

A stylized illustration of a dental clinic. A dentist in a white coat is examining a patient's teeth. The patient is reclined in a dental chair. In the background, there is a large dental X-ray machine, a computer monitor displaying a dental arch and a lightbulb icon, and various dental instruments and equipment. The scene is brightly lit with yellow and white tones.

# Concepts of Microbiological Risk Profile

- ✓ Development through chain of Primary Production and Processing (PPP) standards require thorough assessment of risk to public health and safety.
- ✓ **Codex** defines risk as ‘a function of the probability of an adverse health effect and severity of that effect, consequential to a hazard in food’.
- ✓ **Risk profiling** is defined by FAO/ WHO as process of describing a food safety problem and its context in order to identify those elements of hazard/risk relevant to various risk management decisions.
- ✓ **Risk assessment** is a scientific process undertaken to characterize risk to public health and safety posed by food-borne hazards associated with a food commodity.
- ✓ Risk profile identifies and examines where biohazard may enter dairy supply chain from primary produce to processed food.
- ✓ Outcome of any assessment of risks to public health and safety may include a statement on probability of an adverse health effect due to consumption of food containing a biological, chemical or physical agent.

## **Microbiological Risk Profile**

- ✓ **The assessment of risks to public health and safety from microbiological hazards in milk and milk products has been undertaken in the form of a microbiological risk profile.**
- ✓ **Risk profile identifies key food safety hazards and assesses where in the primary production and processing supply chain these hazards might be introduced, increased, reduced or eliminated.**

## Scope and purpose

- Purpose of risk profile in dairy products is to provide an objective analysis of relevant scientific data and information to identify the public health and safety risks associated with dairy products.
- This will enable risk managers to consider risks associated with dairy products and reductions in risk that may be achieved with various production and process control options.
- Risk profile may also identify the need for more detailed microbiological risk assessments for specific dairy commodities like dairy products prepared from raw milk especially cheese.
- Microbiological risk profile identifies and examines hazards along the dairy supply chain from milk production through to consumption of dairy products.

## **Risk profile encompasses following elements:**

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- **Identification and description of micro-organisms associated with dairy products**

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- **Examination of prevalence and concentration data on potential hazards from products along the entire dairy food chain**

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- **Examination of epidemiological data (domestic and international) related to the consumption of dairy products**

**Risk profile identifies microbiological public health and safety risks associated with dairy products.**

**In compiling risk profile, scientific literature and information should be reviewed. Microorganisms should be representative of those that may be present in raw milk, either directly transmitted via mammary gland or via faecal/ environmental contamination.**

**Estimate of severity of adverse health effects caused by food-borne agent may be based on ranking scheme for food-borne pathogens and toxins described by International Commission on Microbiological Specifications for Foods.**

**ICMSF ranking scheme categorizes hazards by severity of threat they pose to human health i) likely duration of illness, ii) likelihood of death, iii) potential for ongoing adverse health effects.**

<b>Severity</b>	<b>Description</b>
Moderate	Not usually life threatening, no sequelae (morbid symptoms); normally short duration; symptoms are self-limiting; can be severe discomfort
Serious	Incapacitating but not life threatening, sequelae infrequent; moderate duration
Severe	Life threatening, or substantial sequelae, or long duration

Organism	Shed directly in milk#	Contaminant of raw milk##	Survives pasteurization.	Severity of illness §	Dairy products implicated in food-borne illness
<i>Aeromonas</i> spp.	×	✓	×	Serious	+
<i>Bacillus cereus</i>	×	✓	✓	Moderate	++
<i>Brucella</i> spp.	✓	✓	×	Severe	+
<i>Campylobacter</i>	×	✓	×	Serious	++
<i>Clostridium botulinum</i>	×	✓	*	Severe	+
<i>Clostridium perfringens</i>	×	✓	✓	Moderate	+
<i>Corynebacterium</i> spp.	✓	✓	×	Serious	+
<i>Coxiella burnetii</i>	✓	✓	×	Serious	+
<i>Cryptosporidium</i>	×	✓	×	Severe	+
<i>Enterobacter sakazakii</i>	×	✓	×	Severe <sup>^</sup>	++
Pathogenic <i>E. coli</i>	×	✓	×	Severe	++
<i>Listeria monocytogenes</i>	✓	✓	×	Severe <sup>^</sup>	++
<i>Mycobacterium avium</i> sub s. <i>paratuberculosis</i>	×	✓	×	-	-
<i>Mycobacterium bovis</i>	✓	✓	×	Severe	+
<i>Salmonella</i> spp.	×	✓	×	Serious	++
<i>Shigella</i> spp.	×	✓	×	Serious	+
<i>Staphylococcus aureus</i>	✓	✓	x**	Moderate	++
<i>Streptococcus</i> spp.	✓	✓	×	Serious	+
<i>Yersinia enterocolitica</i>	×	✓	×	Serious	+

**Summary of microorganisms to be generally considered in the risk profile**

## Grouping of Dairy Commodities

- Milk and cream
- Butter and butter products
- Concentrated milk products
- Dried milk powders
- Infant formulae
- Colostrum
- Ice-cream
- Dairy desserts
- Dairy-based dips
- Cultured and fermented milk products
- Cheese
- Indigenous dairy products
- Casein, whey products and other functional milk derivatives



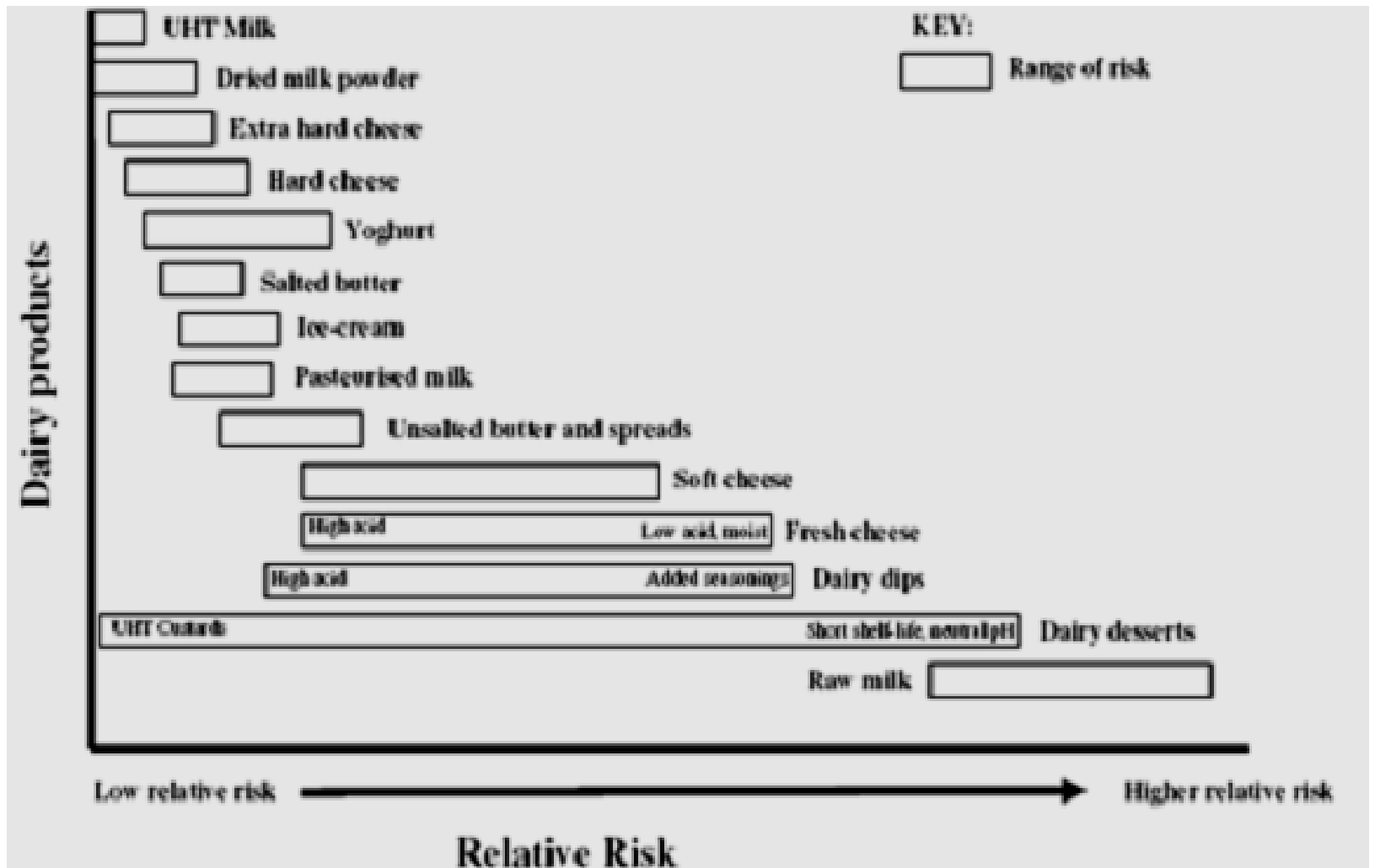
# Risk Ranking of Dairy Products

- ❖ Once shelf-stable UHT product is opened, it may become contaminated and when subjected to temperature abuse it could become a high-risk food.
- ❖ Low pH and low water activity of extra hard cheese means it will be very robust and unlikely to support growth of any pathogen that adventitiously contaminates surface.
- ❖ Dried milk powders and infant formulae are inherently stable products due to their low water activity, however, these products are prone to contamination and upon improper reconstitution become higher risk.
- ❖ Dairy products likely to support growth of pathogens and prone to contamination after pasteurization, may be categorized as **higher risk**, while dairy products that are inherently stable with respect to pathogens, classified as **low risk**.



## Risk ranking of dairy products

Risk ranking	Dairy product	Risk characterization
Higher risk	Unpasteurized	No pathogen reduction step
	Soft cheeses	Mild pH, long shelf life allowing growth of <i>Listeria monocytogenes</i>
	Dairy desserts	Mild pH, fermentable carbohydrate, long shelf life
	Fresh cheese	Dependent on variety - some have low acid, high moisture
	Dairy dips	Dependent on variety - some have low acid, high moisture, added ingredients
Intermediate risk	Unsalted butter	Absence of salt, high moisture content
	Low fat spreads	Absence of salt, high moisture content
Low risk	Pasteurized milk	Storage temperature only hurdle to control post-pasteurization contamination
	Ice-cream	Stored frozen, but soft serve may allow growth of <i>Listeria monocytogenes</i>
	Yoghurt	Low pH does not allow growth of pathogens
	Salted butter	High salt concentration
	Hard cheese	Low water activity, low pH
	Extra hard cheeses	Low water activity, low pH
	UHT milk	Commercially sterile
	Dried milk powder	Low water activity, however prone to contamination



Graphical presentation of relative risk ranking of dairy products

# Risk Management Issues and Control Strategies for Dairy Products

Quality of raw materials

Correct formulation

Effective processing

Prevention of recontamination of products

Maintenance of temperature control through dairy supply chain

**While pathogenic microorganisms may contaminate raw milk supplies, pasteurization is very effective Critical Control Point (CCP) in eliminating pathogens; good manufacturing practices must also be employed to ensure that post-pasteurization contamination does not occur. Aflatoxins can be formed and ingested by dairy cattle during feeding eventually contaminating milk.**

## **Correct formulation:**

- ❑ Ingredients used in manufacture of dairy products that are added post pasteurization must be of a high microbiological standard.**
- ❑ Many non-dairy ingredients added to ice-cream mix after heat treatment include fruits (canned, fresh, or frozen and usually in concentrated sugar syrups), nuts, chocolate, pieces of toffee and biscuit, colors and flavors.**
- ❑ These ingredients and those added to other dairy products such as yoghurt, dairy desserts, dairy dips and cheese may introduce pathogens into product.**
- ❑ Addition of ingredients added after pasteurization was identified as a high risk factor.**
- ❑ Microbial quality of dry-blended ingredients into infant formula was identified as a significant source of contamination as there is no heat treatment to destroy bacteria in the final product.**

## Effective processing (pasteurization):

- ❑ Dairy processing facilities use High Temperature Short Time (HTST) pasteurization (minimum 72°C for 15 secs) or batch pasteurization (65°C for 30 mins) and then rapid cooling to 7-8°C to eliminate pathogens in milk.
- ❑ Some milk and dairy products are consumed as RTE foods and will readily support growth of contaminating microorganism.
- ❑ Dairy industry has been subjected to high level of food safety regulation ensuring high levels of hygiene and sanitation are maintained.
- ❑ Pasteurization process eliminates all pathogenic bacteria found in raw milk, with exception of *B. cereus* and *C. perfringens*.



**HTST pasteurization**  
Milk heated at 72 °C for 15 seconds, then bottled and refrigerated



**UHT pasteurization**  
Milk heated at 138 °C for 2 or more seconds, then sealed in airtight containers for up to 90 days without refrigeration

Milkborne organisms killed by pasteurization: *Campylobacter jejuni*, *Coxiella Burnetii*, *Listeria monocytogenes*, *Escherichia coli* O157:H7, *Mycobacterium tuberculosis*, *M. paratuberculosis*, *Salmonella* spp., *Yersinia enterocolitica*

## Prevention of recontamination of product:

- ❑ Post-pasteurization contamination can pose a major problem where good manufacturing practices are not employed.
- ❑ Pathogenic microorganisms can be introduced into dairy processing environment with raw milk.
- ❑ Once these organisms gain access to processing plant, presence of nutrients and moisture can allow not only for survival but also multiplication of these organisms.
- ❑ Application of food safety programs including elements of GMP and GHP are critical to limit potential for pathogens to contaminate dairy products after pasteurization.
- ❑ Primary organisms of concern are *Listeria monocytogenes* for most dairy products and *Salmonella* in dried milk products.



# Maintenance of temperature control through the dairy supply chain:

- ❑ Intrinsic nature of many dairy products means they will support growth of pathogenic bacteria that may contaminate product, categorizing as 'potentially hazardous foods'.
- ❑ Exception: Yoghurt and hard cheeses (low pH) and ice-cream (stored frozen).
- ❑ As these are potentially hazardous foods, maintenance of temperature control through dairy supply chain is critical to ensure foods remain safe and suitable.

