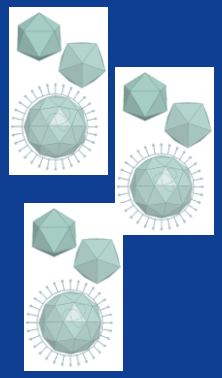

Are There Microbes in My Dairy?

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Are there microbes in MY dairy??

Yes, and many of them are *necessary* for you, and for your products

Examples of Beneficial Microbes

Starter cultures

Inoculation and native cultures

Fermented and probiotic food products

- Many microbes are **useful** (or not **harmful** for humans)

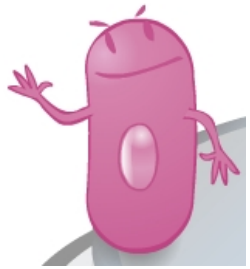
The Main Types of Microbes in Raw Milk

Useful microbes

- Lactic acid bacteria
- Starter cultures (bacteria, moulds, yeasts)

Spoilage bacteria

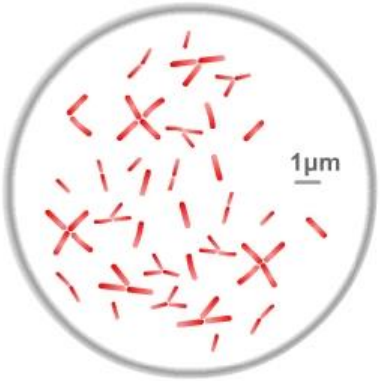
- Psychrotolerant (”psychrotrophs”) bacteria like *Pseudomonas*
- Thermoresistant Clostridia causing butyric fermentation
- Coliforms



Relevant pathogenic bacteria

- *Listeria monocytogenes*
- *Salmonella*
- *Staphylococcus aureus* producing enterotoxins
- *Brucella* and *Mycobacterium bovis*

Raw Milk is a Living Ecosystem



Source: 01 The Solar System PIA10231, mod02

Environmental conditions - Bacterial interactions

An isolated bacteria means nothing without the interaction in the ecosystem

The Ecosystem of Raw Milk - Barriers to the Growth of Pathogens:

BACTERIOCINS

ACIDOLACTIC BACTERIA

NON- LACTIC BACTERIA (eg. *Brevibacterium linens*)

LACTIC ACID

YEASTS AND MOLDS (eg. *Geotricum candida)*

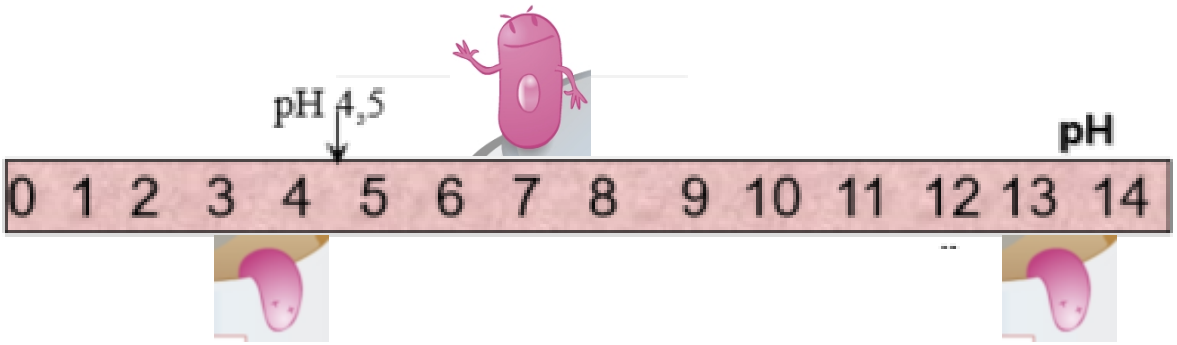
Technological Barriers

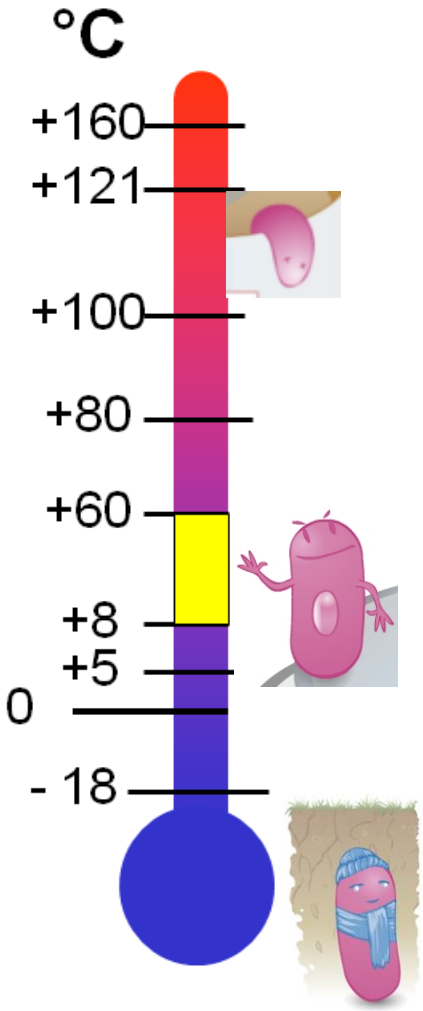
- The diversity of microbial ecosystems can be utilised to protect milk products from pathogens (**Maoz et al., 2003; Eppert et al., 1997; Saubusse et al. 2007)
- This hurdle theory is an old concept (**Leistner, 1985) but now it is becoming known as an efficient tool to prevent development of pathogens (**Ghandi et Chikindas, 2007)
  - An example: The natural interaction of microbes and their metabolites in raw milk and in raw milk cheeses (**Millet et al., 2006)
  - For more information and references, see tool 9.6

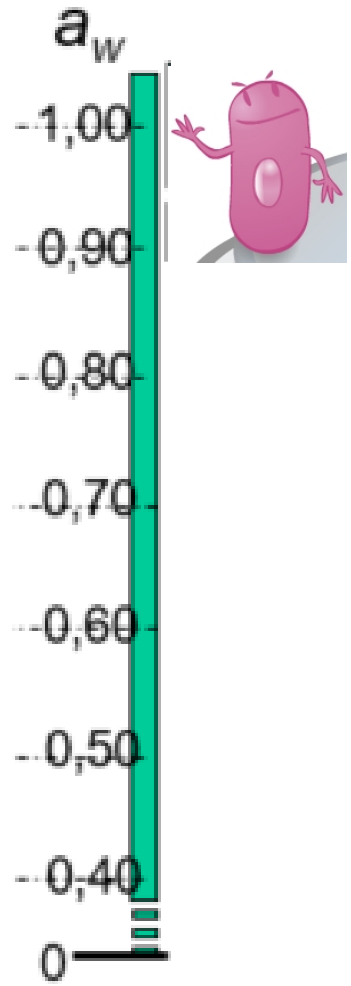
** Authors of scientific studies

Environmental Factors Enabling Microbial Growth

- Moisture
- Nutrients
- Temperature
- Acidity (pH)
- Oxygen level
- Water activity: the quantity of free water in foods, available for microoganisms. Scale 0 (min)-1 (max)







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Some Microbes are *Undesriable* or *Harmful* and Can Cause

Food spoilage (technical problems)

http://cheeseforum.org/articles/wiki-cheese-body-defects-mechanical-holes/

www.villareuter.fi

Food poisoning or infections

There is No Need of Being Afraid of Microbes, but It Must Be Understood That…

in the worst case, a series of small mistakes in hygienic practices might cause even a death of a consumer

Photo: Microbiology International

Personal Hygiene is Important!

Photo:

Microbial colonies on solid medium.

- The surface was touched by a hand
- The plate was incubated for three days at 30 °C
- Each of these colonies originate from one or few microbial cells from the person's hand

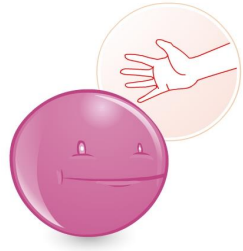
You cannot remove all the hazards
but
you can control the risks

Effects of Harmful Microbes in Foods?

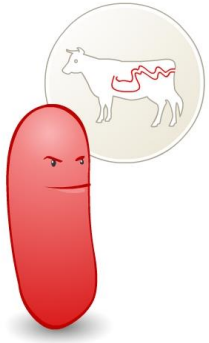
1. Produce toxins → food poisoning and foodborne infections
2. Produce enzymes which degrade food components like fats, proteins and carbohydrates → food spoilage
3. High microbial counts exceed the safety limits→ risk of harmful effect on consumers health

Pathogens Relevant to Dairy Manufacturing Processes

- Food safety criteria:
  - ***Salmonella* spp.**
  - ***Listeria monocytogenes***
  - Staphylococcal enterotoxins **produced by *Staphylococcus aureus***



- Process hygiene criteria:
  - Non toxin-producing *Staphylococcus aureus*
  - *Escherichia coli*



SALMONELLA SPP

FOOD SAFETY CRITERION

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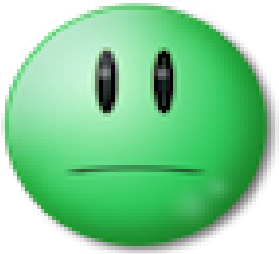
How *Salmonella* Affects Humans?

- Adults:
  - First symptoms: 8-48 h after eating
  - Typical symptoms: diarrhea, belly cramps, fever, vomits, headache
  - Duration: 2-4 days and often spontaneous healing
- Immunosuppressed people:
  - Septicemia, potentially life-threatening
- Mortality rate: approx.. 0.2 %



SALMONELLA spp: Where Do They Live?

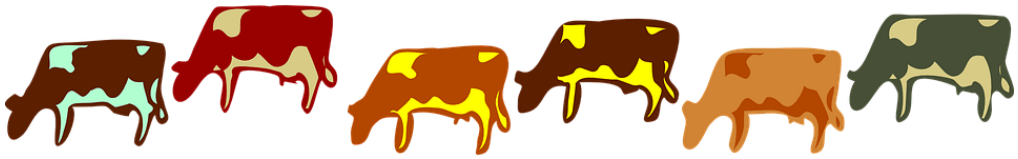
- Various species (all potentially pathogens)

RESERVOIR ANIMALS	RESERVOIR PEOPLE	WATER, SOIL
Faeces Milk (rare but not impossible) Placenta, abortion…	Faeces	to be careful with fertilization (contaminated manure!) (see the guide: *Milk Production sheet*)
	OTHER ANIMALS: birds, fowls, rodents	

RESERVOIR: Where the infectious agent normally lives and multiplies, typically without injury to itself, and serves as a source of infection for others

SALMONELLA: Do They Survive in the Environment?

- Usually they do not grow BUT,
- They may survive for a long time:
  - In water: 3 months
  - In manure: 1 month
  - In slurry: 2-3 months



- Attention: rodents and fowls can be reservoir animals

SALMONELLA – How to Avoid It in Milk?

- To identify and isolate positive animals (faeces and even milk samples)
- To keep good hygiene during milking
- To clean milking machines properly
- After fertilisation with manure, wait one to three months before animals to grass
- Water: if possible, to protect drinking through and/or to clorinate
- Attention with birds, fowls, rodents

Salmonella – How to Avoid Contamination in a Cheese Dairy?

- Avoid contamination in milk
- Good hygiene practices:
  - After using the toilets
  - Clean shoes and clothing
- To avoid working in case of disease symptoms related to gastrointestinal tract, like diarrhea
- To use good quality water

LISTERIA MONOCYTOGENES

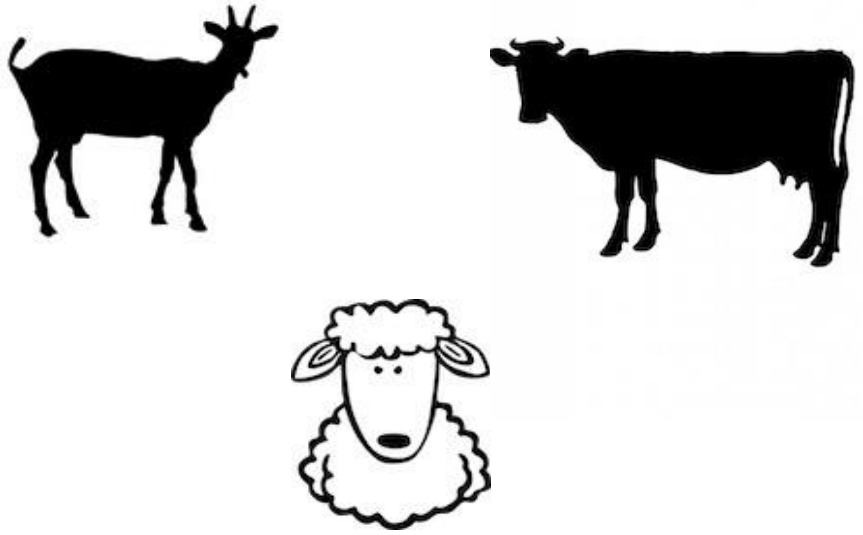
FOOD SAFETY CRITERION

How *Listeria monocytogenes* Affects Humans?

- Often only mild symptons: diarrhea, fever, headache.
- Main risks to « high risk population »: infants and small children, pregnant women, immunosuppressed people:
  - Meningitis
  - Abortion
- Low disease rate but high mortality rate in immunosuppressed people« high risk population »: 15 – 30 %

How *Listeria monocytogenes* Affects Ruminants?

- Meningitis
- Abortions
- Subclinical mastitis
- Eye problems
- Endocarditis



PRESENT IN ALL ANIMALS IN GENERAL

Listeria monocytogenes : Where Does It Live?

UBIQUITOUS GERM: EVERYWHERE

- Faeces, also from healthy humans
- Breast excretion (rare but possible)
- Soil, plants
- Fodder, mainly silage
- Stagnant water
- Evaporators in maturations rooms

Listeria monocytogenes, In Which Conditions It Grows?

- TEMPERATURE (cold resistant)
- Growth Temperature: 0ºC to 45ºC
- Optimum: 30-37ºC
- Lethal: >60ºC

- pH: 4.39-9.40
- Optimum: 7
- aW: 0.92-0.97

- SALT (very resistant)
  - ≤ 19.5º Baumé
  - 21% w/v

No growth:

- pH ≤ 4.4, or
- $a_W \leq 0.92$, or
- pH: ≤ 5 and a_W: ≤0.94

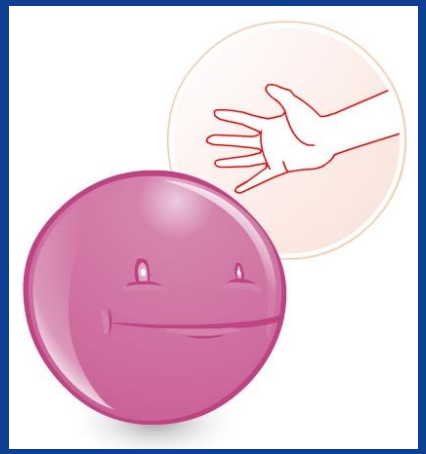
*a_W(Water activity): The quantity of free water in foods, available for microorganisms. Scale 0 (min) to 1 (max)

Risk Factors for *Listeria monocytogenes* Contamination in MILK

- Contamination by feaces of animals during milking → avoid with good hygiene
- Contaminated water
- Contaminated feed, especially silage
- Subclinic mastitis
- Reservoir in wild animals as red deer, wild boars and rodents

How to Avoid *Listeria monocytogenes* in a Cheese Dairy?

- To prevent milk contamination
- Good hygiene practices:
  - Personal hygiene, clean shoes and dress
  - To avoid direct or indirect contact of food with soil (e.g. splashing)
- To avoid stagnant water and condensation
- Clean evaporators carefully
- Avoid dust from silage area



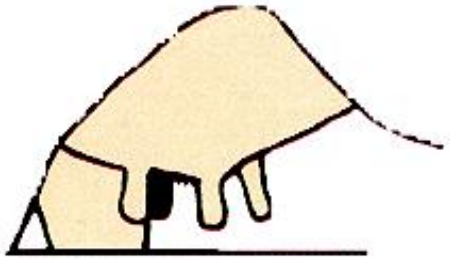
STAPHYLOCOCCUS AUREUS

PROCESS HYGIENE CRITERION

FOOD SAFETY CRITERION ONLY IN CASE OF PRODUCTION OF STAPHYLOCOCCAL ENTEROTOXIN

STAPHYLOCOCCUS AUREUS

- Main reservoir: mucous of animals and humans (nostrils, throat, teat), superficial wounds, hair



- Also in air, water, surfaces
- Very persistant in the environment

Many *Staphylococcus aureus* Strains Produce Enterotoxins

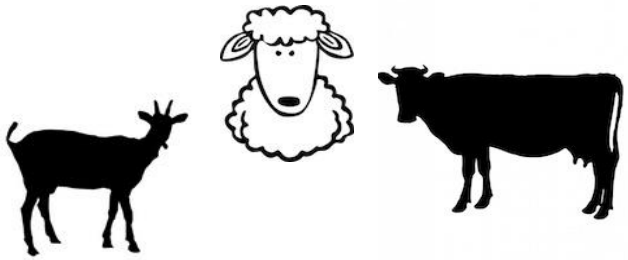
- When do *S. aureus* bacteria produce enterotoxin?
  - The level of contamination: > 1 000 000 cfu/g, and
  - Good environmental conditions: pH >4.5, T >10 °C, aW >0.88, salt up to 20 %
  - Not all *S. aureus* strains
- The toxin is resistant to:
  - Pasteurisation
  - Low moisture
  - Freezing
  - Proteolytic enzymes present in stomach (pepsin and rennin)

How *S. aureus* Affects…

PEOPLE

- Vomit, abdominal cramps, diarrhea, headache
- Usually not life-threatening; mortality is highest in risk groups: immunosuppressed people and children under five years

ANIMALS



- Clinical and subclinical mastitis:
  - Sheep and cows: the most common cause of mastitis
  - Goats: in 2,5% of mastitis but high secretion to milk
- In suppurative wounds: metritis, vaginitis, abscesses

Staphylococcus aureus, In Which Conditions it Grows?

- GROWTH TEMPERATURE
  - From 7ºC to 48ºC
  - Optimum: 35-40ºC
- Survive well in refrigerated and frozen temperatures
  - SALT (very resistant)
    - > 20% w/v

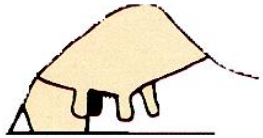
pH:
- 4-10
- optimum: 6-7

a_W:
- 0,83-0,99

*a_W(Water activity): The quantity of free water in foods, available for microorganisms. Scale 0 (min) to 1 (max)

Staphylococcus aureus, How Contamination Occurs?

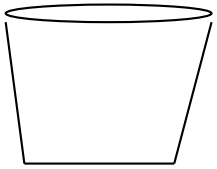
Animals with mastitis by S. aureus



Skin of udders

Milk

Wound from animals or from the milking person

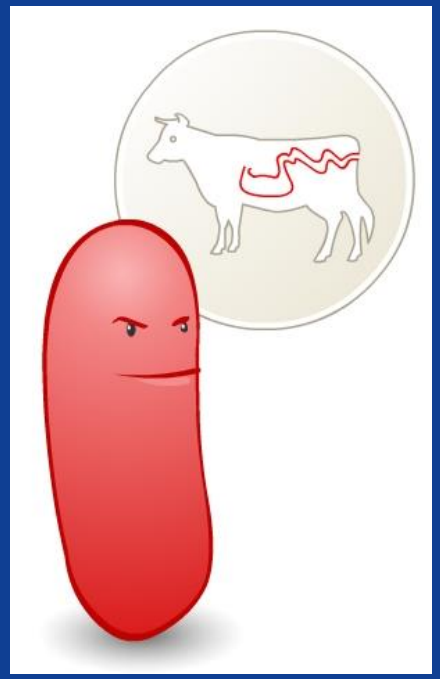


Contaminated materials

Final product

Colds

Hands of producers



ESCHERICHIA COLI

PROCESS HYGIENE CRITERION

ESCHERICHIA COLI

- Common in the intestines of animals and people
- Presence in food indicates poor hygiene
- Most strains are non-pathogenic (specific strains producing shiga-toxins are pathogenic)
- Causes defects in cheese:
  - Gas production
  - Off-flavors

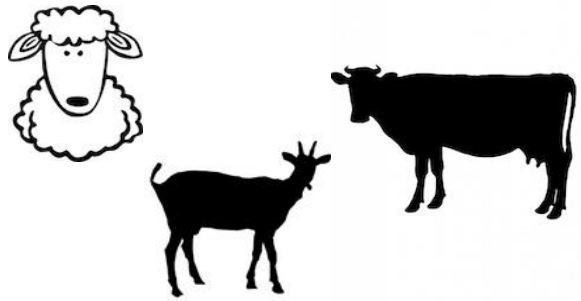
There are Rare Pathogenic *E. coli* Strains

ADULTS:

- Gastrointestinal symptoms: bloody diarrhoea, fever, dehydration

BABIES:

- Hemolytic uremic syndrome (especially in children)
- Meningitis and septicemia



ANIMALS:

- Gastroenteritis versus septicemia
- Clinical mastitis

ESCHERICHIA COLI, How Does It Live?

- GROWTH TEMPERATURE
  - Temperature: 7°C to 46 °C
  - Optimum: 35-40 °C
- Survive well in refrigerated and frozen temperatures

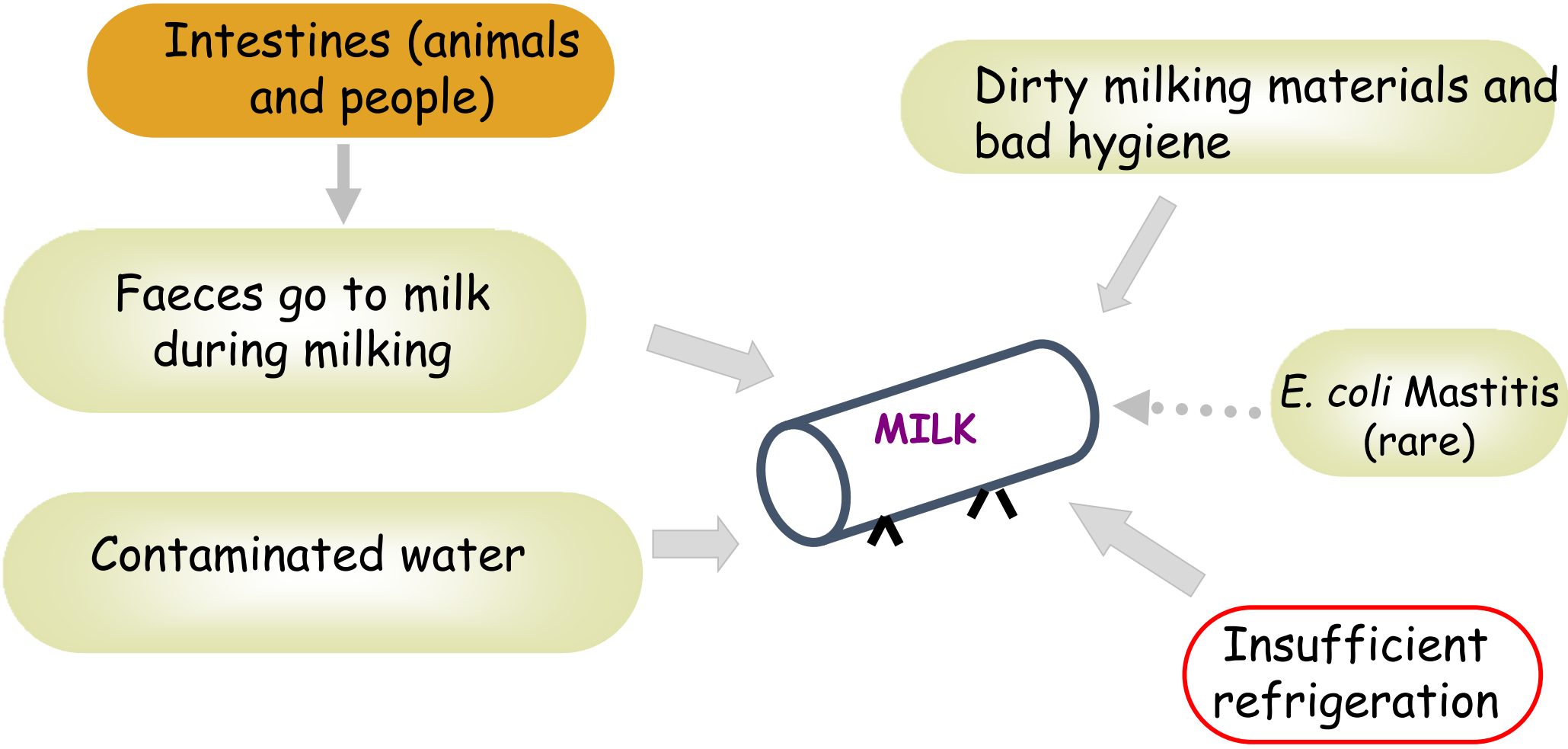
- SALT:
  - No growth > 6% w/w

- pH:
  - 4.4-9
  - Optimum: 6-7

- a_W*:
  - 0.95-0.995

*a_W(Water activity): The quantity of free water in foods, available for microorganisms. Scale 0 (min) to 1 (max)

ESCHERICHIA COLI, How Contamination Occurs?



How to Prevent Contamination in a Cheese Dairy?

- To prevent milk contamination
- Fast and sufficient refrigeration of milk
- Good hygiene practices: hands, clean materials and equipment
- Avoid contaminated water
- Pest control (reservoir)
- Lactic cheeses: right acidification

Are Cheeses Safe Foods?

Some official data about it

can be found in tool 9.10

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