Effects of mastitis in dairy cows on milk quality and composition

The economic losses caused by this disease in dairy farming

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Key Real-World Facts about Mastitis:

Estimated to cost the global dairy industry 19.7 – 32.0 billion US$/yr

Estimated average cost of a single clinical mastitis case (in GBP, USD and RWF) *(Ref slide 23)*

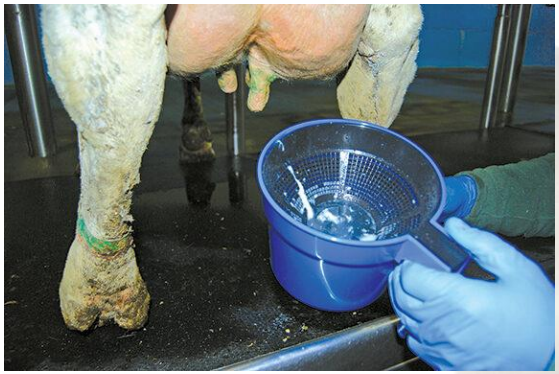
GBP: £249 *USD: $336* *RWF: 469,614*

Effects of mastitis in dairy cows on milk quality and composition

- What is mastitis?
- Clinical or sub-clinical?
- Why is mastitis important?
- Milk quality around the world?
- How can mastitis be reduced?

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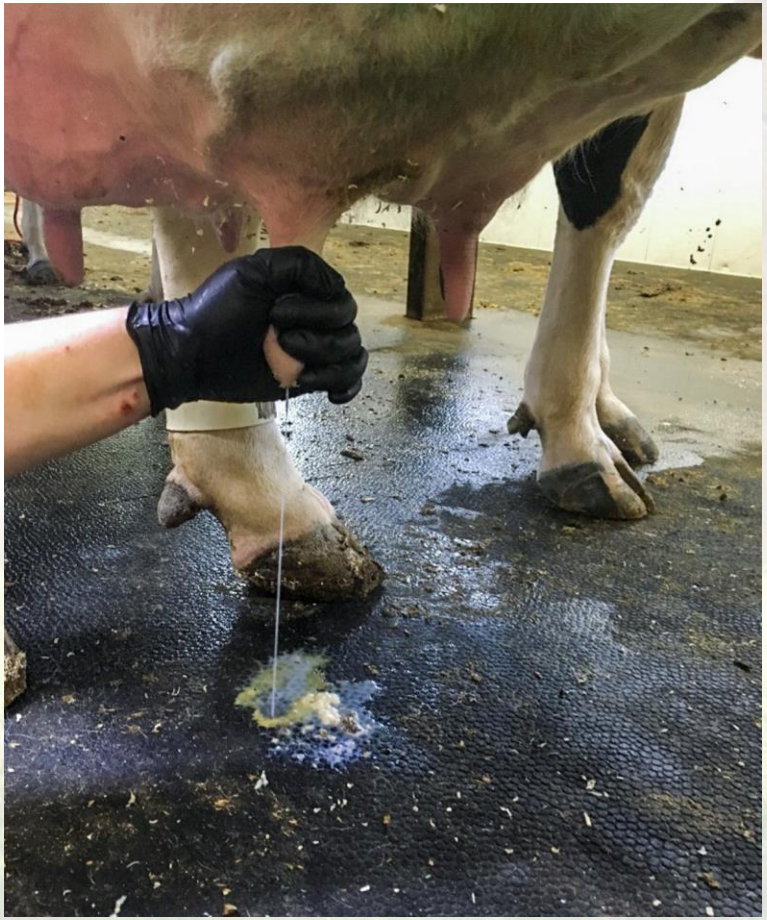
What is mastitis?





- Bacterial invasion of the bovine udder through the teat canal.
- Depending on the bacterial pathogen and the number of bacteria present, infections can be classed as clinical or sub-clinical.

Clinical infection



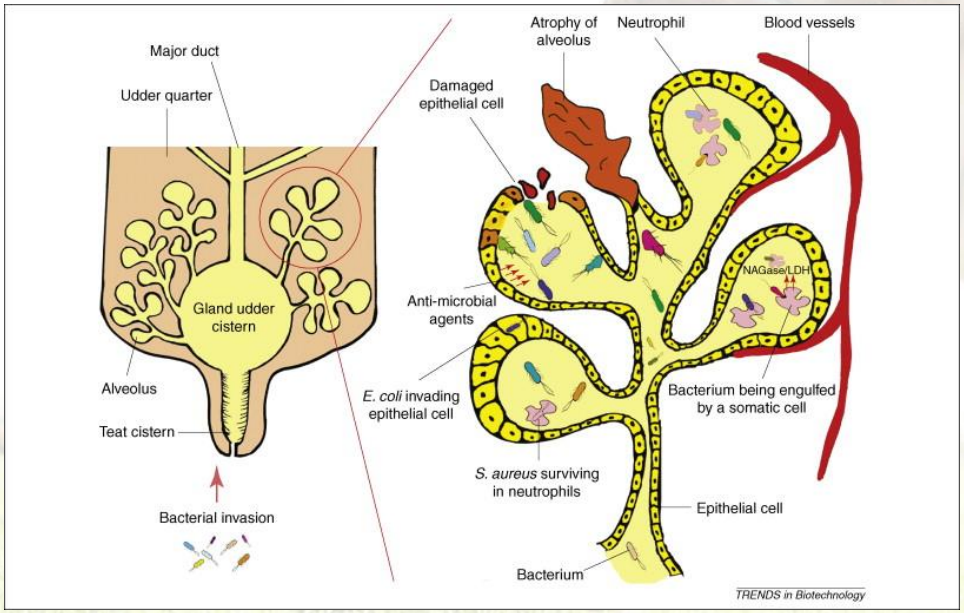
- Cow exhibits definitive symptoms:
  - Udder
    - Swelling
    - Heat
    - Hardness
    - Inflammation
    - Pain
  - Milk
    - Watery appearance
    - Flakes
    - Clots
    - Pus
    - Pathogens can be isolated

Sub-clinical infection



- Cow exhibits no definitive symptoms:
- Udder
  - No noticeable change
- Milk
  - Milk looks completely normal
  - Pathogens can be isolated
  - Somatic cell count
    > 200,000 cells/ml

Immune response and Somatic cells



- White blood cells (leucocytes) enter alveoli and milk ducts from the blood in response to bacterial invasion.
- Leucocytes envelop and destroy the pathogens
  - Numbers of white blood cells related to size of the challenge.
  - Numbers of white blood cells reported as Somatic cells (SCC)

Mastitis

Why is it important?

- Painful and distressing disease for cattle
- Reduces milk yield
- Adversely effects product quality
- Potential food safety concerns
- Premature culling
- Cost of treatment
- Milk quality penalties
- Impacts farmer income

Mastitis is a painful condition



- Detection complicated by stoic nature of cows
  - Visible signs of pain (touch response & adjusted stance)
  - UK survey of veterinary surgeons scored pain suffered by cows on a scale of 1 – 10
    - Severe mastitis = 7
    - Mild mastitis = 3
  - Pain reduces the ability to express normal behaviour

Petersen Wolfe 2012, Vet.Clin. Food Admin 28, 289-305
Fitzpatrick.C.E. 2013 JDS Vol 96 2847 - 2856

Impact of clinical mastitis on milk yield

- Early lactation – yield drop of 6%
- Mid lactation – yield drop of 5%
- Late lactation – yield drop of 4%

- M A Purto *et al*. (2021). The hidden cost of disease: I. Impact of the first incidence of mastitis on production and economic indicators of primiparous dairy cows. J Dairy Sci., 104, pp 7932 - 7943

Influence of SCC on milk yield

Uninfected quarter considered to have a SCC < 200,000 cells/ml.

- SCC – between 200,000 – 400,000 cells/ml milk yield reduced by 10.15%
- SCC – between 500,000 – 600,000 cells/ml milk yield reduced by 11.92%

F C Ferreira *et al.* (2022). Do you know the cost of one case of clinical mastitis for your herd? https://www.agproud.com/articles/54258-do-you-know-the-cost-of-one-case-of-clinical-mastitis-for-your-herd

Influence of SCC on milk yield

- Milk yield depression increases between parity 1 and 4. Older cows suffer greater yield depression.
- Higher yielding animals are impacted to a greater extent.

H Hogeveen (2019). Production Diseases Reduce the Efficiency of Dairy Production: A Review of the Results, Methods, and Approaches Regarding the Economics of Mastitis. Annual Review of Resource Economics, **11**, 289-312

Impact of SCC on cheese



- SCC over 200,000 cells/ml will affect the yield of cheese.
- Each incremental increase in SCC of 100,000 cells/ml above 200,000 cells/ml will reduce cheese yield by around 1%.
- Increase in rennet clotting to cutting time.
- Development of off-flavours and texture

Pers.communication : Specialist Cheesemakers Association
https://www.specialistcheesemakers.co.uk/about.aspx

Effect of mastitis on milk composition

Increasing SCC leads to a decrease in:

- Lactose
- Fat
- Protein

But an increase in:

- Sodium
- Chlorine
- Electrical Conductivity

Influence of clinical mastitis on milk bacteriological quality



- Clinical mastitis will significantly increase total bacterial count (TBC) of milk.
- This can impact the shelf life of un-pastuerised milk products.
- Some mastitis pathogens are thermoduric and their toxins can negatively impact UHT products.

Economic impact of mastitis and SCC



- Affected by the severity of the disease, cow's milk yield and the stage of lactation.

When considering costs:

- Milk yield
- Milk price
- Premature culling
- Veterinary costs
- Milk quality penalties

Economic impact of mastitis and SCC

- Considered the most important and expensive disease of the dairy herd.
- Estimated to cost the global dairy industry 19.7 – 32.0 billion US$/yr*
- Barrier to imports (USA <750,000 cells/ml & EU < 400,000 cells/ml)
- Generally, levels of SCC are easier to determine than clinical prevalence.
- Recording of clinical mastitis is a considerable barrier to monitoring levels and driving improvements.

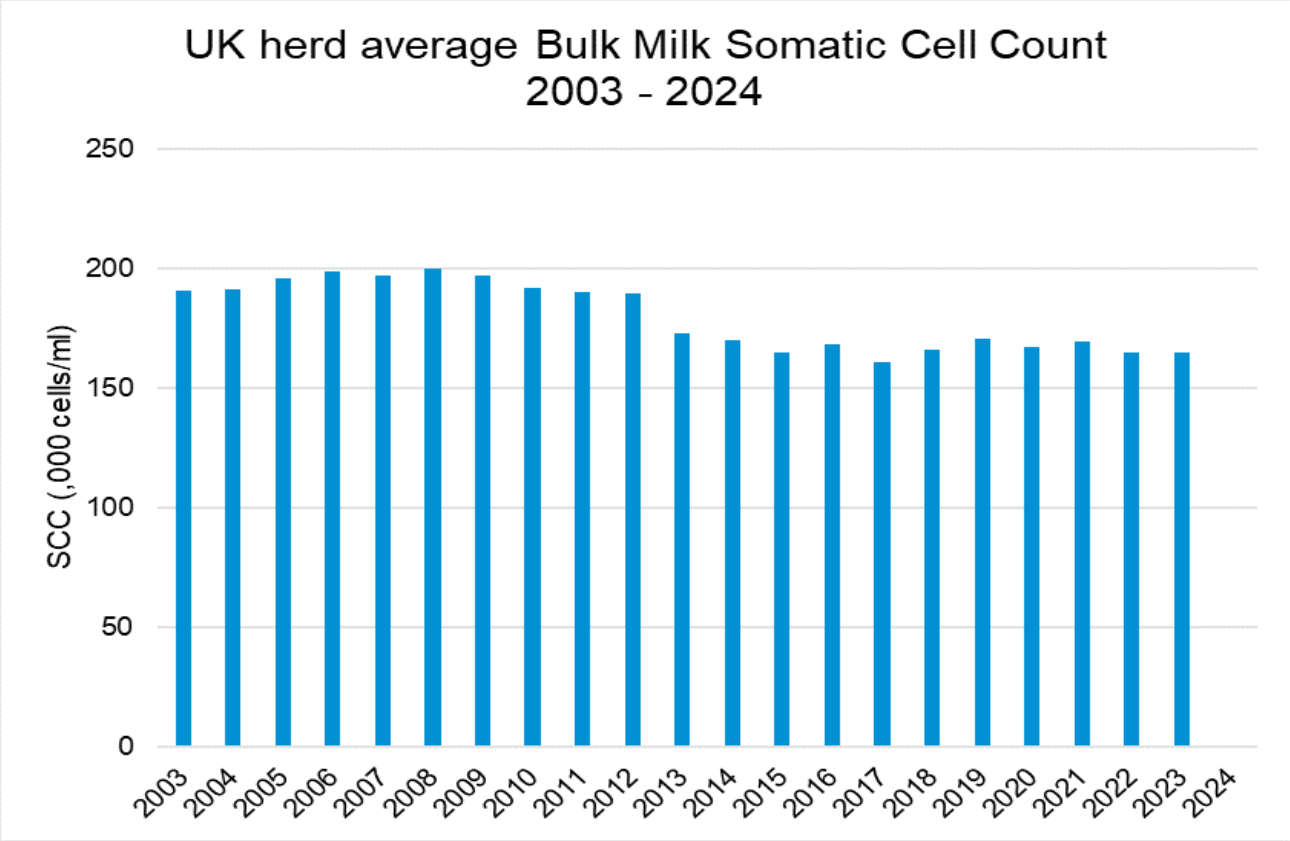
*Moredun Research Institute 2022

Example National SCC levels

Country	Year	Annual mean (´000 / ml)
Australia	2022 / 2023	164
Finland	2023	136
Republic of Ireland	2023	190
United Kingdom	2024	155
Belgium	2022	194
Brazil	2021	466
Canada	2022	171
Denmark	2023	176
Italy	2022	227
USA	2022	169

1. NMC Annual Conference 2025, Charlotte, North Carolin

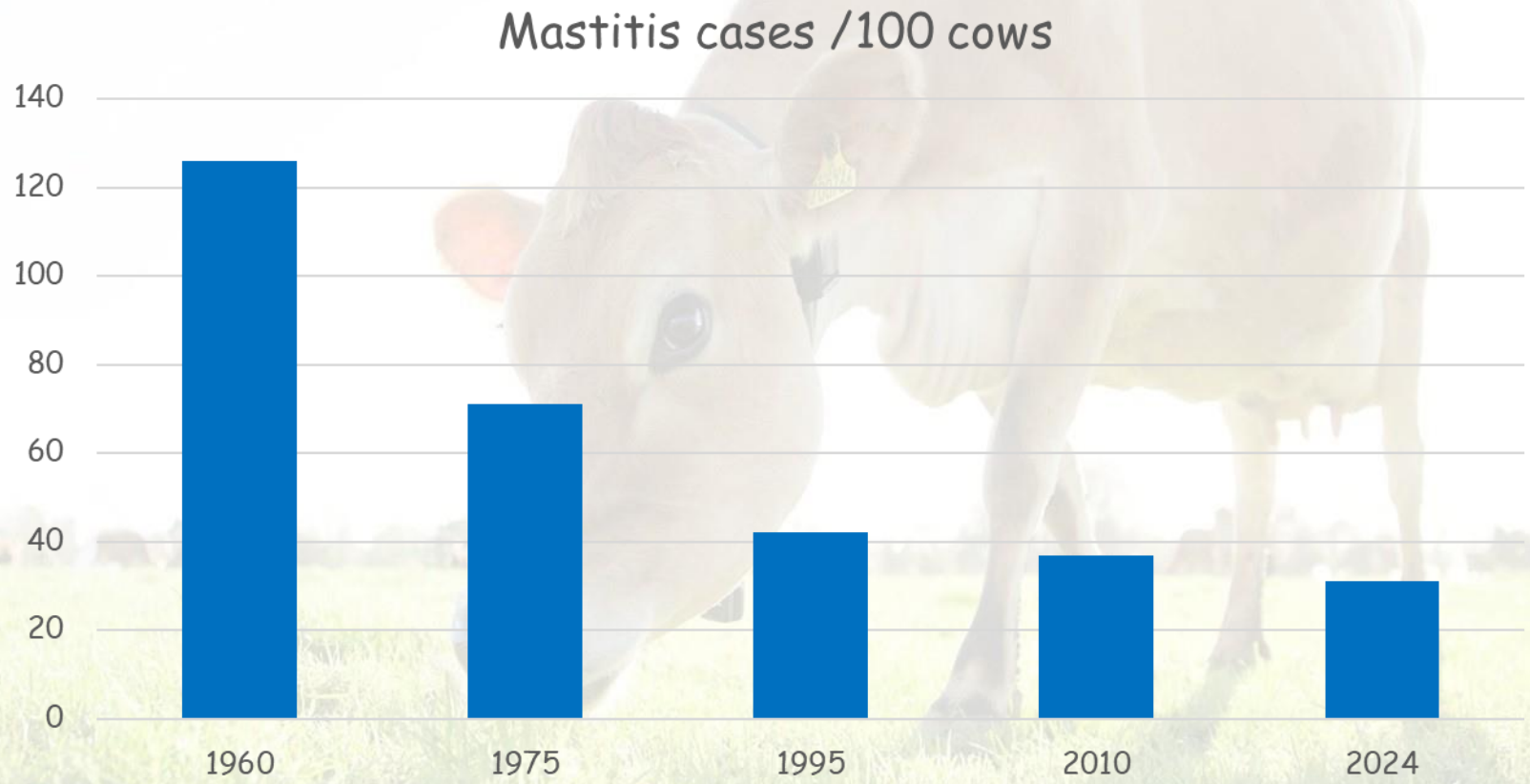
UK herd average SCC



AHDB (2025) https://mastitiscontrolplan.co.uk/the-uk-situation

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UK Clinical mastitis



AHDB Dairy National Mastitis Control Plan

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Economic impact of mastitis and SCC

- Lost milk sales.
- Severity (mild , moderate, severe, fatal).
- Antibiotics and other treatments.
- Milk price.
- Time.
- Veterinary costs.
- Increased culling.
- Fatalities.
- Loss of genetics.

Wide disparity between countries in cost of mastitis

- Milk price
- Milk yield
- Labour costs
- Veterinary costs
- Value of cull cattle
- Cost of rearing a replacement

Estimated average cost of a single clinical mastitis case (£ and RWF))

Country		£	USD	RWF
UK		230	311	433,780
Ireland		218	294	411,148
Italy		238	321	448,868
USA		286	386	539,396
Australia		210	284	396,060
Denmark		312	421	588,432

NMC January 2025 –Milk Quality around the world

Milk Quality Challenges



- Farm level
- Milk transporters
- Milk Collection Centres
- Milk Transportation

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Farm level



- Detection of abnormal milk
  - Pre-milking suckling
  - Fore milking
  - California mastitis test

Farm level





- Detection of abnormal milk
  - CMT tests (commercial or local detergents)
  - Fore-strip cups to detect clots
  - Exclude milk that is abnormal
- Milk quality based payment scheme?

Cleaning of milking containers







- Plastic containers commonly used.
- Cleaning often relies on cold water and liquid soap.
- Water either captured roof water or river water.
- Provide training and support to recognize the value of hot water and liquid sanitisers (detergent and disinfectant).
- Air drying after cleaning.

Milk Collectors





- Milk collectors travel between multiple farms.
- Milk from multiple farms mixed in single container.
- Duration of the collection run and heat gain.
- Containers often only rinsed at the Milk Collection Centre (MCC).
- Financial risk sometimes remains with the collector.

Milk Collectors



- Milk collectors keen to 'first sift' milk before accepting.
- Pilot project - milk collectors' issued with a testing kit.
- Trained to examine milk:
  - Visible debris
  - Abnormal smell
  - Density
  - Rancidity (alcohol test)
- Reject abnormal milk.

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Milk testing at Milk Collection Centres

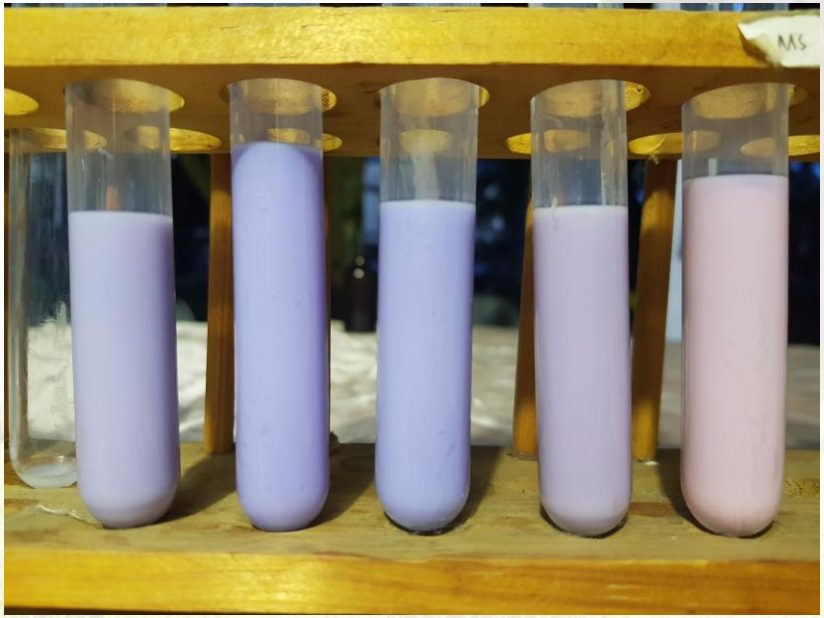
Test	Sample
Visual appearance	Individual container
Smell	Individual container
Alcohol Test	Individual container
Density Test	Individual container
Antibiotic test	Composite sample
Resazurin Test	Composite sample

Resazurin testing



- Historically often only done on the bulk tank prior to transportation.
- Impossible to identify an individual poor quality milk container.
- Largest cause of milk rejection by processors.

Resazurin testing



- When bacteria grow in milk, they use up the oxygen present.
- Certain chemical dyes such as Resazurin change colour according to the amount of oxygen present.
- The change in colour depends on the number of bacteria present in the milk.
- The Resazurin test is a rapid (10-minute) test to indicate the bacterial quality of the milk.

Resazurin testing interpretation

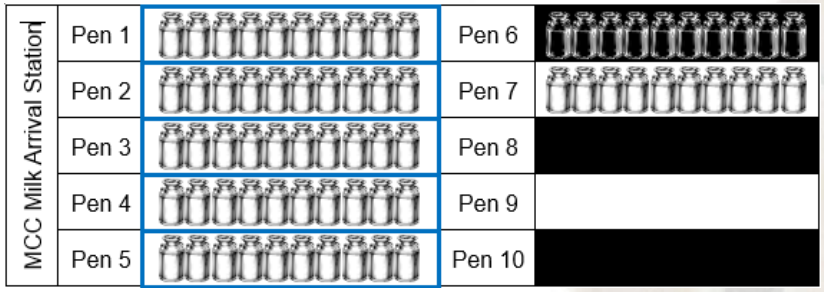


Number on chart	Colour Grade of Milk	Interpretation	Pass/Fail
6	Blue	Excellent	Pass/ Accept Milk
5	Light Blue	Very Good	
4	Purple	Good	
3	Purple / Pink	Fair	Fail/ Reject Milk
2	Pale Pink	Poor	
1	Pink	Bad	
0	White	Very Bad	

- Milk that scores 6 (blue) to 4 (purple) is considered acceptable.
- Milk that scores 3 (purple / pink) to 0 (white) is unacceptable and should be rejected.

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Concept of 'Penning' milk containers

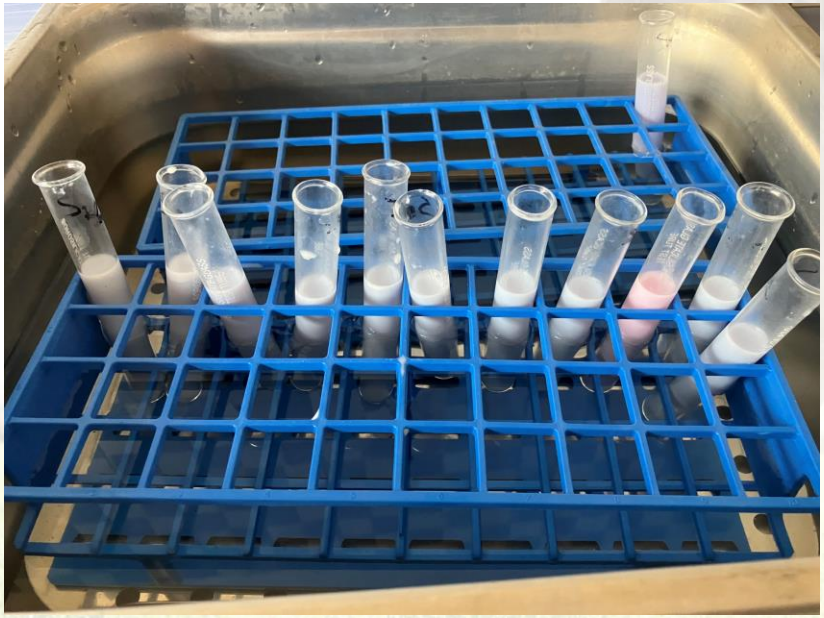




- Milk reception can be chaotic and not all cans are tested.
- Creating pens for 10 milk cans prevents these 10 cans being accepted until all tests have been carried out.

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Use of pens to identify rejected milk



- Composite sample from 10 containers in a pen failed.
- Milk kept in the pen.
- Individual containers tested.
- Single container fails and is rejected.
- Other 9 containers pass and are accepted.

Cleaning milk tanks, milk reservoirs and milk containers



Challenges include:

- Water quality
- Water temperature
- Cost of sanitisers

Milk transport





- Challenges include:
  - Transport in un-shaded vehicles.
  - Long journey times.
  - Waiting at the milk reception.

Conclusion



- Mastitis is a significant economic concern.
- It can adversely impact milk yields and product quality.
- It can act as a barrier to exports.
- Mastitis control starts at the farm level.
- Milk quality does not improve after the milk leaves the cow!

Acknowledgments



- Jersey Overseas Aid.
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