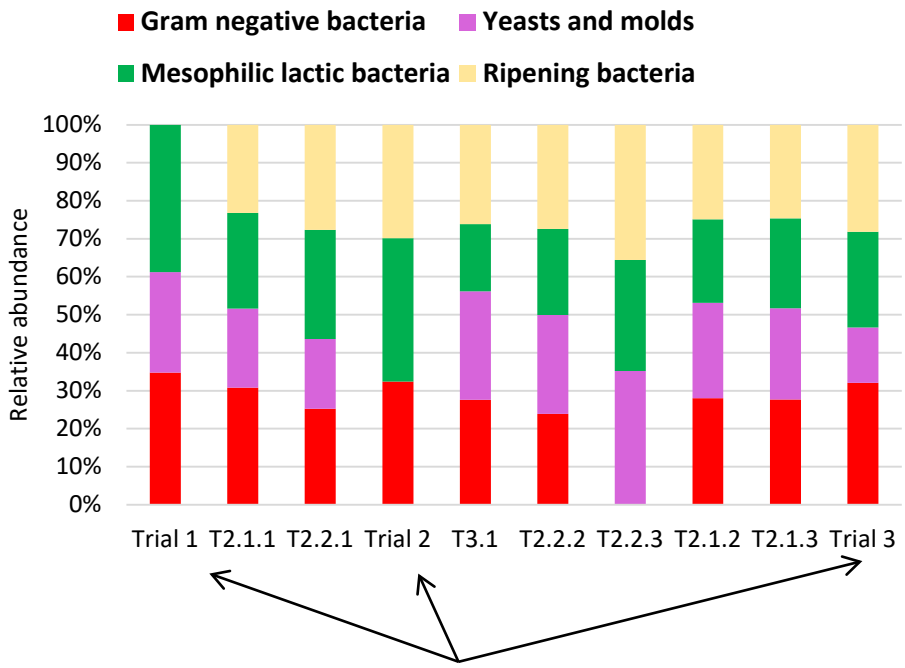
3. Complex biofilm implantation through a section of the milking pipeline → Evaluation of the biofilm in the pilot after :
   1/ Cleaning/disinfection procedure
   2/ **Circulation of UHT milk,** biofilm from experimental farm through **a section of the milking pipeline**

Evolution of microbiota in the pilot during the experimentation

Evolution of total mesophilic aerobic bacteria counts in UHT milk after circulation in the pilot (n=1)



Evolution of relative abundance of microbiological groups in UHT milk after circulation in the pilot (n=1)



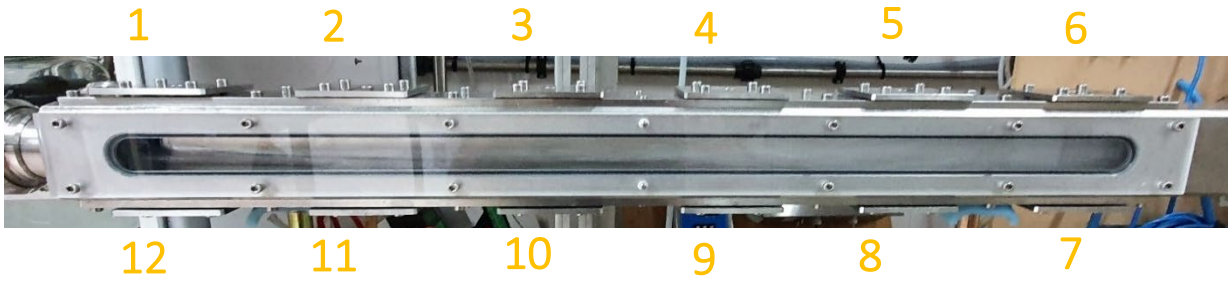
No implantation procedure

Graphic legend :

- Resident biofilm characterization
- Complex biofilm implementation - milk – 2 days
- Complex biofilm implementation– milk – 1 day
- Complex biofilm implementation– section of the milk pipeline

Colonisation of coupons by complex biofilms

Coupon positions in the holding section



✓ Microbial colonization of the coupons is time- and coupon position-dependent

✓Spoilage bacteria settle better on coupons

✓Ripening microbiota is more abundant with 2 days-implanted biofilms

✓ Higher implantation with 2 days experiments

Conclusions and perspectives

- ✓ Resident biofilm, due to the current design of milking machines :
  - Ripening and spoilage microbiota: representative of real milking machine
  - Resident biofilm modified with important addition of some microbiota
- ✓ Microbiological groups: stable during experimentation, but further analysis required (metabarcoding in progress)
- ✓ Longer implantation procedures promotes biofilm development in the pilot
- ✓ Focus on coupons: higher colonization by spoilage bacteria and 2 days-implantation favours complex biofilm growth
- ✓ Other results not presented: evolution of the physico-chemical properties of the surfaces

- ✓ Successful development of a pilot installation and protocols to study the impact of C&D procedures on biofilms in milking machines
  - ✓ Resident biofilm: necessary to be controlled before each experimentation
- ✓ Need for reflection upon enhancing milking machine design for better cleanibility