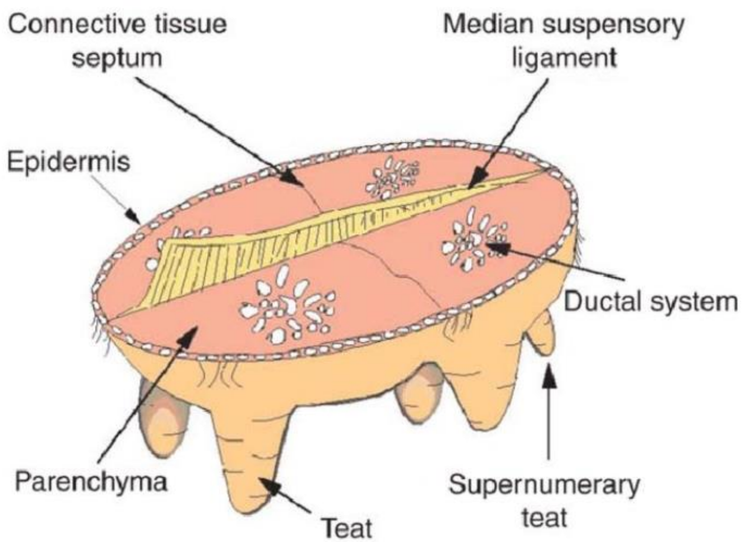
Euroopa Maaelu Arengu
Põllumajandusfond:
Euroopa investeeringud
maapiirkondadesse

Mastitis inflammation from a broader prospective



Zanetta Chodorowska,
TSM Ruminant Biomin GmbH

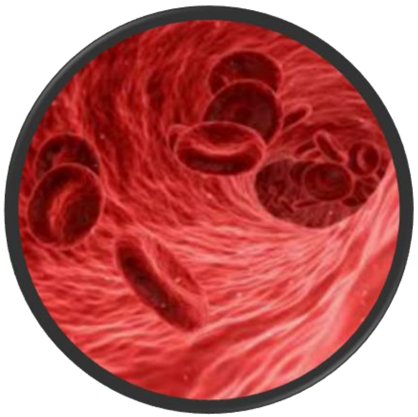
To produce high amount of milk we need healthy animal with strong immune system

Biosynthesis of milk requirement

All of the milk precursors come from blood.

For 1 liter of milk 400- 500 liter of blood have to pass through the udder

When a cow produces 40 liters of **milk** per day, how much will this be…?

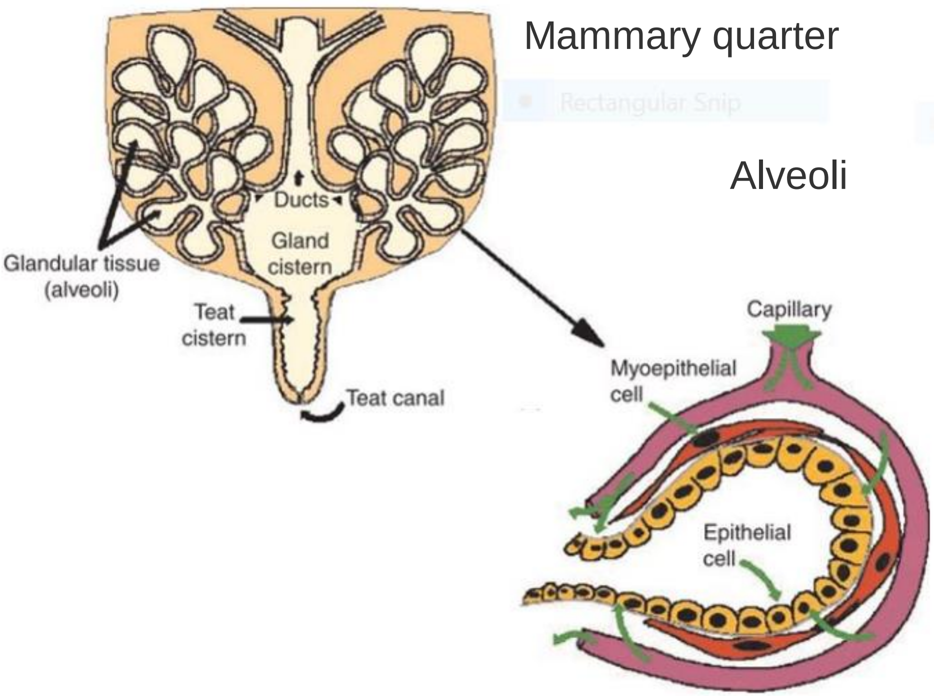


Milk producing cells are Extremely delicate

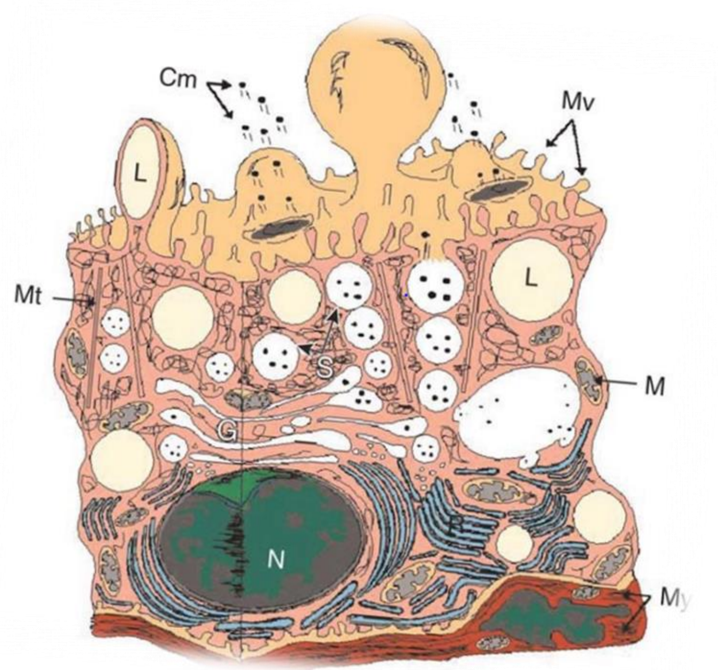
The secretory cells are, surrounded by a layer of myoepithelial cells and blood capillarie.

Mammary quarter

Alveoli



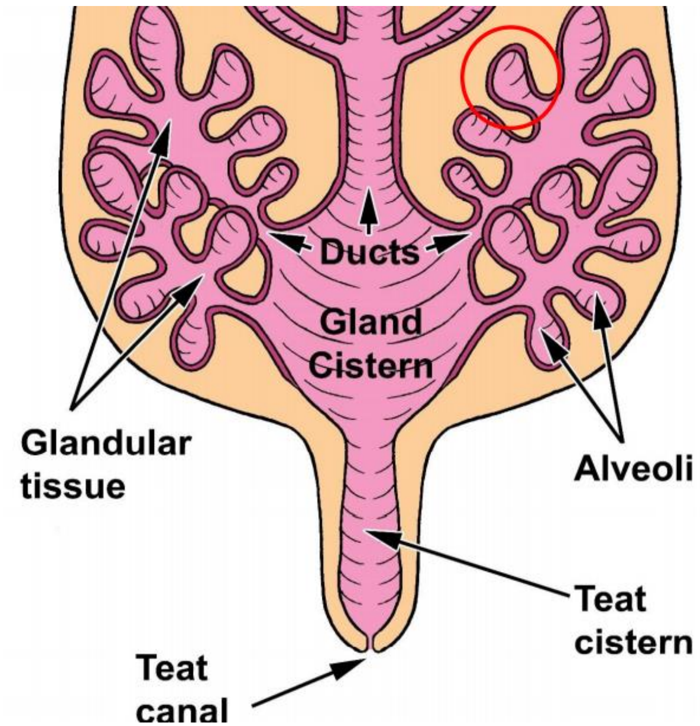
Secretory alveolar cell



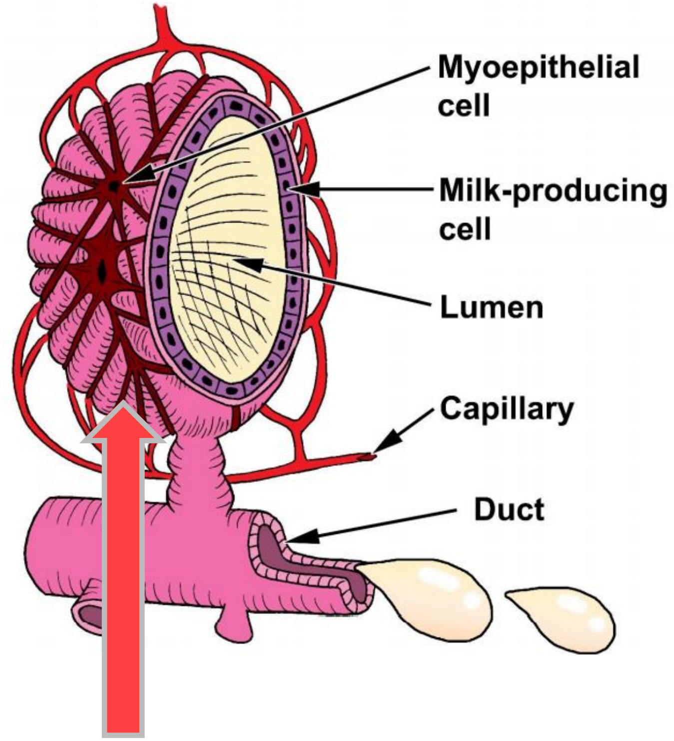
nucleus (N) mitochondria (M) secretory vesicles (S) casein-containing secretory vesicles (G)

4 separate udder quarters

Teat canal & teat cistern drains milk from Glandular tissue which is made of millions microscopic Alveoli



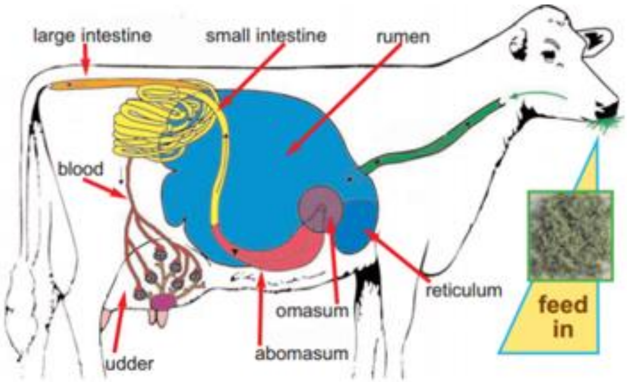
Myoepithelial cells contract in response to oxytocin



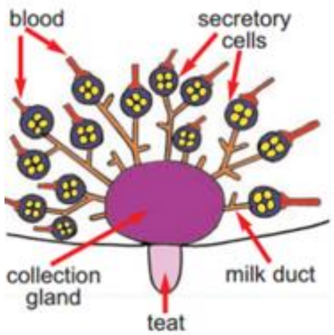
Alveolar structure is very sensitive to bacteria toxins

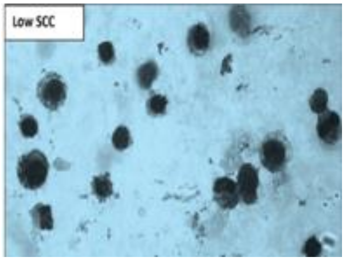
SSC in milk coming from healty cow is low

Nutrients are transported from the bloodstream into mammary tissues to be converted into milk,



Immune cells are also transported via blood into milk as a surveillance mechanism to look for bacteria





The Somatic Cell Count (SCC) is a main indicator of milk quality

The majority of somatic cells are *leukocytes* (white blood cells) - which become present in increasing numbers in milk usually as an immune response to a mastitis-causing pathogen - and a small number of epithelia cells,

Lymphocytes

Detect, phagocytize pathogens

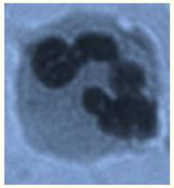
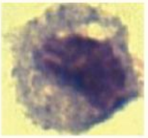
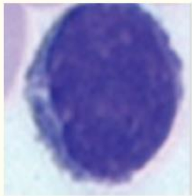
& initiate and coordinate immune response

Macrophages

the first cells to synthesize and release pro-inflammatory cytokines

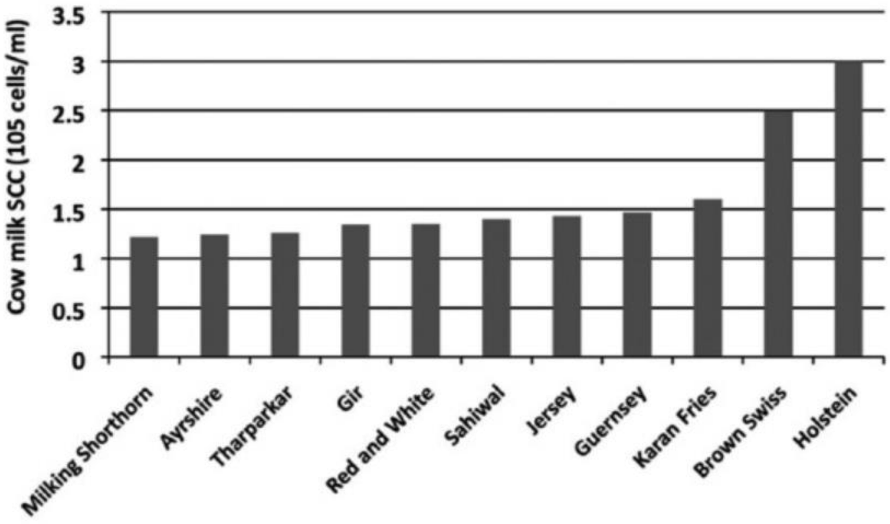
Macrophages & Neutrophils

play a role in the phagocytosis and destruction of bacteria.

Parameters	Neutrophils	Macrophages	Lymphocytes
Milk leukocyte of cow at 100× (Olympus IX51 microscope)			
Morphological characteristics	Diameter 12-15 μm, nucleus is multilobed with bridges	Diameter 20-30 μm, the largest cell type in milk	Diameter 9-16 μm, deeply stained round nucleus with little cytoplasm
Percentage of leukocytes in healthy and mastitis milk of different species			
Healthy cow	19	66*	15
Mastitis cow	75*	17	8

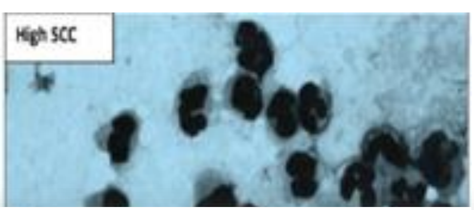
Milk SSC, what is high count in you opinion?

- 100.000
- 200.000
- 250.000
- 300.000
- 400.000

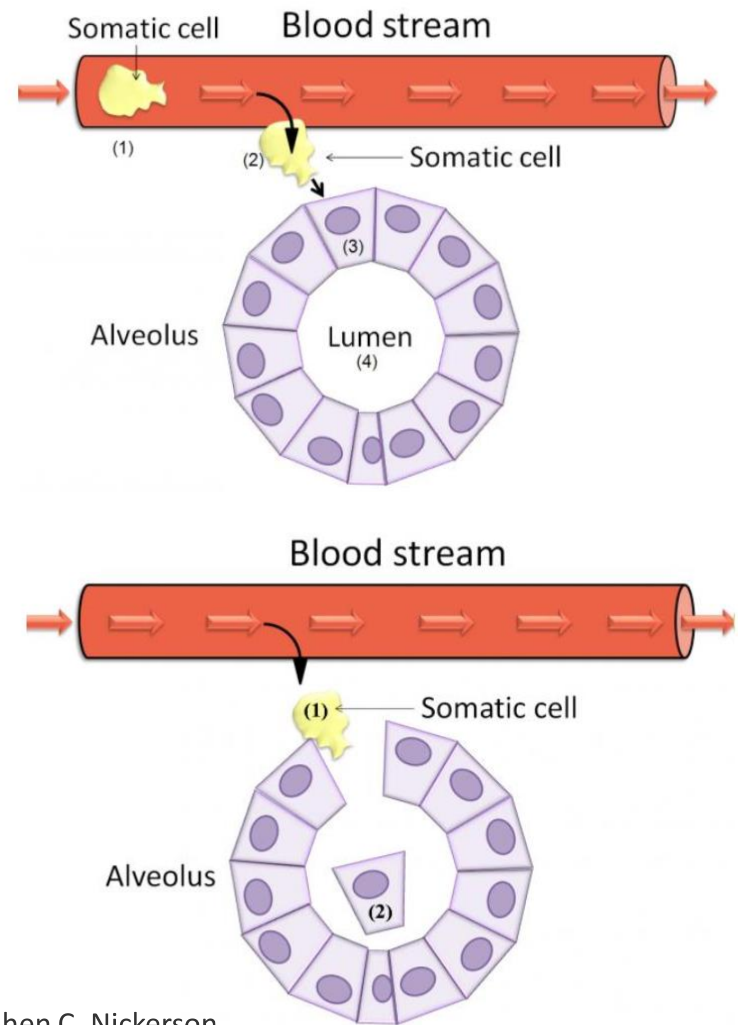


When the udder gets infected SCC in milk increase

- somatic cells – predominantly leukocytes & neutrophils transported via bloodstream crosses the bloodstream
- migrates to the layer of milk producing cells
- move into the alveolar lumen to look for bacteria.



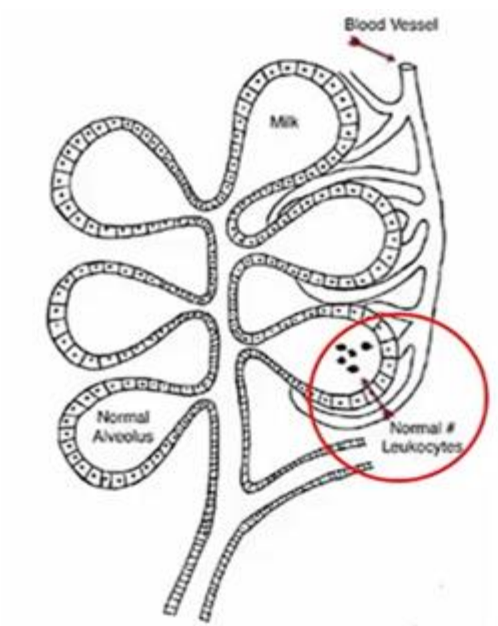
200.000SCC > 1.3L/d lost

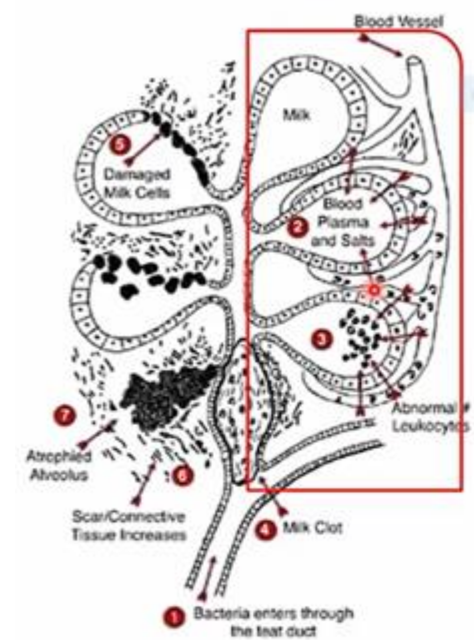


Stephen C. Nickerson, University of Georgia

Udder inflammation with elevated milk somatic cell caunt (SCC)

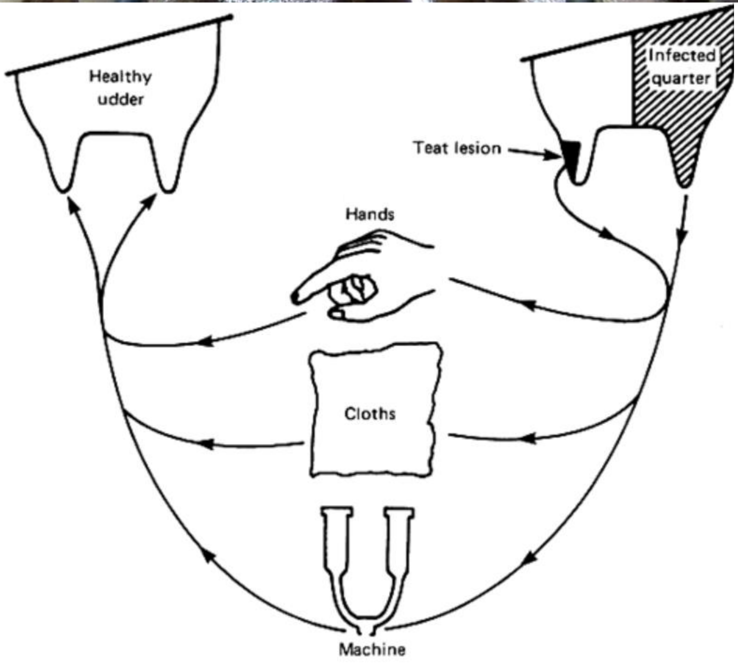
Activation of the mammary immune system, typically caused by a pathogen infection – mostly due to management deficiencies on the farm.



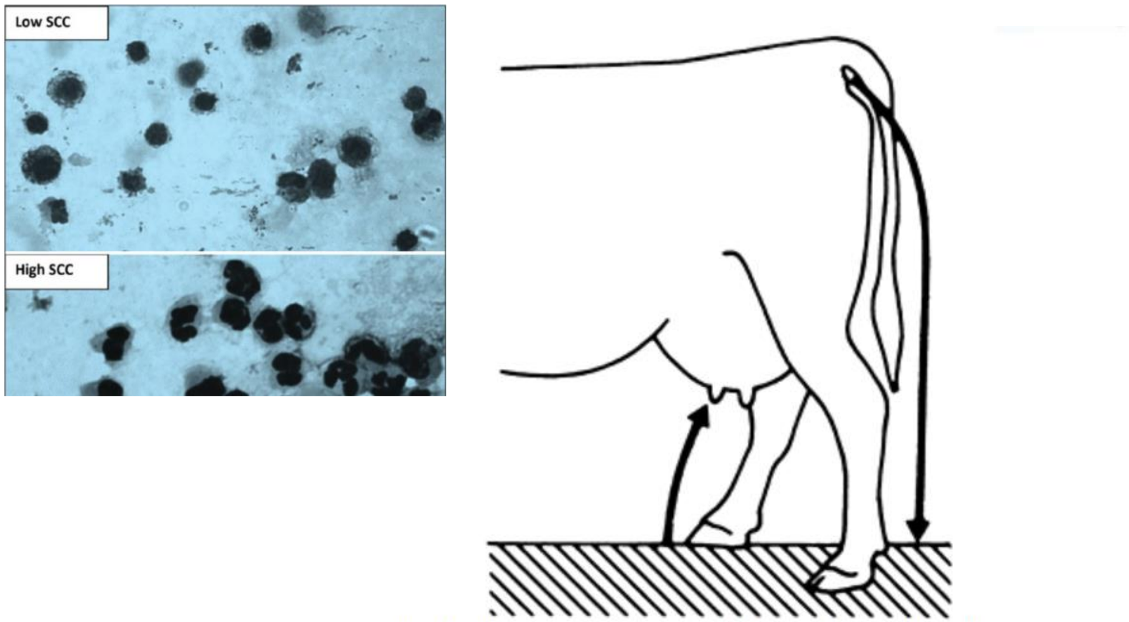


Lost of milk producing cells can not be regenerated in that lactation.

How the udder gets infected :
Staph is spread during milking or environment



Spread of mastitis bacteria at milking from infected quarters and teat lesions



Spread of the bacteria from dung etc that multiply in bedding materials

The cost of mastitis is huge!

Subclinical Mastitis >200.000SCC

1. **718kg of lost milk production,** ($285). Losses extend through 210 days in lactation.
2. **2.5 X more likely to develop a clinical case of mastitis by 60** (DIM) than the rest of the herd — not to mention the cost of treatment and reduced milk production [2]
3. **3 X more likely to be culled first 60 DIM** when compared with unaffected cows
4. **17 additional days open** (not pregnant)

(Kirkpatrick MA, Olson JD. Somatic Cell Counts at First)

Table 1. Somatic Cell Counts as They Relate to Estimated Milk Losses

CMT (Score)	WMT (mm)	Somatic Cell Count (cells/ml)	DHIA SCC (linear score)	Milk Loss (%)	Estimated Milk Production Loss Per Cow/Year* (lb)
Negative or Zero	2 5	100,000 200,000	3 4	3 6	400 800
Trace or Slight Gelling	8 10 12	300,000 400,000 500,000	5	7 8 9	1,000 1,200 1,300
1 or	14 16 18 20 22	600,000 700,000 800,000 900,000 1,000,000	6	10 11 12	1,400 1,500 1,600 1,650 1,700
2	29	≥1,600,000	≥7	≥12	≥1,700

*Based on 14,000-15,000 lb average/cow/year.
Source: Mastitis: Counter Attack, Philpot and Nickerson (1991).

Mastitis & fertility

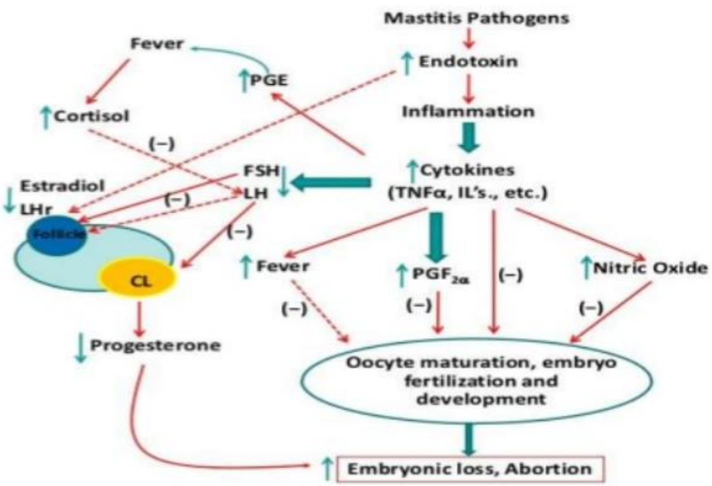
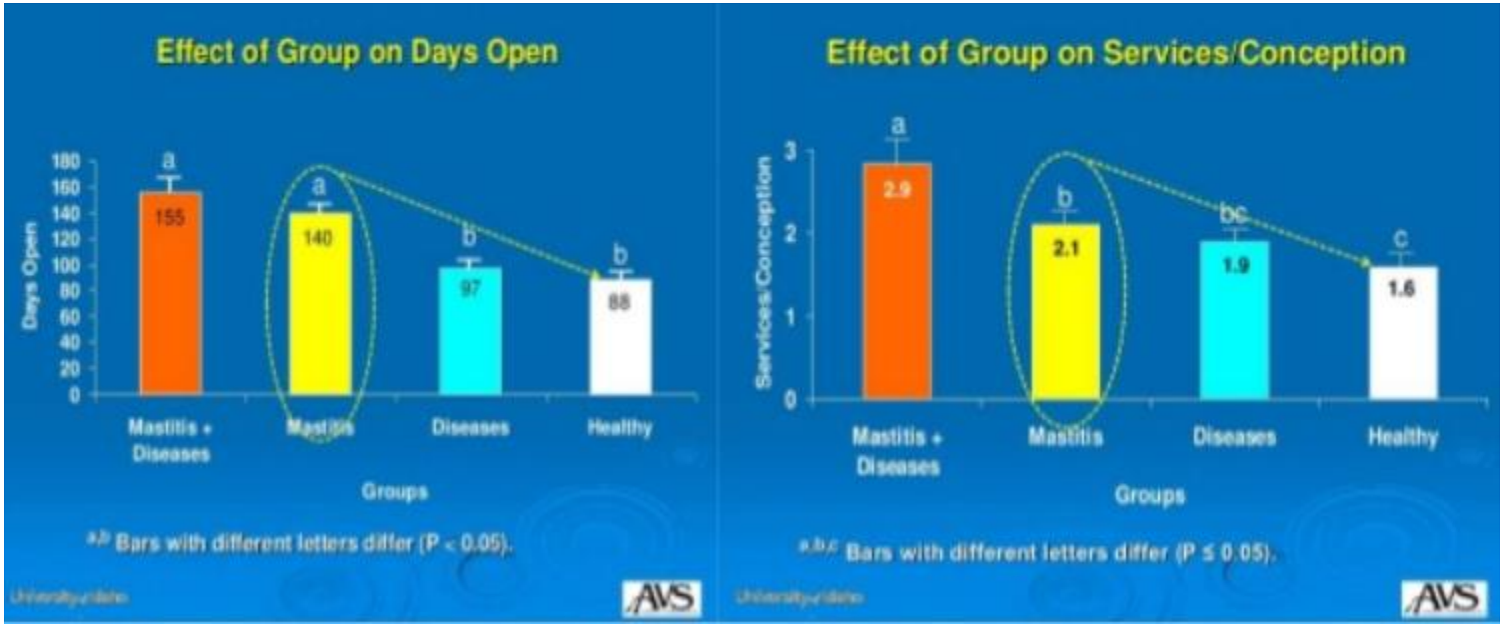


Figure 3. Potential mechanisms by which mastitis affects fertility.



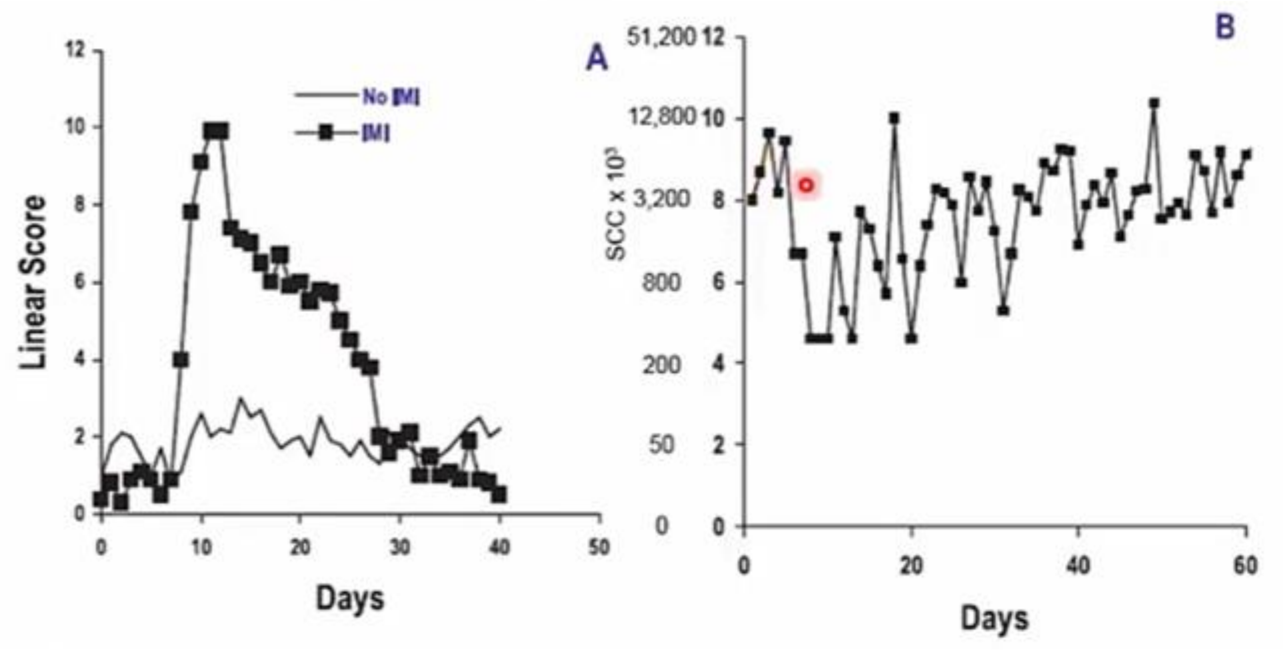
Why mastitis treatment not always work ..

Mastitis

- Cow Immune Status & History
- Environment & Management
- Pathogens load & virulence
- Protocols and Procedure

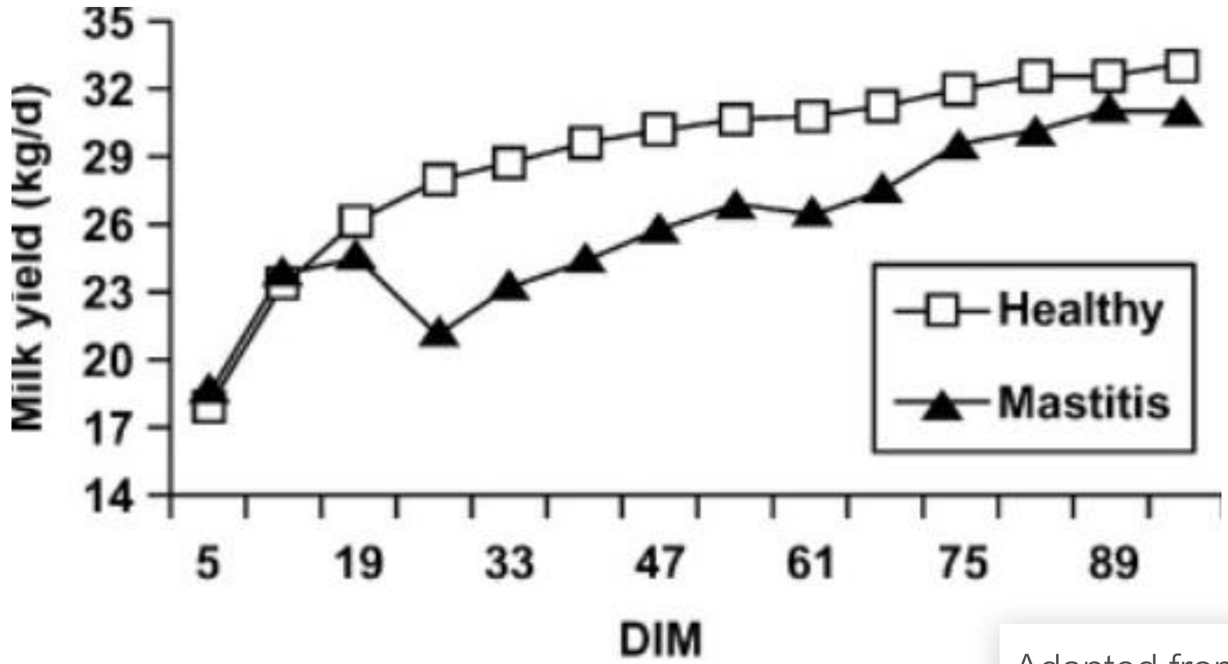
The first 1-2 weeks & the last 7-10 days before calving is the time of greatest susceptibility to new environmental infections,

Mastitis incidents



Schunkken et all, Vet Res 2003

If you have case of Mastitis before pick of lactation you destroy all cow lactation curve



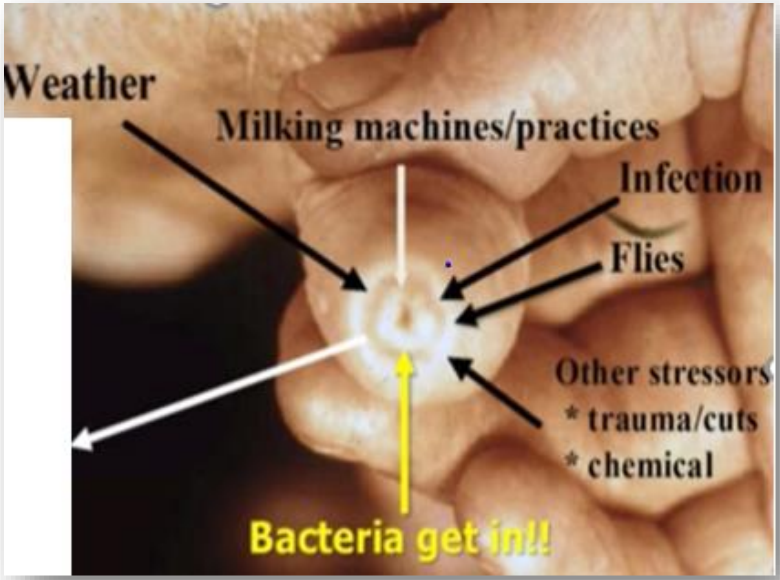
Adapted from DJ Wilson 2004

We need strong animal to fight infection

To prevent mastitis is needed:

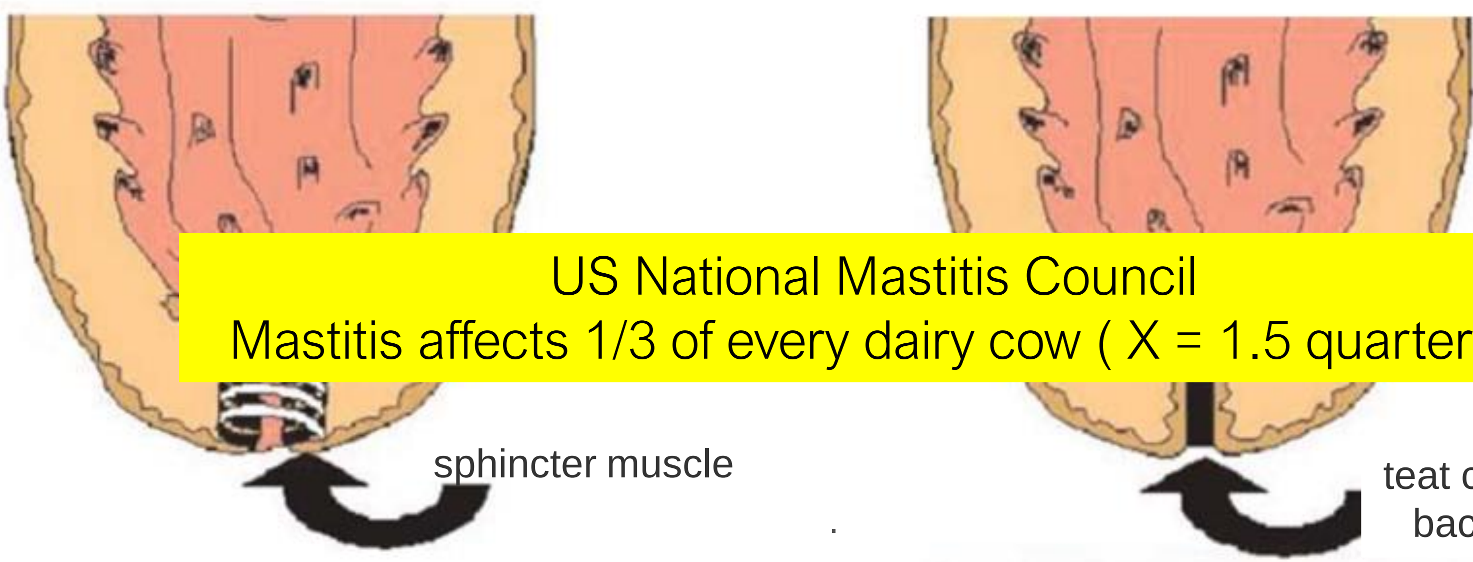
1. Strong immune system
2. Good calcium status
3. Feed Intake & Nutrition /Se.Zn,Cu,.
4. Avoid stress, (oxidative)
5. Prevent Metabolic Disorders

- ketosis, metritis, hypocalcemia



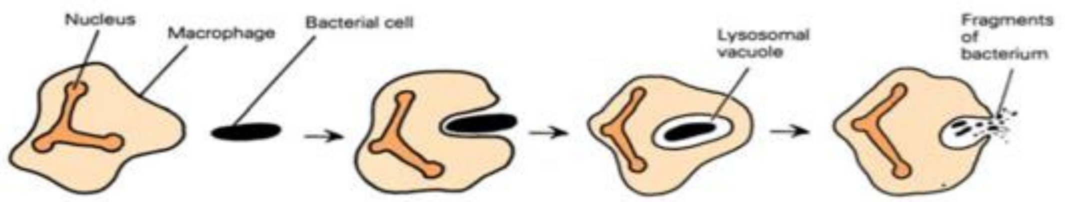
6. Good Management
7. Vaccination program
8. Protocols
9. Dry cows Treatment
10. Knowledge transfer to people working on farm

Cow defense mechanisms: anatomical and cellular_ non specific and targeted



US National Mastitis Council
Mastitis affects 1/3 of every dairy cow (X = 1.5 quarters)

50 million neutrophils /ml of milk with phagocytic capacity

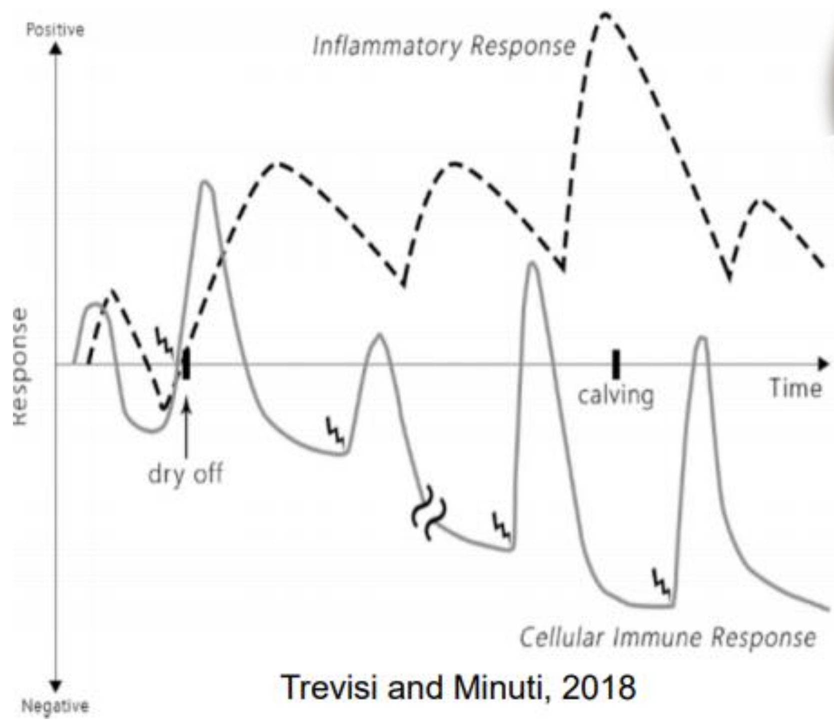


Roger Blowey BSc, BVSc, FRCVS, Peter Edmondson MVB, Cert. CHP, Dip. ECBHM, FRCVS

1.Transition cow Immune System

UNIVERSITÀ CATTOLICA del Sacro Cuore

,,Dysregulation of Inflammatory Respond, observed in nearly all cows”



What is the source?

1. Mammary Gland
2. Uterus
3. Sterile inflammation
4. Gastrointestinal tract?

What are the consequences?

ADSA DISCOVER Conferences

39th ADSA Discover Conference Program

The Transition Period – From Physiology to Management

October 27-29, 2020 held virtually

Hosted by the American Dairy Science Association®

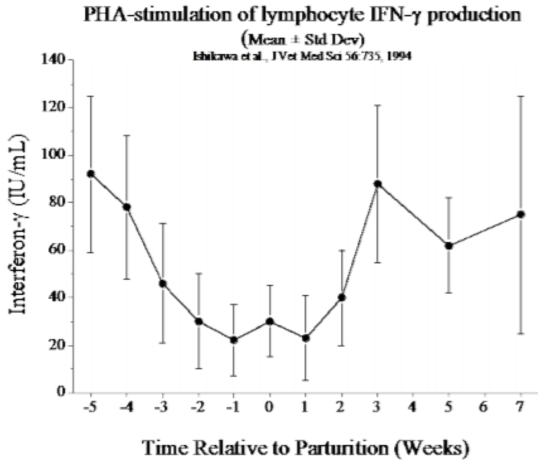
The possible relationship between the cellular immune response (——) and the systemic inflammatory response (– – –)

(Bertoni et al., 2008; Bradford et al., 2015; Erminio Trevisi and Minuti, 2018)

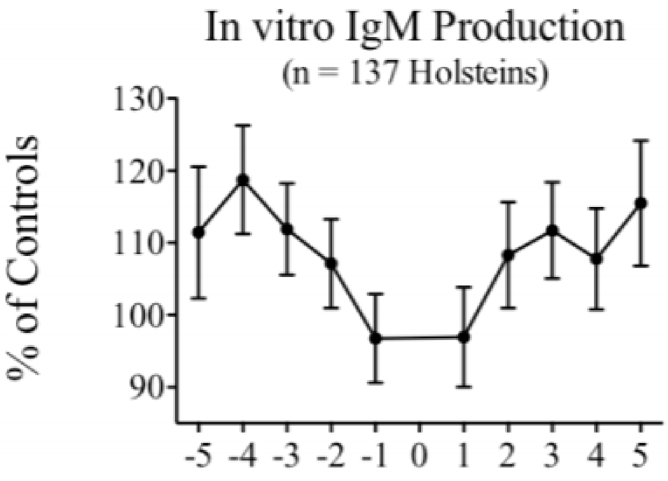
1a. Transition cow Immune system

Jesse Goff Iowa State University

1. 25 - 40% decline in both neutrophil function (innate immunity) and lymphocyte function (acquired immunity)
2. Metabolic diseases, (such as milk fever & ketosis), often result in 60 to 80% loss of immune function followed by decrease in gut integrity.
   - Transition diseases: milk fever, ketosis, metritis , endometritis, RP, DA



Ishikawa et al., 1994.)



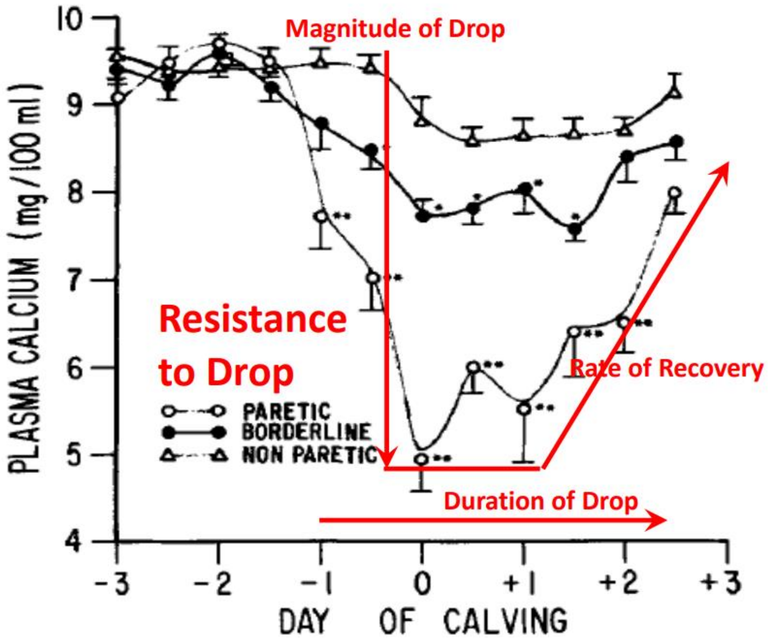
Detilleux et al., 1995b.)

2. Good calcium status

Calcium (**Ca**) is necessary for proper muscle contraction of

(Loss for Milk 40g, Fetus 10g,..)

Laura Hernandez UW



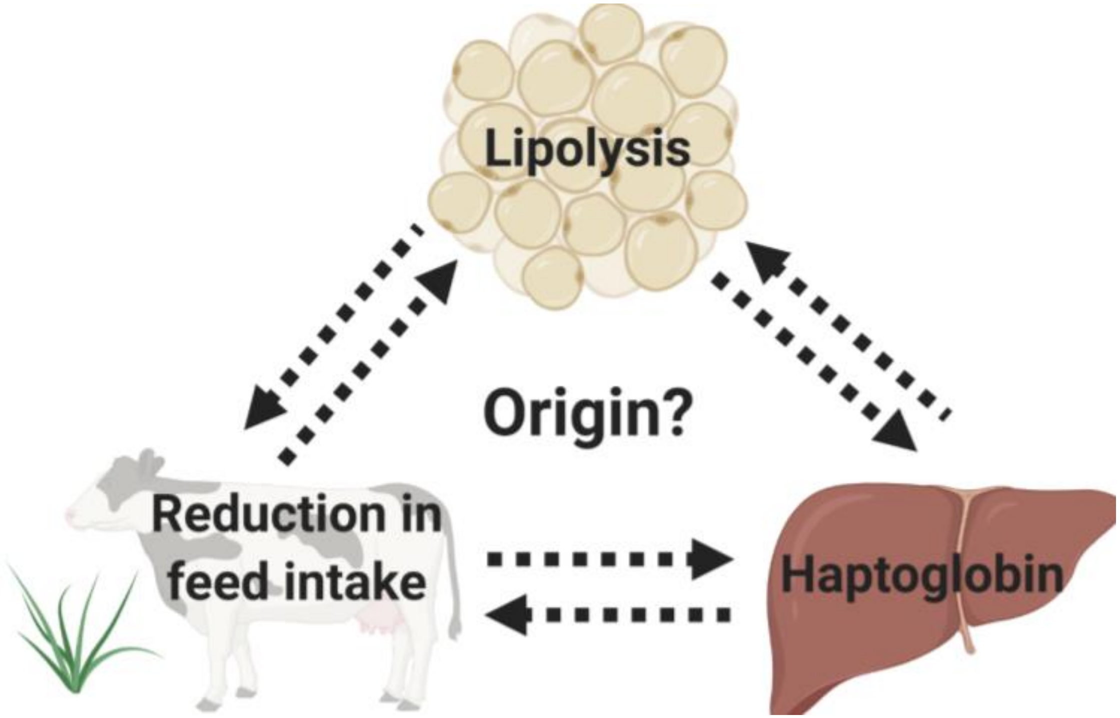
Factors regulate Ca homeostasis:

- Resistance to Drop
- Magnitude of Drop
- Duration of Drop
- Rate of Recovery

Ronald L.Horst and Jorgensen, 1982

3. Feed intake before and after calving

Reduction in FE, lipolysis, systemic inflammation



Osvaldo Bogado Pascottini
Ghent University
/University of Antwerpen

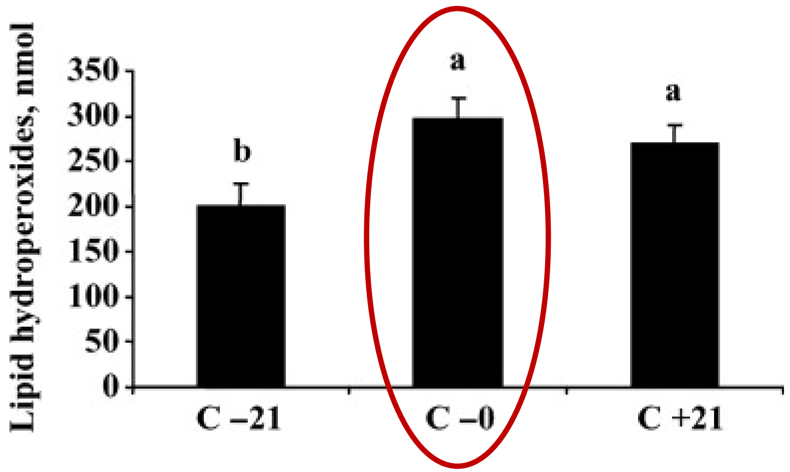
cows stop eating because they suffer from systemic inflammation, or the reduction in the feed intake is responsible for the decreased energy balance and systemic inflammation…?

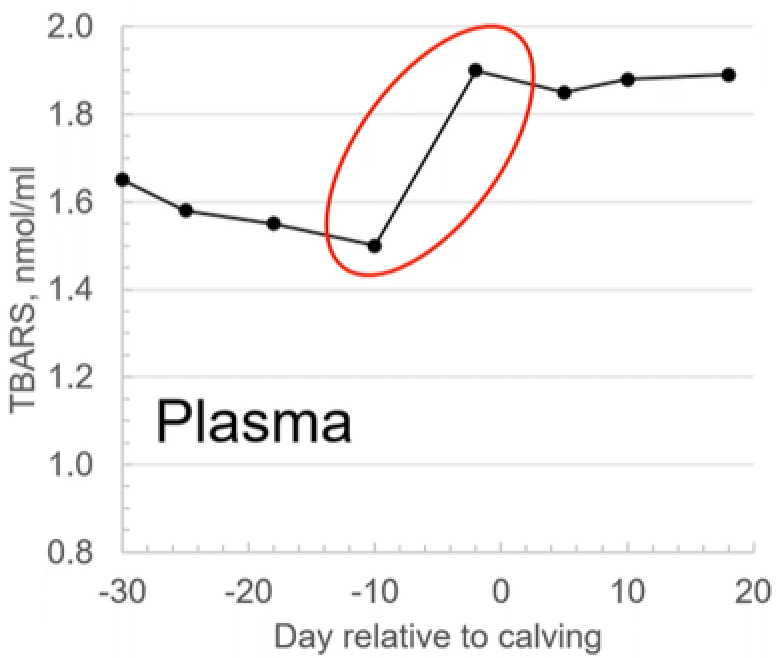
4. Oxidative stress

Calving goes with massive oxygen consumption.

Transvers of AOX to colostrum, reduced intake.

Oxidative stress is an underlying factor in dysfunctional host immune and inflammatory responses, which can increase susceptibility to a variety of health disorders (Sordillo and Aitken, 2009)





 Soridillo et al 2007 Umberto Bermabucci at al., 2005

5. Metabolic Disorders in Transition cows

Diseases incidence in transition cows

Disease	Median Incidence Risk (%)	Range of incidence risk (%)	Estimated Cost ($/case)
Hypocalcemia	6.5	0.3 – 22	335
Subclinical Hypocalcemia	22	8 – 54	125
Retained fetal membranes	8.6	1.3 – 39.2	285
Metritis	10.1	2 – 37	359
Subclinical metritis	53	37 – 74	-
Ketosis	4.8	1.3 – 18.3	145
Subclinical ketosis	43	26 – 55	67
Lameness	7.0	1.8 – 30	302 – 400
Clinical mastitis	14.2	1.7 – 54.6	185 – 205
Subclinical mastitis	30	15 – 60	-

Van Saun and Sniffen, 2014

Conclusion ..
We need to care more
Dysregulation of immune function in transition cows

1. Decrease circulating Ca
2. Decrease DMI
3. Ketosis
4. Oxidative stress

&

- Increase oxygen consumption
- Increase milk production

Immune activation decreases circulating Ca
(Kvidera et al., 2017; Horst et al., 2017)

Immune activation cost
1 kg of glucose within 12 h
Kvidera et al., 2016, 2017 a,c).

Prevent pathogens infection

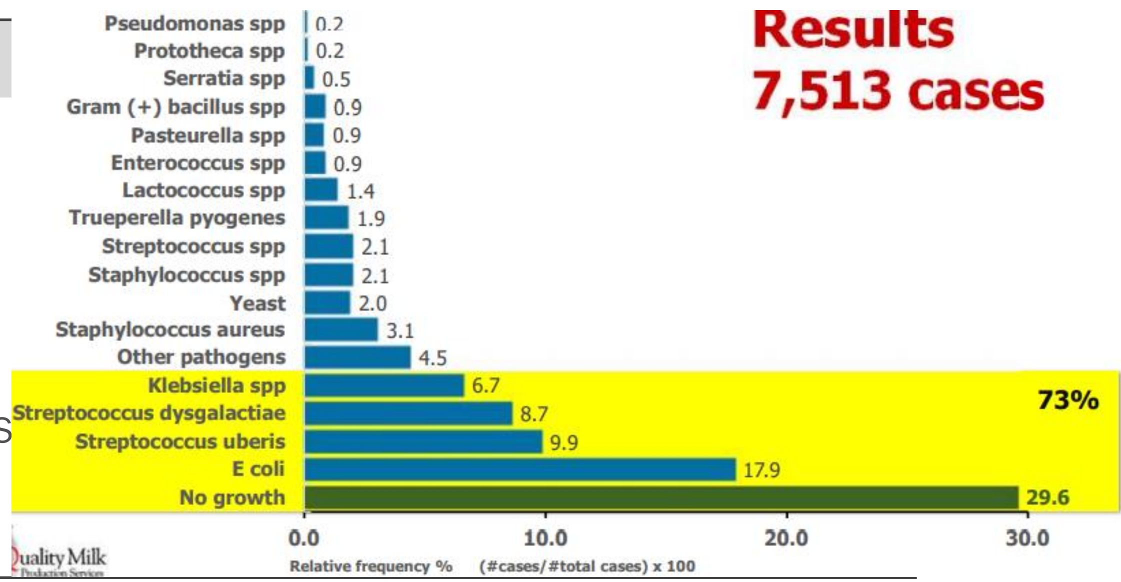
environmental (bedding) & contiguous (cow-cow)

Contiguous :

Staphylococcus Aureus – Streptococcus Agalactia/Disagilactia – Mycoplasma Bovis

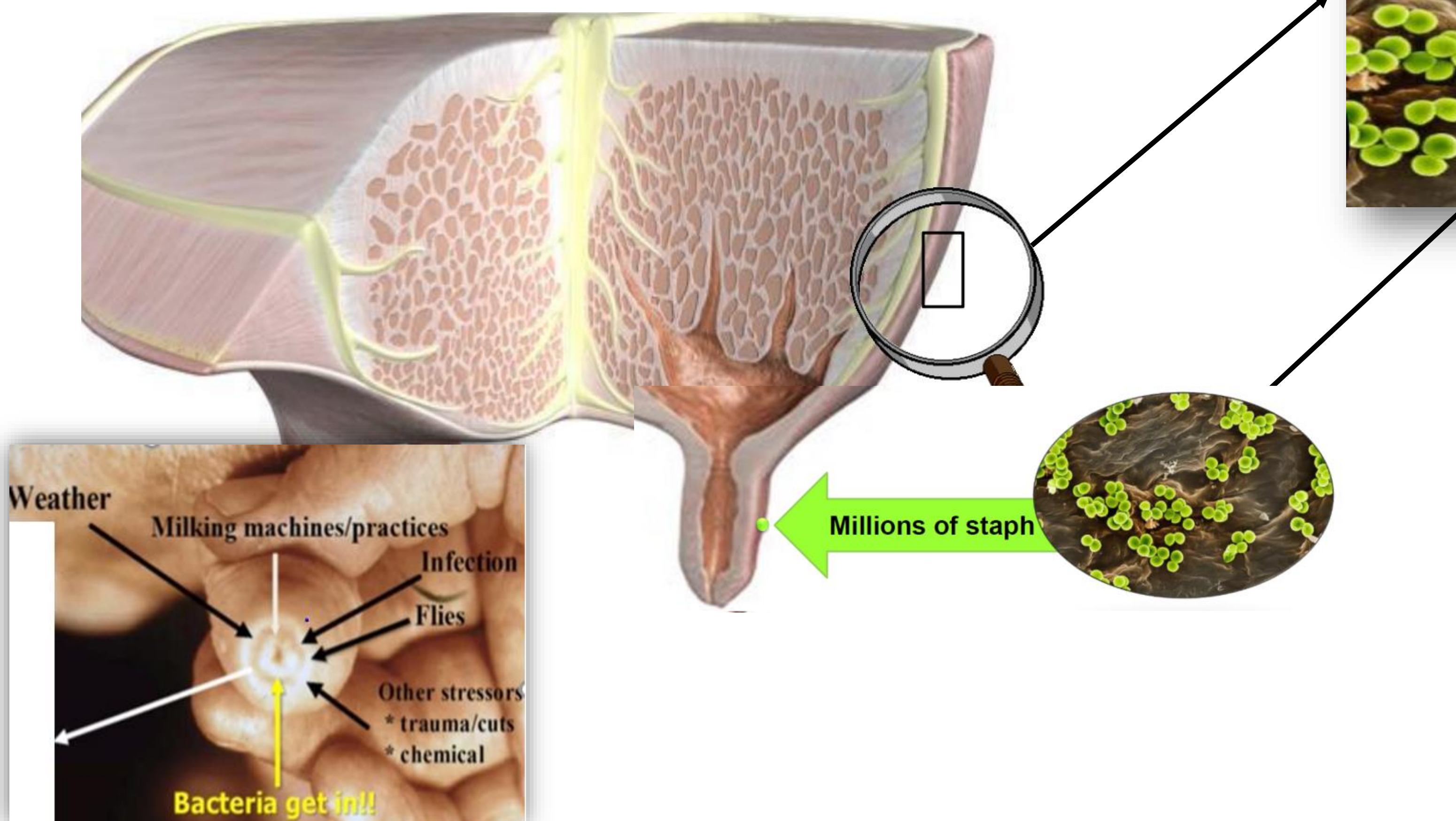
Bacteria

Gram+	Gram -
Streptococcus spp	E coli
Staphylococcus spp	Klebsiella
Corynebacterium spp	Serratia
Bacillus spp	Enterobacter
Nocardia	Citrobacter
	Pseudomonas
	Pasteurella
	Proteus



Pathogens pass through teat canal multiply in cisterns, release toxins that cause inflammation

Bacteria on teat surface are in opportunistic position to enter the teat canal



Control what you can

Early detection and treatment of infected animals

She is already down

Milking routines

Record keeping

Milk Culture

Culling

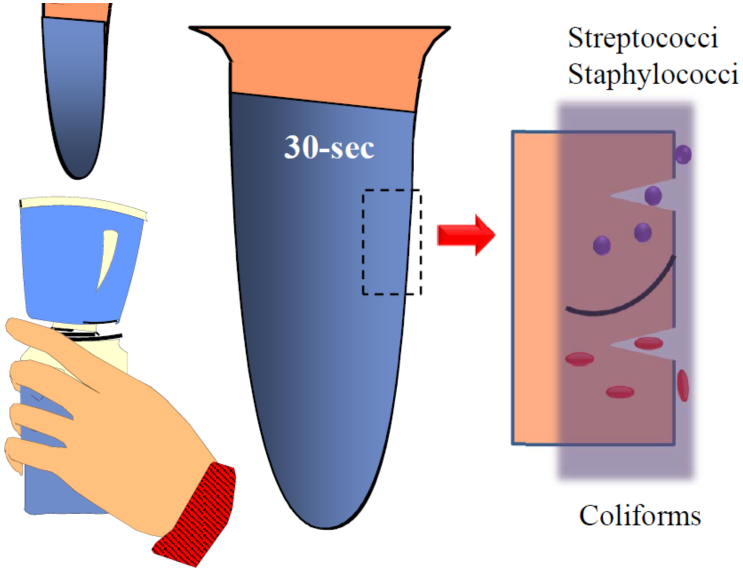
Educatio
n

Milking installation

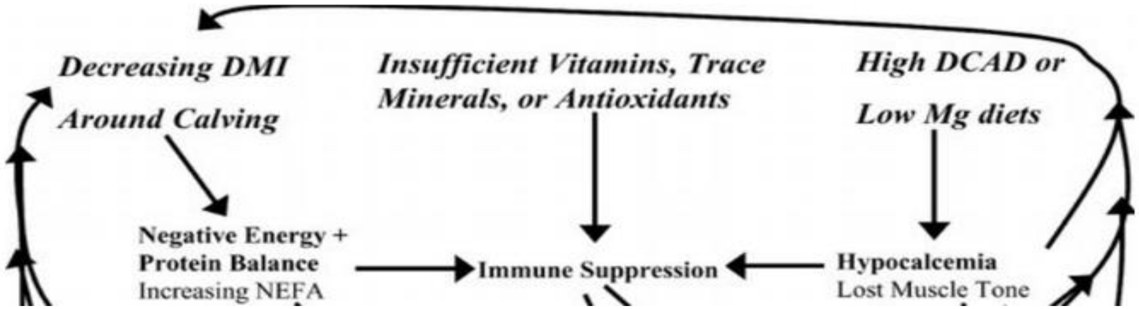
Vaccination

Dry cow therapy and/or a teat sealant

Milking routine



Take Home : There is a need for wider approach to prevent mastitis inflammations



Management	Protocols	Personnel education
Phytogenic antioxidant effect	Mycotoxin Risk Management	Hypocalcemia prevention Nutrition
Personnel Education	Trace Minerals Vitamins	Use antibiotics only on cows that will benefit

Thank You

There is a need to enhance immune system

Trace minerals prepartum improve metabolic status

SYMPOSIUM: BOVINE IMMUNOLOGY
Summary of micronutrient effects on mammary gland immunity.

Micronutrient	Observation
Se	neutrophil function Improved bactericidal capabilities of neutrophils Decreased severity and duration of mastitis
Vitamin E	Increased neutrophil bactericidal activity Decreased incidence of clinical mastitis In combination with Se, decreased prevalence of IMI at calving
Vitamin A	Decreased SCC Moderated glucocorticoid levels
β-Carotene	Increased bactericidal function of phagocytes Increased mitogen-induced proliferation of lymphocytes
Cu	Deficiency decreased neutrophil killing capability Deficiency increased susceptibility to bactericidal infection
Zn	Deficiency decreased leukocyte function Deficiency increased susceptibility to bacterial infection

L. M. SORDILLO,1 K. SHAFER-WEAVER, and D. DeROSA