

Microbiological trouble shooting in the manufacturing environment

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8/26/2019	HV	HFW	spot	WD	5 μm
12:41:24 PM	5.00 kV	18.9 μm	2.0	10.6 mm	
					OSU Quanta 600 -

The OSU Food Safety Squad (well, most of us)



OSU Food Safety & Quality Systems Lab Mission

Serve as a resource for the food industry to help better understand the microbial challenges of their products and production system and support their ability to produce safe and wholesome products.

- What does this mean:
 - Sometimes a simple email or phone call
 - Training (workshops or on-site)
 - Review production/quality data
 - Plant visit
 - A review of the regulations and existing literature
 - Testing recommendations
 - Communication with regulators to confirm issues
 - A process validation/challenge study (bench, pilot or commercial-scale)
 - Long-term research studies
 - Help navigating reconditioning proposals
 - **Ultimately, whatever might be needed....**

We've worked with

100+

companies.

Every problem will likely inform another one down the road.

Studying “rare” events

In established food production and processing systems, the detection of food safety and quality challenges are rare.

The key is grasping the context of the problem and proving/disproving theories using a combination of “in lab” and “at scale” approaches.

Rare event: Coliform detection in young Cheddar cheese

Why is this happening?

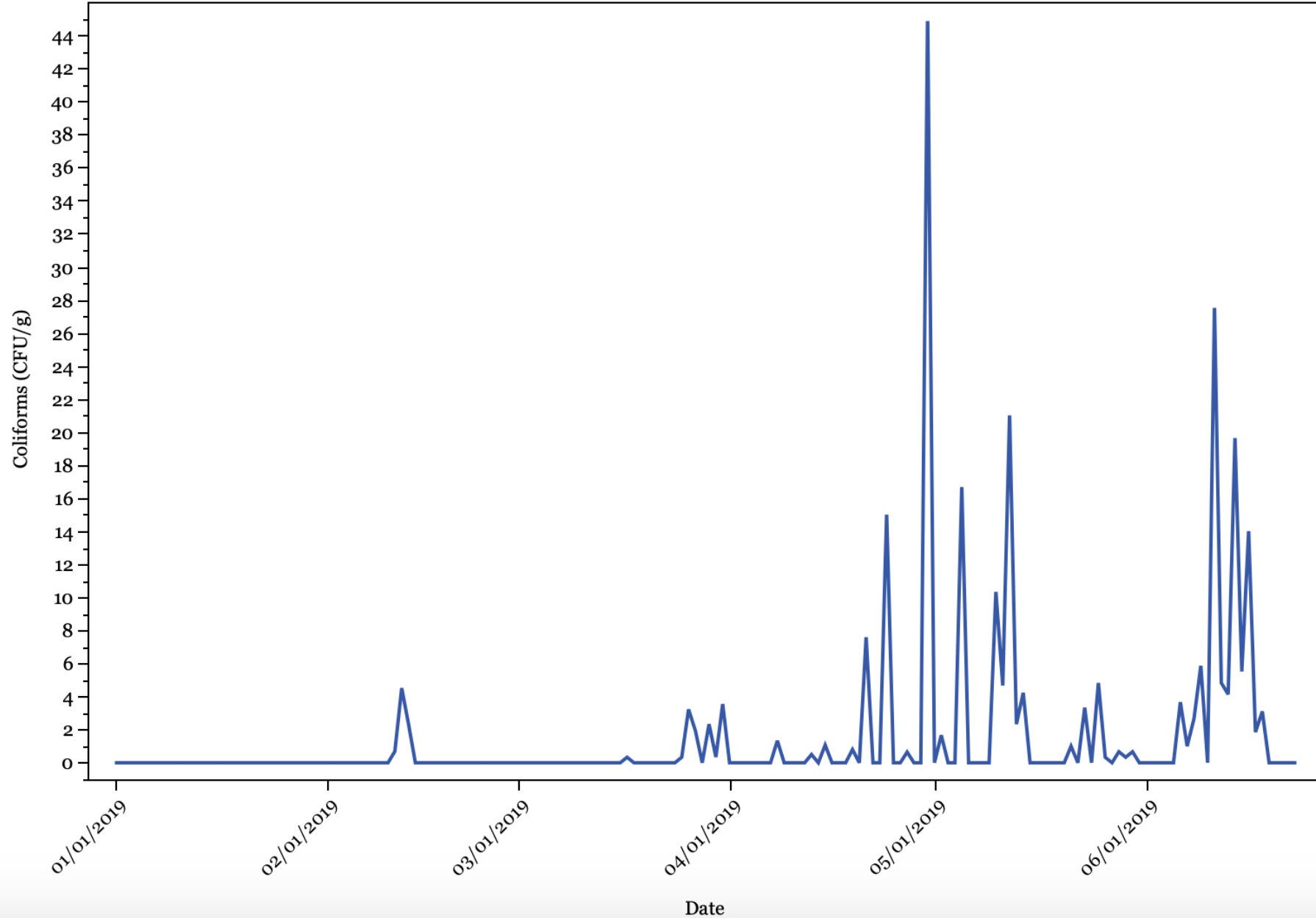


Brandon Selover, MS 2020
Research Associate
Xibus Systems

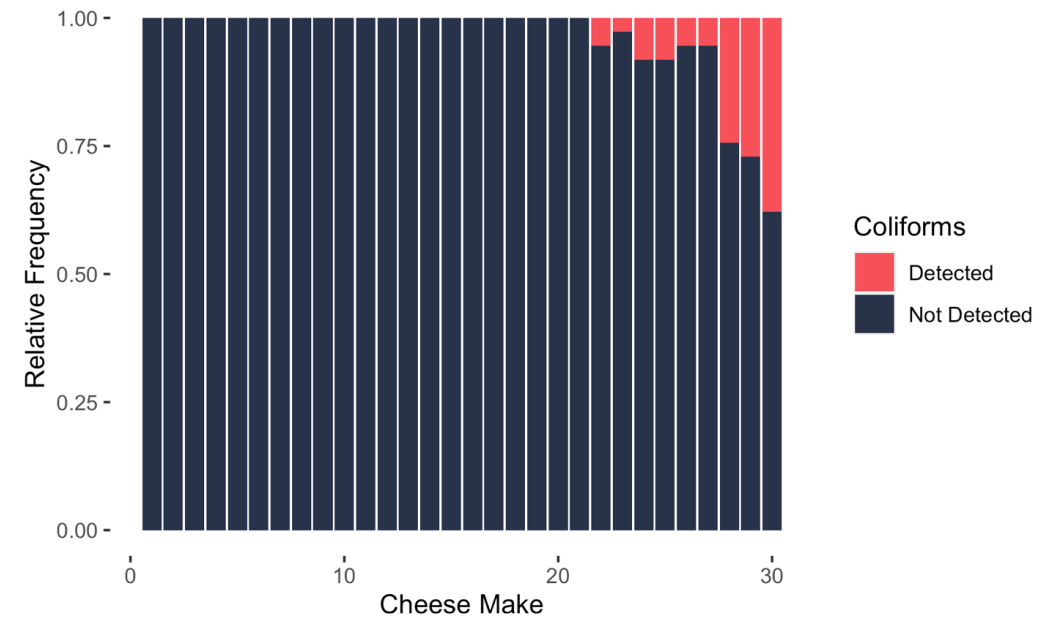
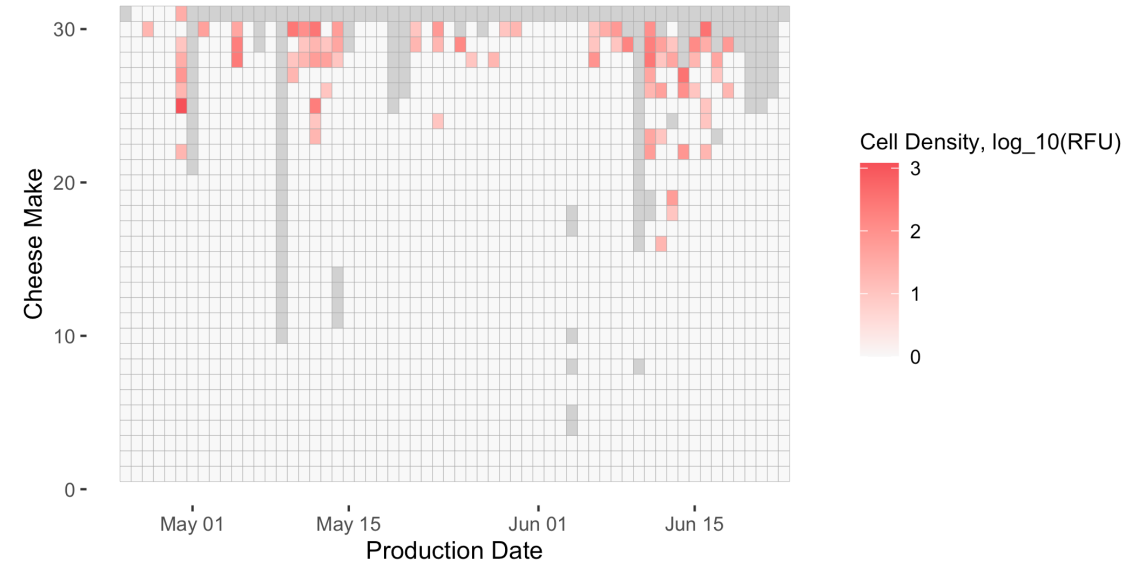
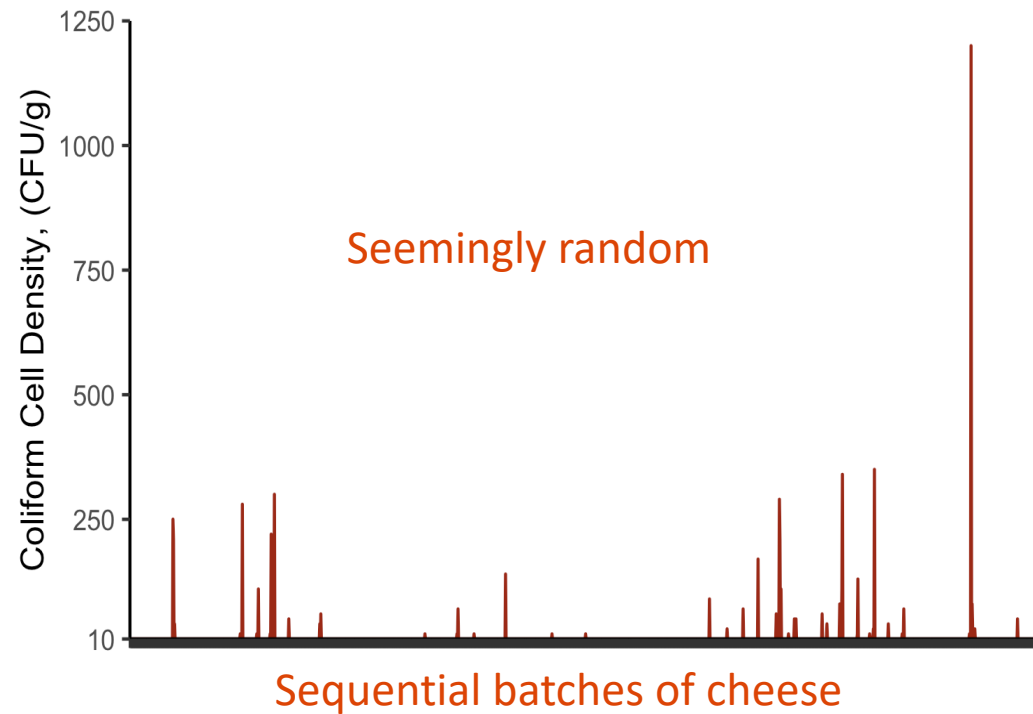


Jared Johnson, PhD 2021
Bioinformatician
Washington Dept of Health

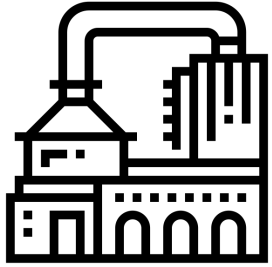
Company Problem Definition: Finished cheese has intermittent coliform contamination.



What first appeared random was not. Coliform detection was **always** later in the production day.

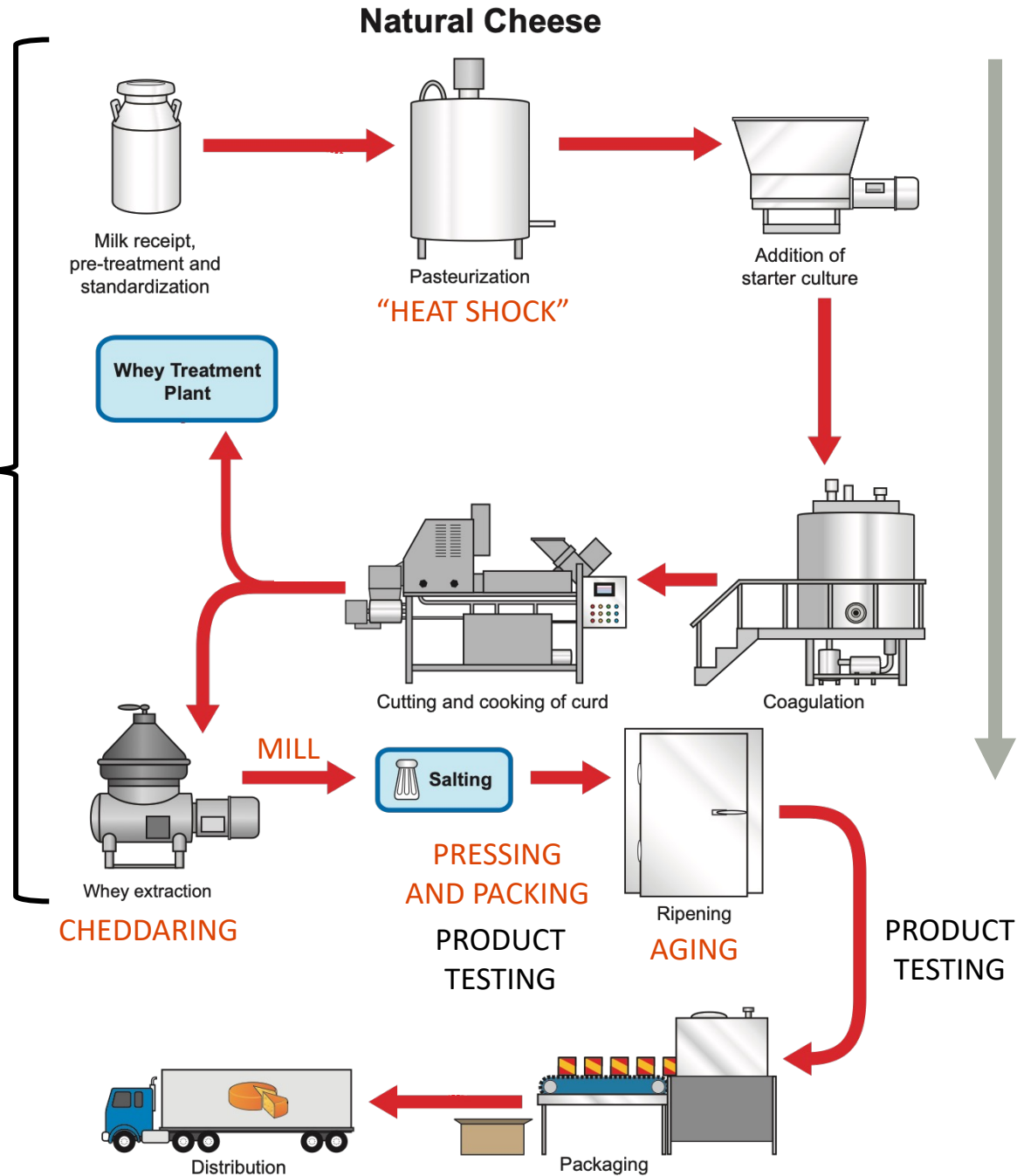


Coliforms are growing *somewhere* in the
process.



There isn't enough time for things to grow...or is there?

5 hrs

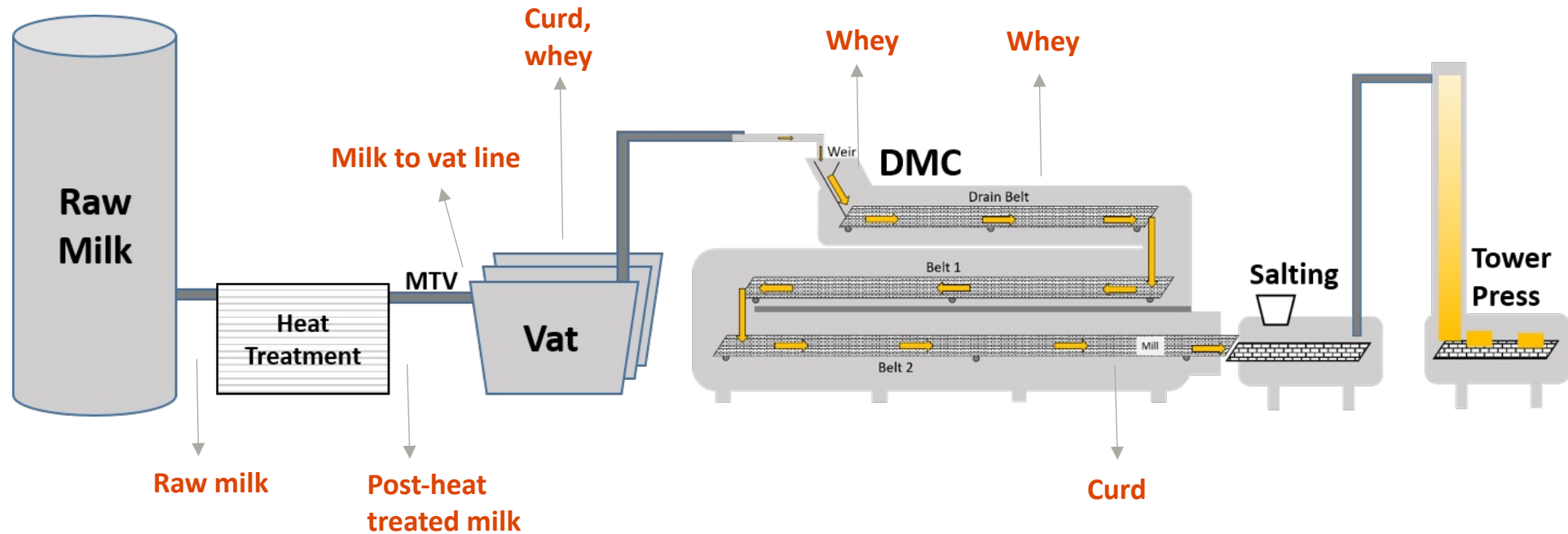


20 hour production day
30ish vats per day
4 hour sanitation shift
Midday clean

QUALITY DEFECTS DETECTED

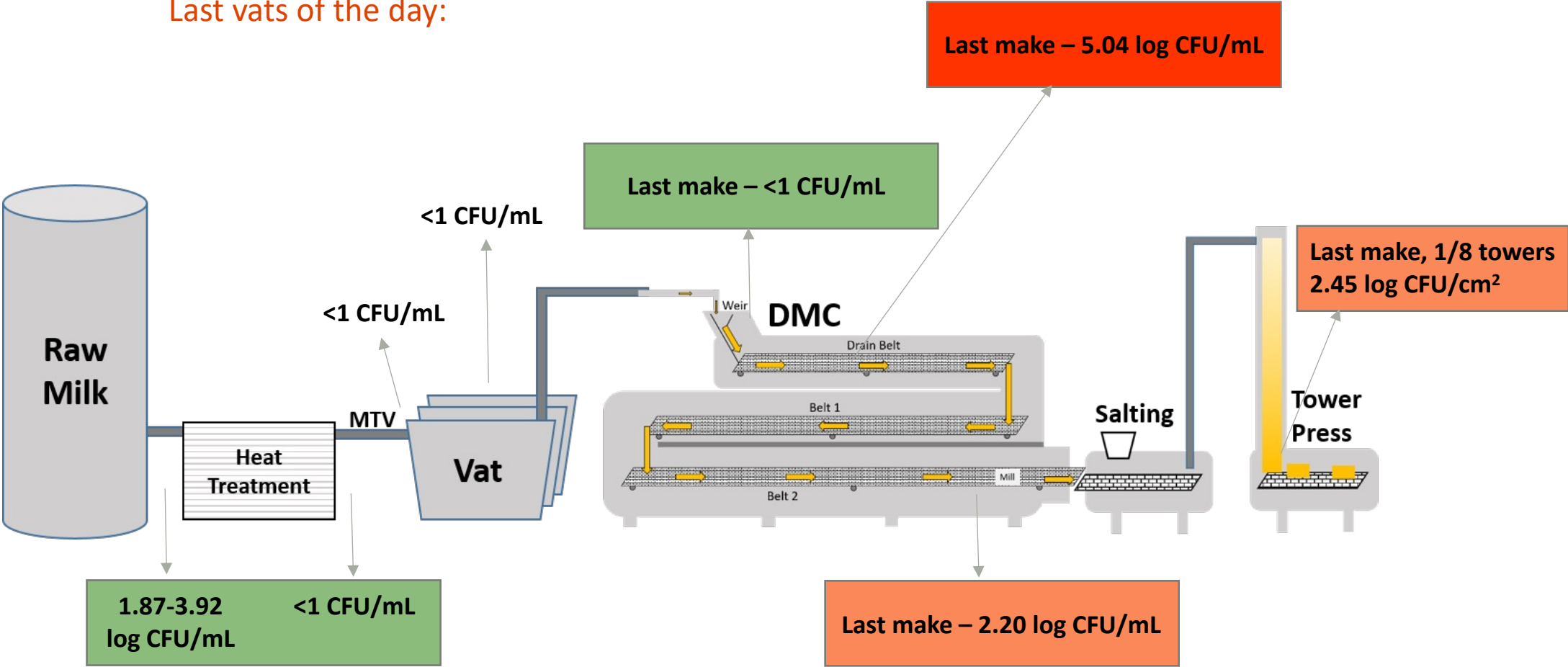
Investigative Sampling Strategy

Multiple times over multiple days and throughout production



Coliforms are only detectable in the DMC.

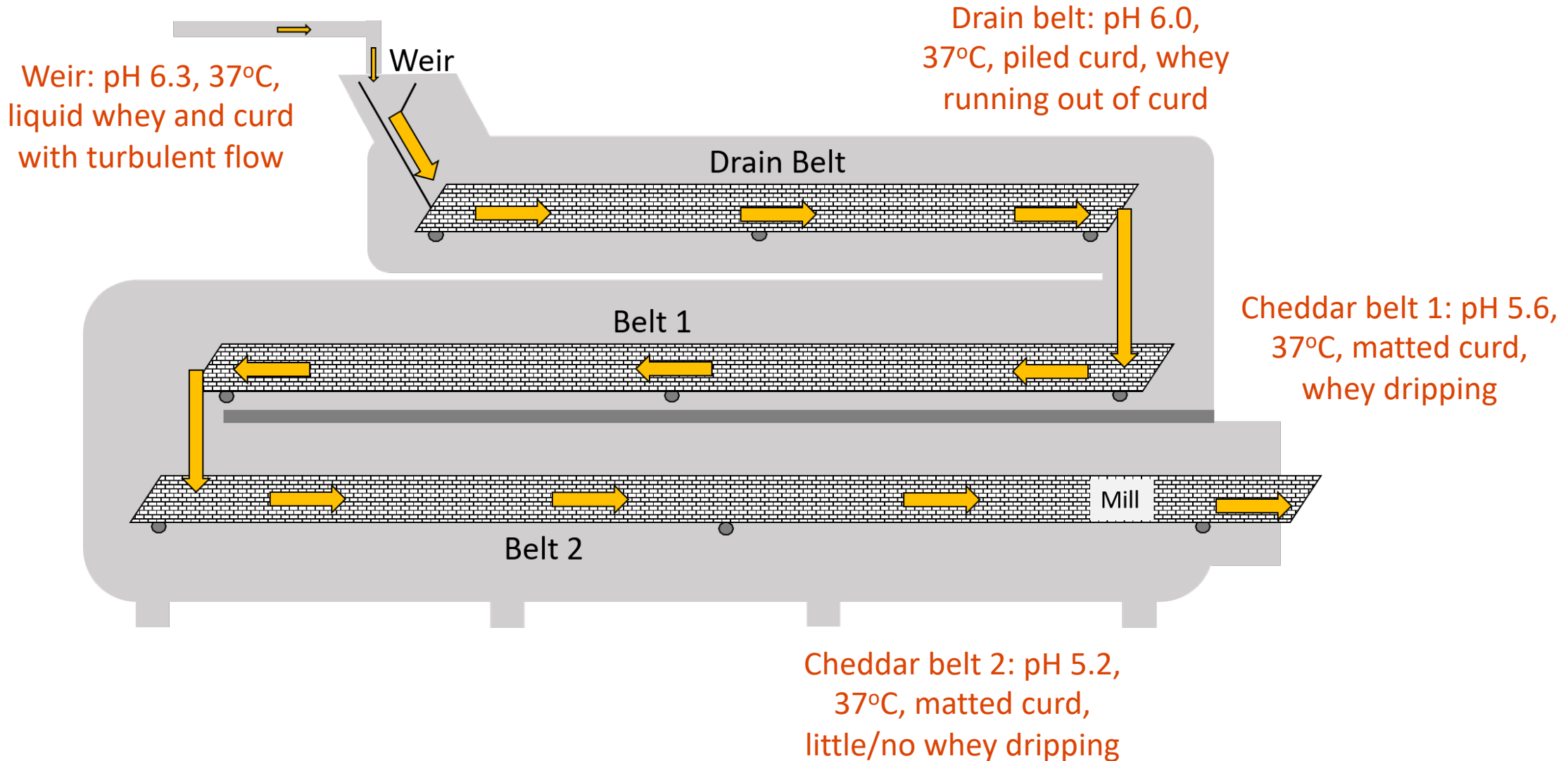
Last vats of the day:



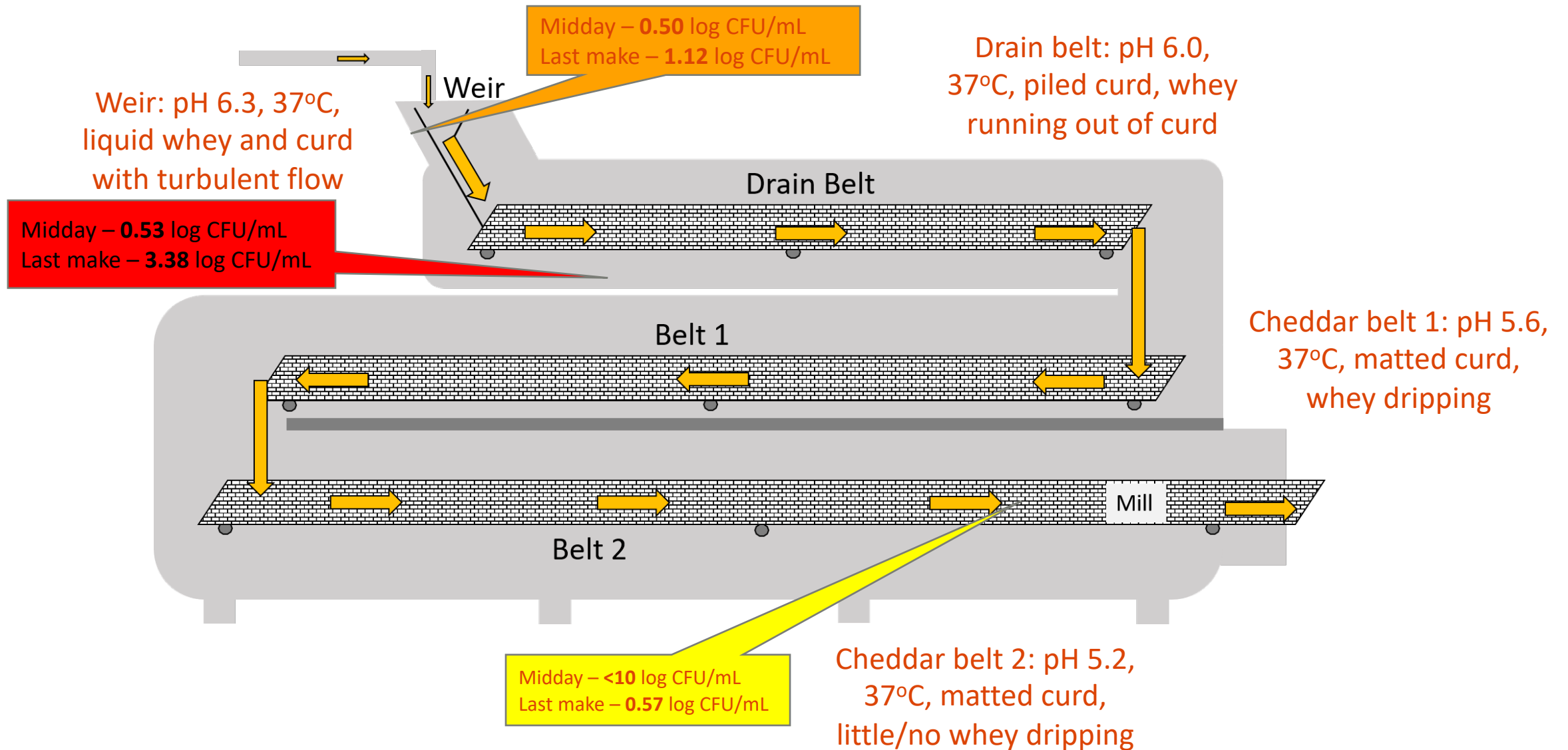
Heat treatment is effective.

A closer look at the DMC:

Product parameters differ at each production stage.



Coliforms grow in the drain belt section.



4 days of sampling in the DMC

Conclusion:

Coliforms grow in the drain belt section of the DMC during the production shift and contaminate subsequent cheese makes.

Mitigation options:

Reduce time between sanitation events.

OR

Eliminate source(s) of coliforms.

NEXT QUESTIONS

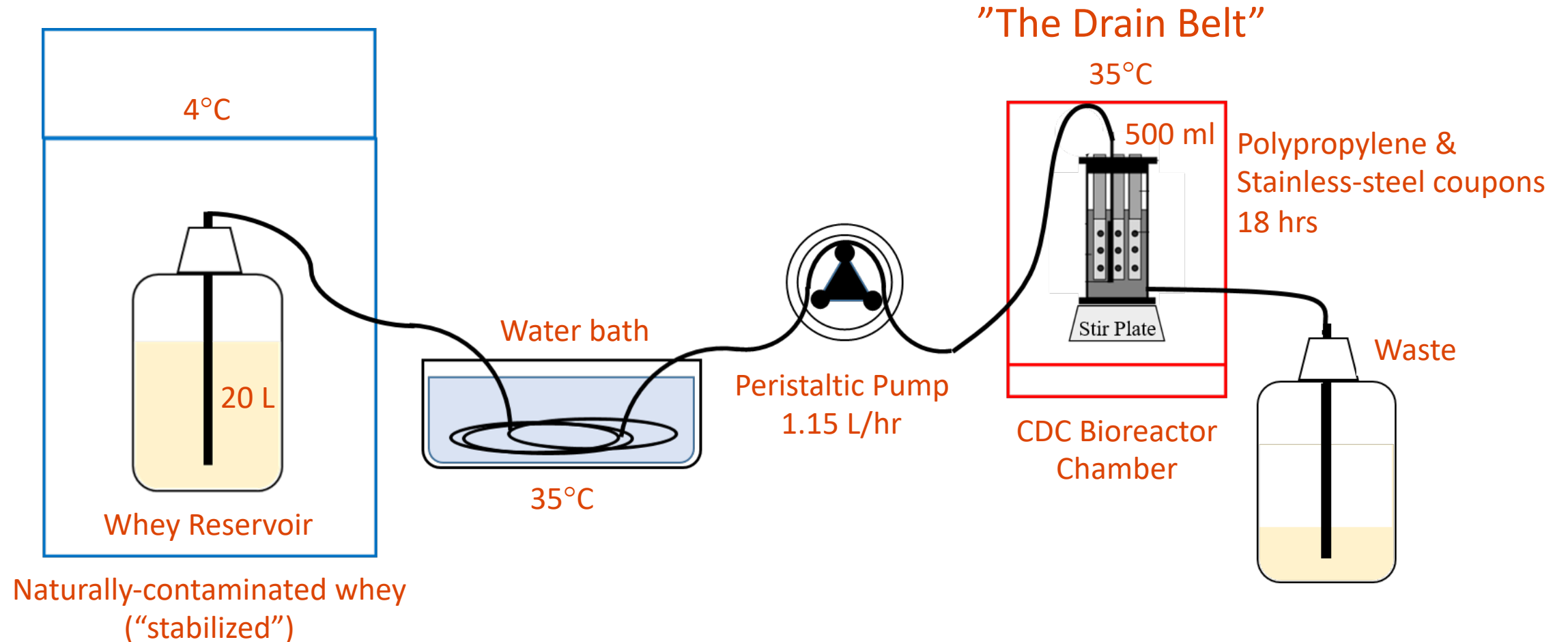
Where are all the coliforms coming from?

- Raw milk?
- Incomplete cleaning/sanitation?

Can they grow to sufficient cell density during a production day?

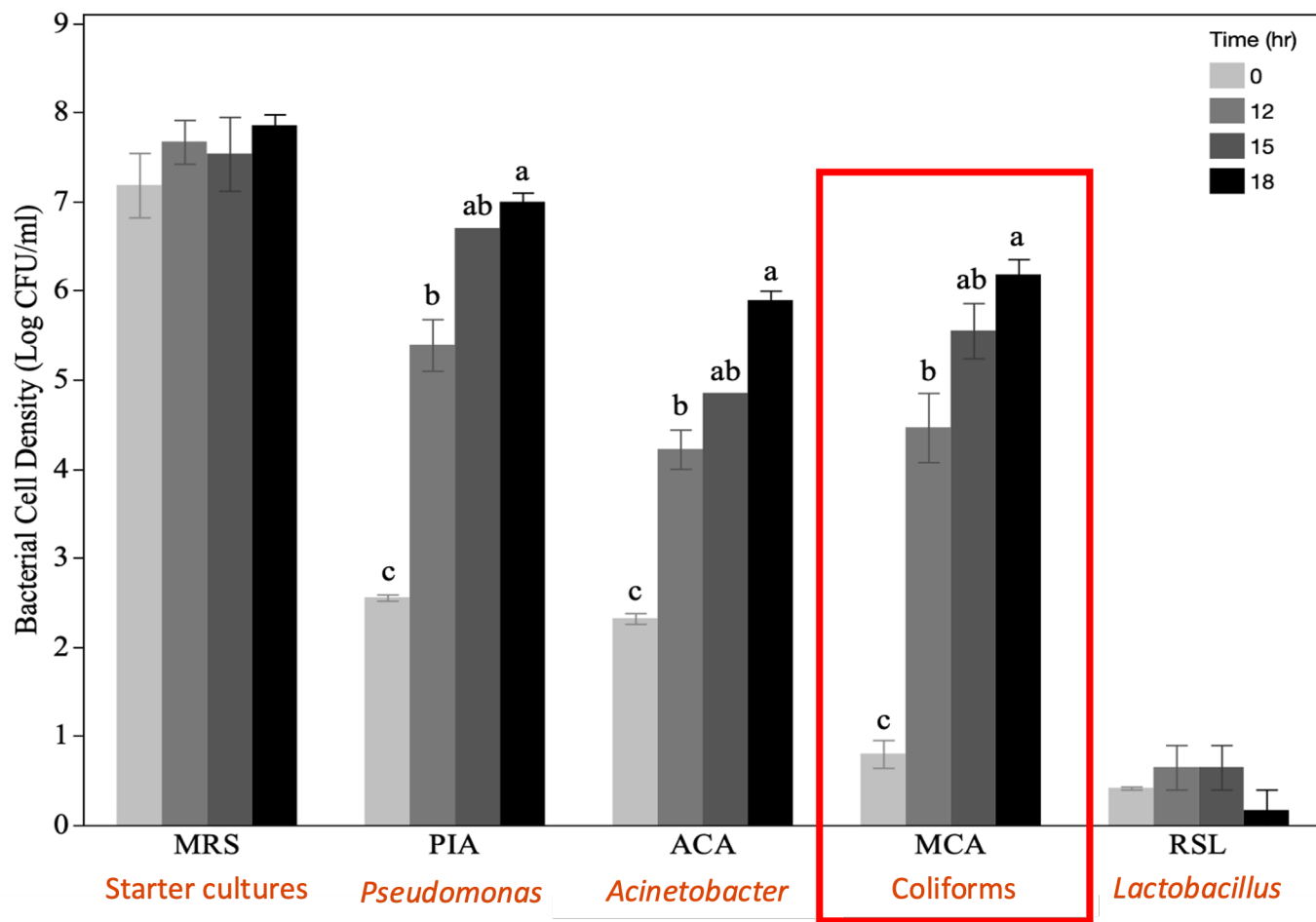
We can't separate these inputs in the "real-world".

Designing a lab-scale system to mimic the drain belt

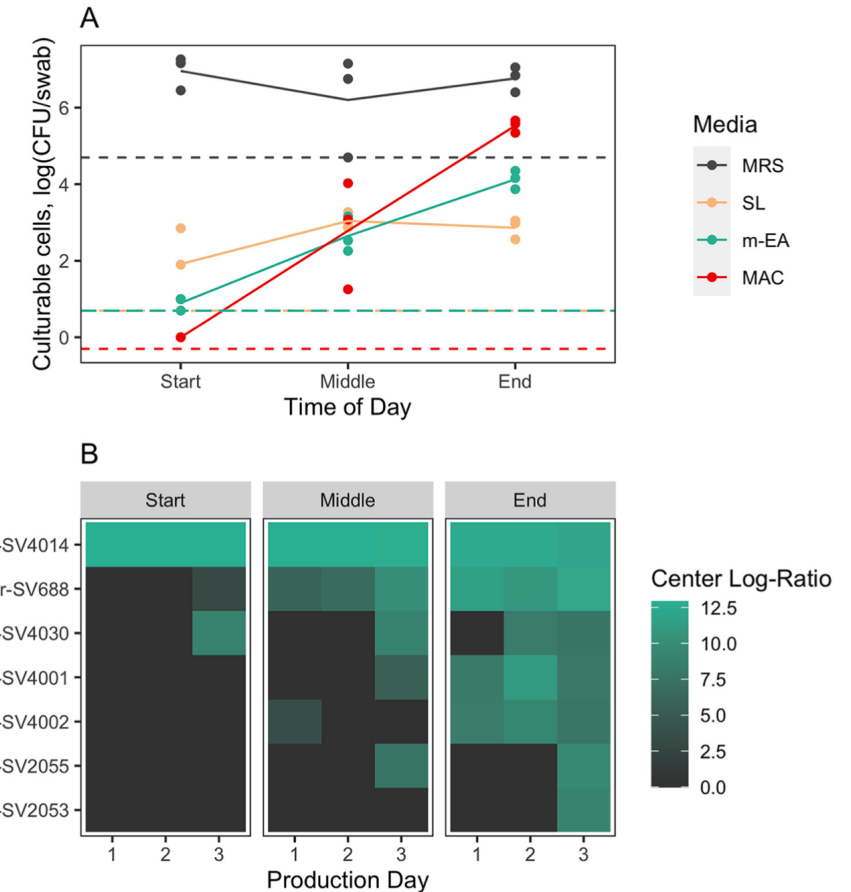


Coliforms can increase in the bulk whey within 18 hrs (among other bacterial subpopulations).

Model system (whey)



Commercial system (DMC swabs)



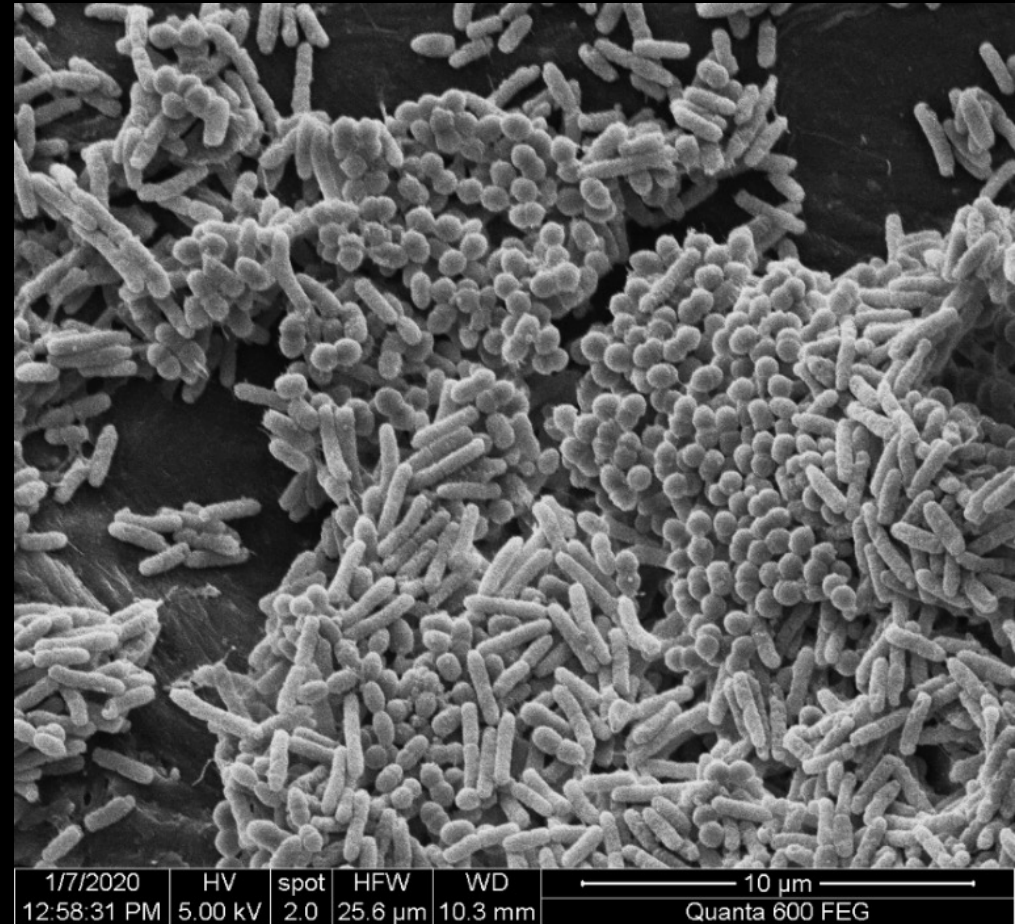
Bacteria attach and grow on polypropylene within 18 hrs.

12 hours



~4 log/coupon

18 hours



~5-7 log/coupon

Conclusion:

Low levels of coliforms on incoming whey/curds could seed the drain belt each day.

Mitigation option:

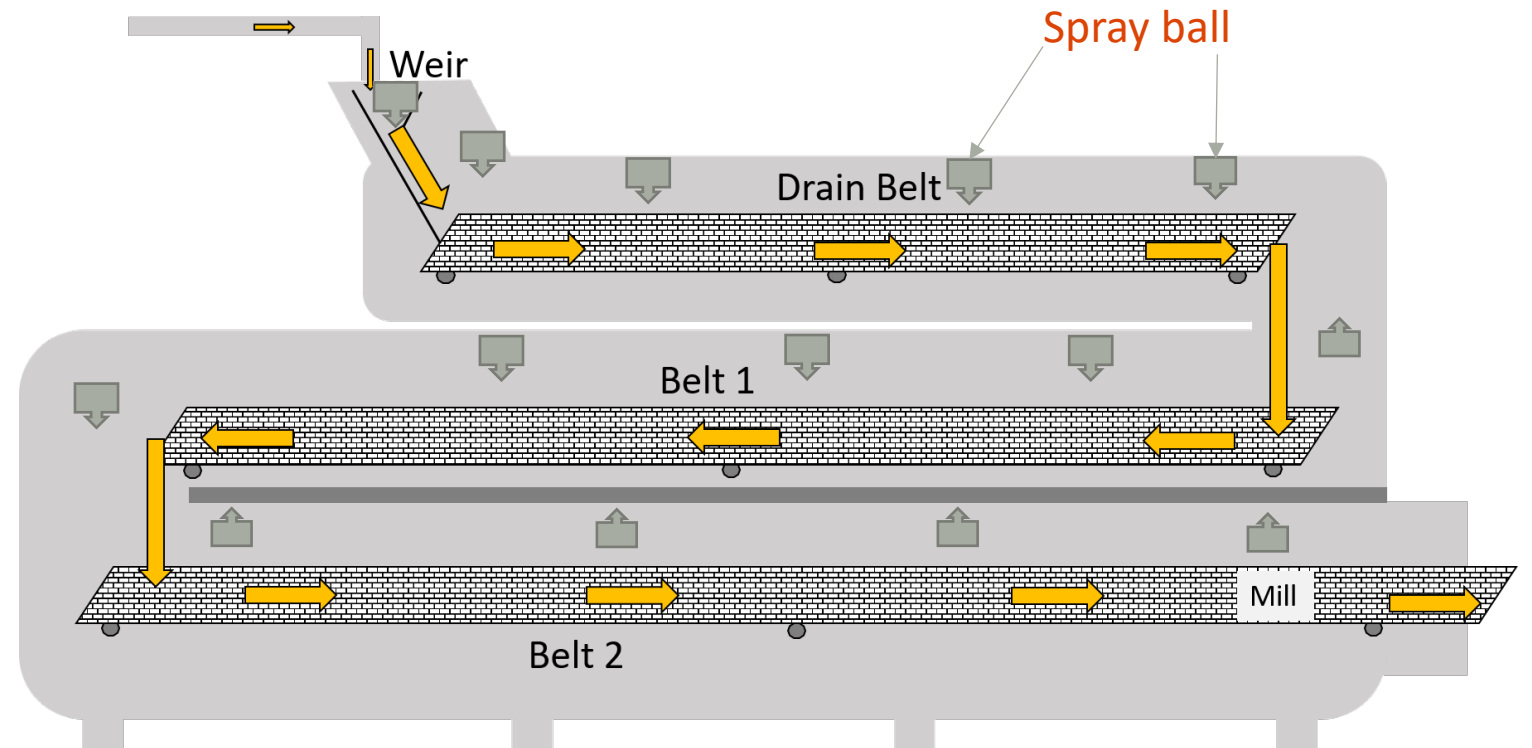
Increase heat treatment to further reduce coliforms before entering the DMC.

But is this the only source?

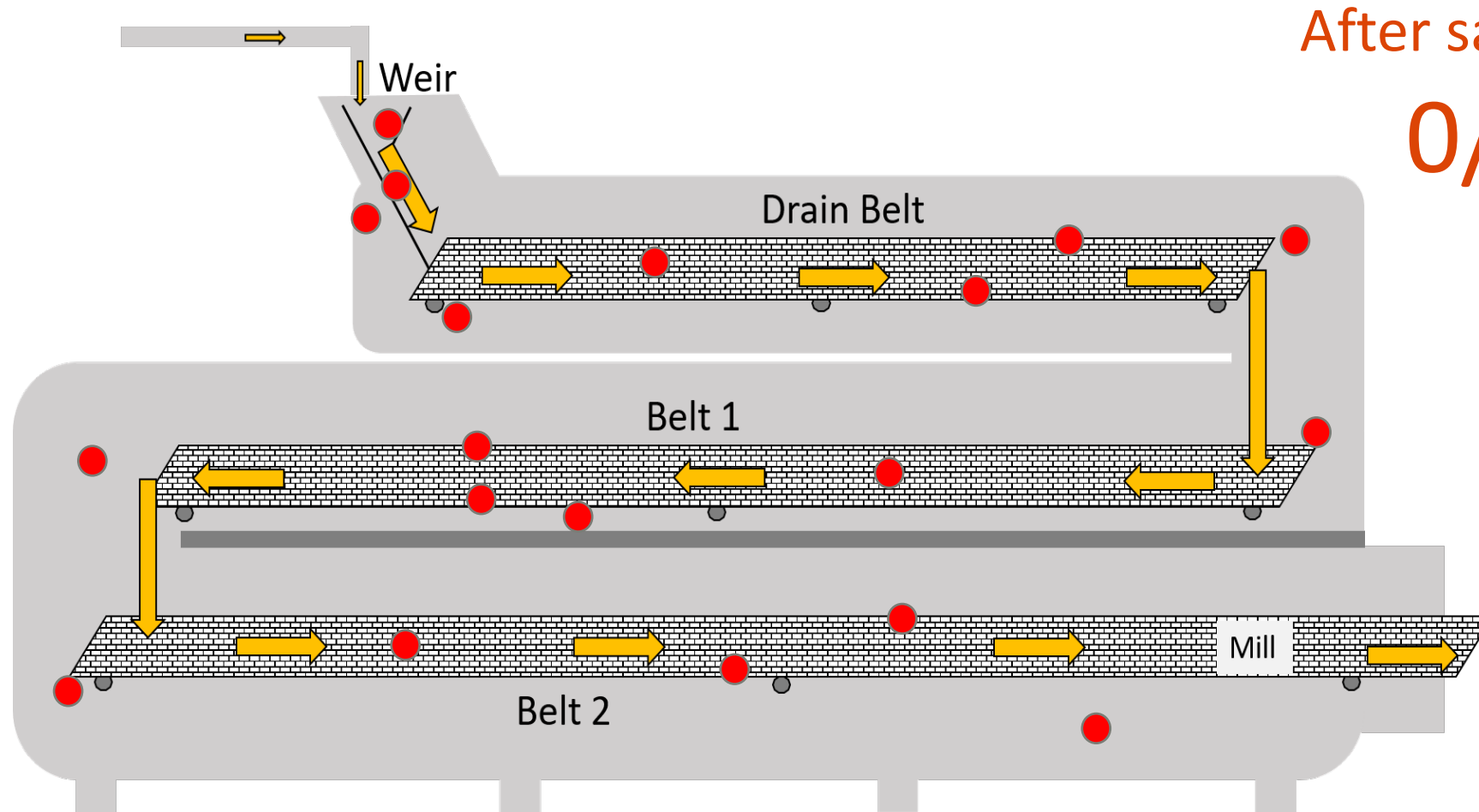
Could there be a harborage site in the DMC?

Clean-in-place sanitation

- Hosed out by workers
- CIP delivered via sprayers
- Caustic, detergent, sanitizer
- End of day (~18 h)



Does sanitation remove ALL of the coliforms?



After sanitation:

0/60

Belt sampling is limited by accessibility in the DMC.

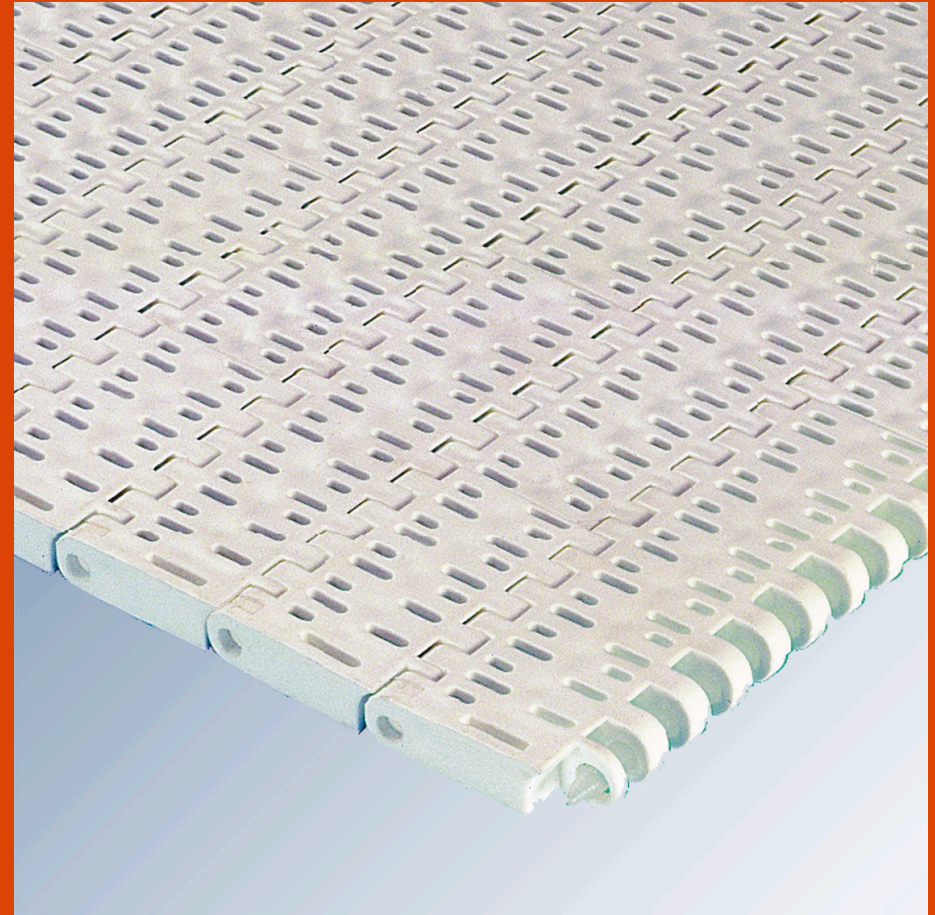


We needed a better way to sample the belt after sanitation.

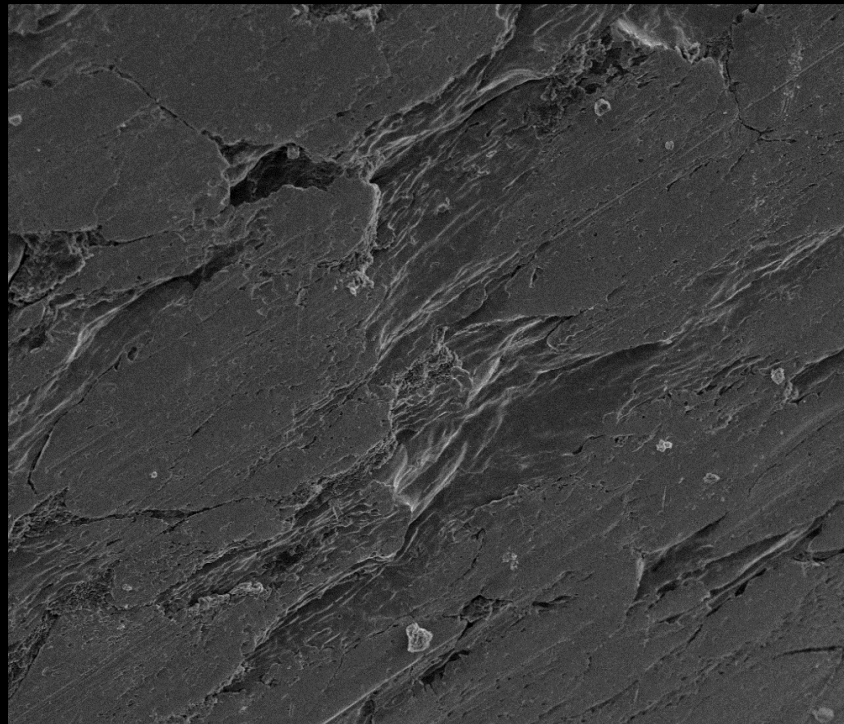
- The entire drain belt is replaced every few years.
- We lucked out and they replaced it in February.
- Collected belt pieces after sanitation.
- Enrichment and SEM.

22% (7/32)

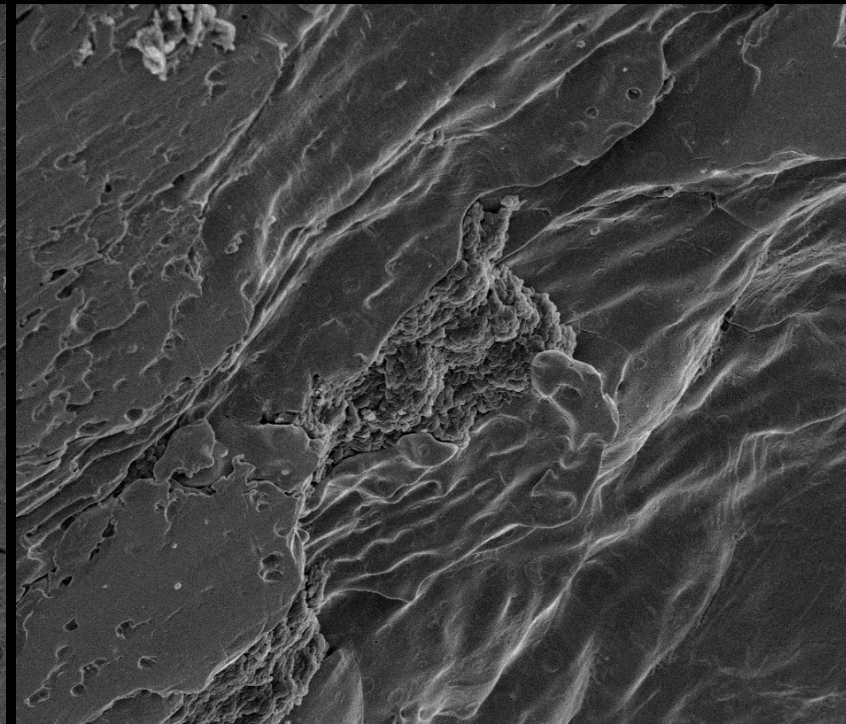
of belt pieces harbored coliforms after CIP.



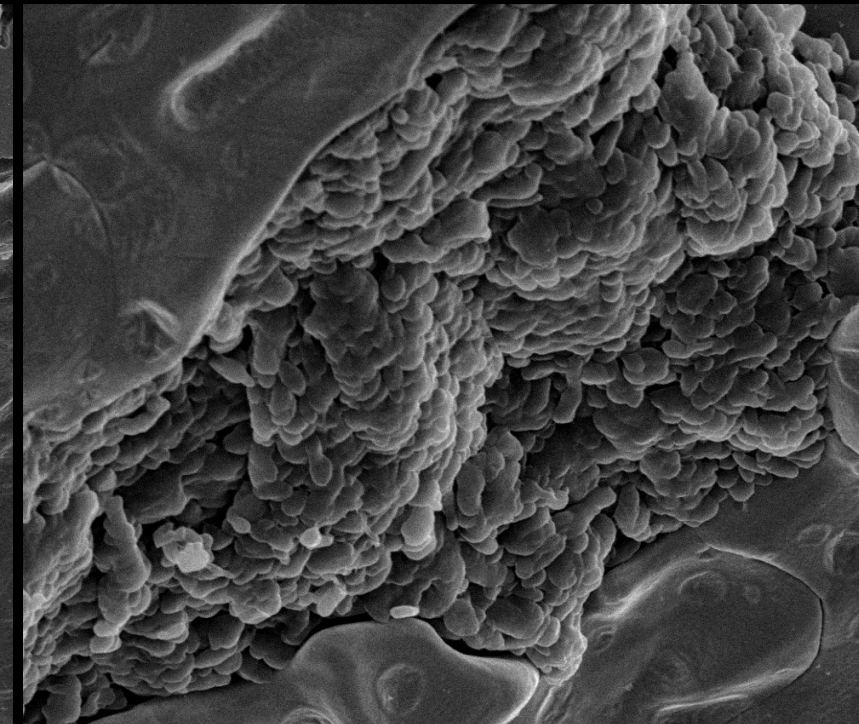
Bacteria are lurking in the belt.



5/9/2020	HV	HFW	spot	WD	50 µm
9:56:44 AM	5.00 kV	197 µm	2.0	15.1 mm	OSU Quanta 600



5/9/2020	HV	HFW	spot	WD	20 µm
9:55:56 AM	5.00 kV	51.2 µm	2.0	15.1 mm	OSU Quanta 600



5/9/2020	HV	HFW	spot	WD	5 µm
9:54:02 AM	5.00 kV	12.8 µm	2.0	15.1 mm	OSU Quanta 600

Coliforms are NOT
the only bacteria
lurking in the belt....

Enterobacter

Bacillus

Stenotrophomonas

Pseudomonas

Streptococcus

Acinetobacter

Lactococcus

Klebsiella

Staphylococcus

Achromobacter

Escherichia

Enterococcus

Conclusion:

Coliforms are surviving CIP in the drain belt section of the DMC.

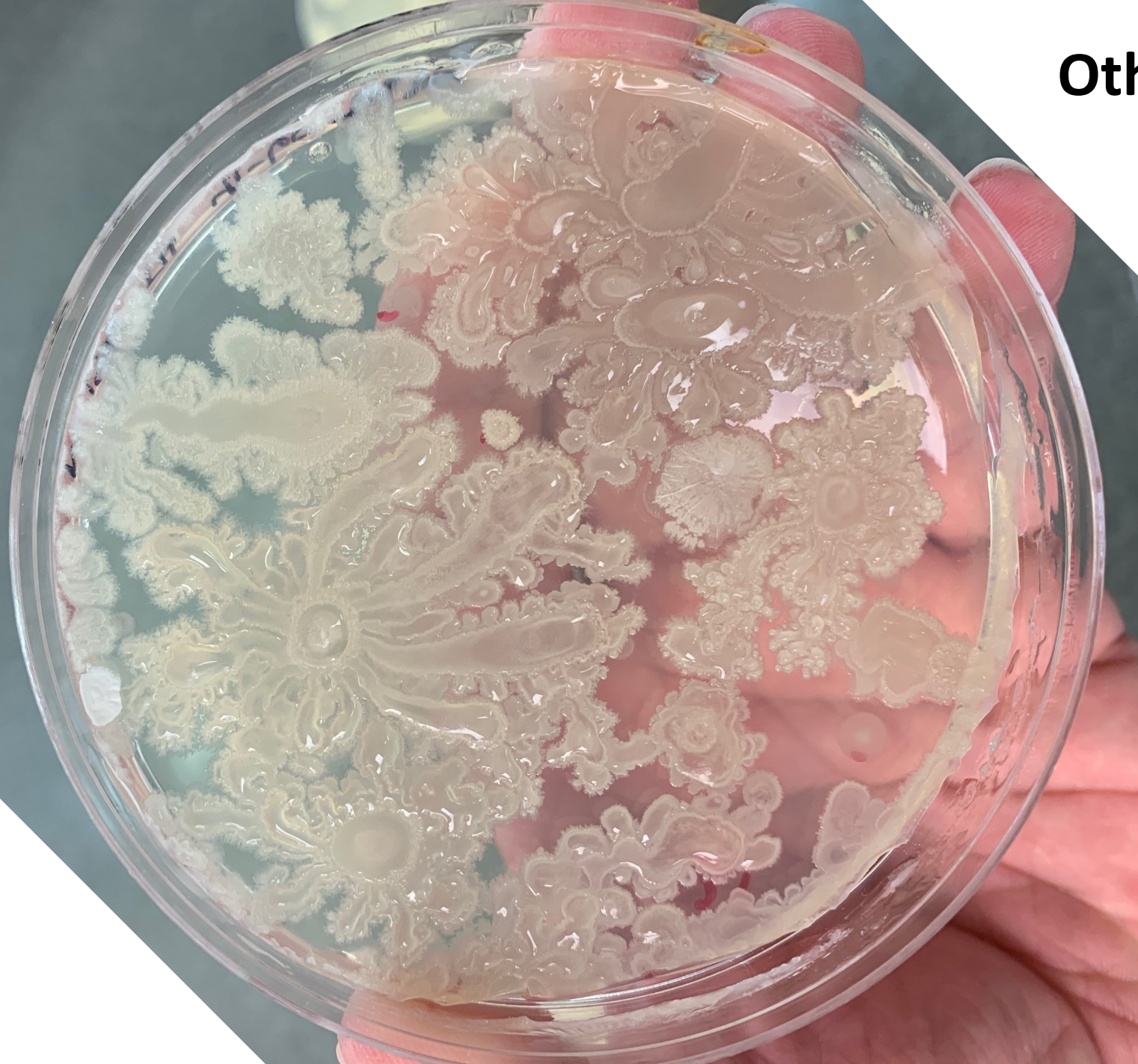
Mitigation options:

Enhanced CIP and/or more frequent belt replacement.

The big takeaway:

Microbial problems always have a cause.

And the OSU Food Safety Squad **LOVES**
trying to figure it out!



Other microbial curiosities in dairy systems:

“Late blowing” in semi-soft cheeses

Rework practices and milk spoilage

Sporulation during powder production

“Band-Aid” chocolate milk

Sock filter management and raw milk quality

Color loss in strawberry milk

Thank you for your attention.



A huge thank you to

**BUILD
DAIRY**

And numerous industry partners!

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Department of Food Science & Technology

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