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Lecture title: Milk contaminants (Part 1).

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Milk contaminants (Part 1)

There are many milk contaminants, which can be mainly classified into microbial and chemical contaminants.

Microbial contaminants of milk derive mainly from milking due to the exposure of udders to the environment, equipment, storage, dirty pipes, and others.

Chemical contaminants of milk come from several sources including:

1. Application of agrochemicals.
2. Use of legal or illegal veterinary products.
3. Feed and forages contaminated with natural toxins.
4. Improper use of chemicals during milk production, processing and packaging stages.

Contamination of milk can occur by two methods:

a. Direct contamination occurs during milk processing (milking, handling, storage and pasteurization) and milk industrialization.
b. Indirect contamination is associated with the ingestion of contaminants both from the environment and from substances of veterinary use.

Although pathogenic microorganisms (microbial contaminants) are considered the main hazard that threatens the safety of milk, they do not represent the highest percentage of reported cases, as they reached (14.57%). The most commonly reported contaminants are of chemical origin (85.43%), with heavy metals (22.18%), antibiotics (22.18%), pesticides (22.05%), mycotoxins (9.97%), and hormones (9.06%) (Figure 1).

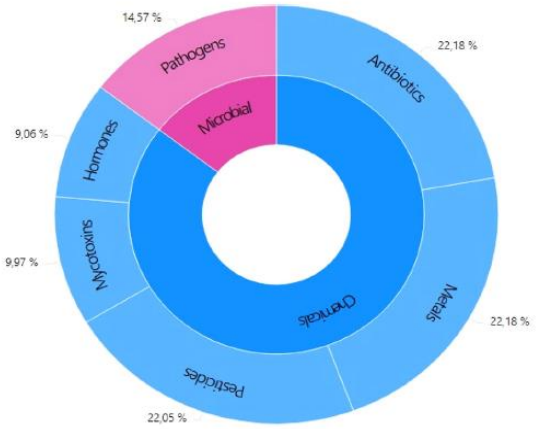

Figure 1: Distribution of contaminants in bovine milk between 2010-2021.

1. Microbial contaminants:

The presence of several pathogenic microorganisms has been reported in raw and pasteurized milk. Microbial contamination of raw milk can be due to:

1. Diseases such as mastitis.
2. Improper handling on production farms.
3. Milking equipment.
4. Water sources.
5. Feeding.
6. Utensils and equipment used for milk storage on the farm or during transport.
7. Poor hygienic practices within the dairy industry can lead to the formation of biofilms (A biofilm is a community of microorganisms attached to an inert or living surface by a self-produced polymeric matrix) on the sprinklers of cooling systems, pipes, cooling tanks, storage, and transport tanks (Figure 2). The contact of pasteurized milk with these surfaces increases the risk of contamination with pathogenic microorganisms, posing a danger to the consumer and the quality of the product.

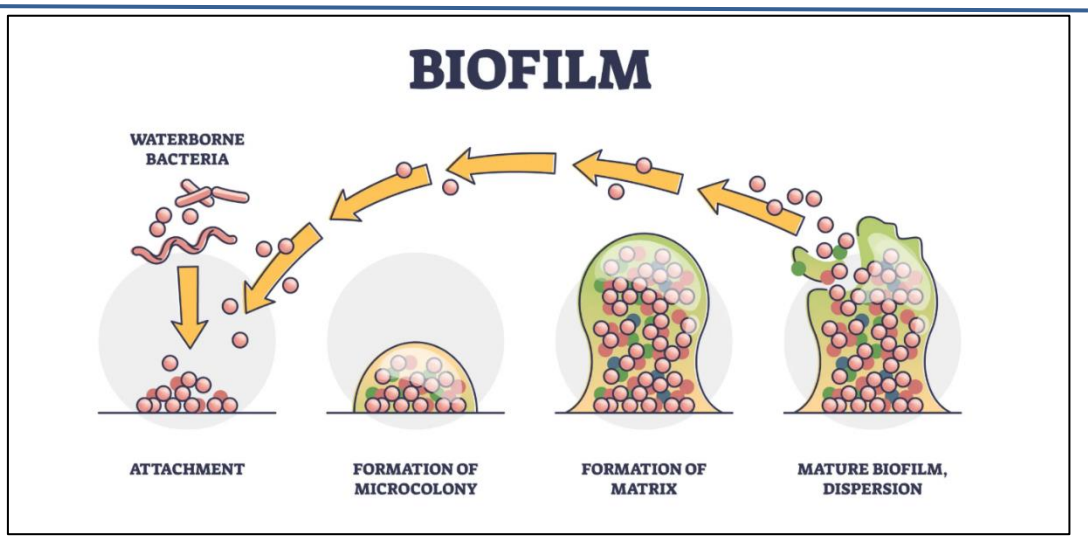

Figure 2: Biofilm formation.

The main types of microorganisms present in milk are bacteria, yeasts, and molds. Presence of Corynebacterium, Staphylococcus, Streptococcus, Bacillus, and Micrococcus species has been evidenced in the teat of dairy cattle. These bacteria have also been identified in milk, demonstrating that during milking, milk can become contaminated by contact with the teat under unhygienic conditions. In case of mastitis, Staphylococcus and Streptococcus species have been identified in milk samples, with *Staphylococcus aureus* being the main cause of mastitis. Enterobacteriaceae (Klebsiella, Enterobacter, Citrobacter, Salmonella, *Escherichia coli*, Shigella, Proteus, Serratia, and others), Pseudomonas spp., Staphylococcus spp., and lactic acid bacteria (Lactobacillus, Lactococcus, Enterococcus, Pediococcus, Leuconostoc, Streptococcus, Carnobacterium, Fructobacillus, Oenococcus, and Weissella) were identified in the equipment used for milking, indicating that milk is obtained on farms under unhygienic conditions. Consumption of milk contaminated by pathogenic microorganisms such as Campylobacter, Salmonella, Yersinia, *E. coli*, Listeria, and *Staph. aureus* (found in the intestinal flora

or in the udder of cows) can cause muscle and stomach pain, gastrointestinal diseases with diarrhea, fever, and nausea.

Yeasts genera that have been detected in raw milk include Kluyveromyces, Rhodotorula, Debaryomyces, Geotrichum, Pichia, Candida, Trichosporon and Cryptococcus. Several yeasts metabolize organic acids in fermented foods causing an increase in the pH and thus allowing the growth of spoilage and pathogenic bacteria. Some yeasts may pose additional threats to food safety because they are associated with opportunistic infections and other adverse conditions in humans.

Molds commonly found in raw milk include Penicillium, Geotrichum, Aspergillus, Mucor, Fusarium and Cladosporium. Molds are the main spoilage organisms of various food products, causing substantial economic losses. Also, some molds are capable of producing mycotoxins, which are associated with various adverse effects on human health including mutagenic, carcinogenic, and teratogenic effects.

Consumption of raw milk poses potential risks due to the possibility of transmission of certain parasites such as Toxocara larvae and Toxoplasma tachyzoites from infected lactating animals. In addition, milk-borne zoonotic outbreaks of cryptosporidiosis, giardiasis, and cysticercosis can occur due to fecal and environmental contamination of milk and milk products.