Relating Microbiological Testing and Microbiological Criteria to Public Health Goals

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Industry uses of microbiological testing and microbiological criteria in the manufacturing and marketing of processed foods

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Different types of criteria exist

They are used to determine the acceptability of a food.
**Microbiological standards**

They are used to determine the acceptability of a food or compliance with regard to a regulation or policy.

**Microbiological guidelines**

Are advisory and may be established to indicate expectations when best practices are applied to manufacture safe foods.
**Microbiological specifications**

*Industry Retail*

Purchase specifications defining the microbiological limits for an ingredient or a finished product.

*Supplier*

*Customer*

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**How are criteria established?**

**Basic Texts**

Codex Alimentarius

**PRINCIPLES FOR THE ESTABLISHMENT AND APPLICATION OF MICROBIOLOGICAL CRITERIA FOR FOODS**

CAC/GL21 -1997

Based on principles of the ICMSF (Vol 2)
New approach - From MRA

ALOP → FSO/PO → MC

FSO

Micro Criteria

Goal for process design to obtain acceptable food.

Applied to processing operations

Statement of conditions that differentiates acceptable from unacceptable lots of food.

Applied to individual lots or consignments of food.

(Comparison of a few elements only; for more see ICMSF Vol 7)

Food Chain - Example

Performance objective

Performance criterion

Control Measure

Food Safety Objective

Public health burden

primary production
manufacturing
transport
retail
preparation
cooking
consumption
exposure

control measure
control measure
control measure
How are FSO or PO used by industry?

\[ H_0 - \Sigma R + \Sigma I_{RC+G} \leq FSO / PO \]

Starting level  
Increase  
RC: Recontamination  
G: Growth  
Hazard level at moment of consumption  
Reduction  
Hazard level in the food chain

Food Chain - Ingredients

MANUFACTURE

Specifications
Ingredients - Specifications

- Milk Powder
- Different usage
- Different specifications

Ingredients - Specifications

- High Risk Level - Ingredient
  - Historical data
  - Usage and further processing
  - Type of finished product
  - Requirements
  - Supplier audits
  - etc...

Confidence Level - Supplier

High
**Food chain - Finished Goods**

MANUFACTURE

Specifications

Criteria Guidelines Specifications

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**Why not relying only on end product testing?**

10 samples
0.1% contaminated ~1% probability of detection

10 samples
20% contaminated ~35% probability of acceptance

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Why not relying only on end product testing?
Food chain - Manufacturing

In processing testing

MANUFACTURE

Specifications

Criteria
Guidelines
Specifications

Food chain - Example of Infant Formula

WET

DRY

CCP
How to control Salmonella or Enterobacteriaceae?

Medium Hygiene

High Hygiene

Zoning includes appropriate

- Design of building(s),
- Design of air handling/flow,
- Flow of people and materials

How to control Salmonella or Enterobacteriaceae?

WET CLEANING

DRY CLEANING
How to control Salmonella or Enterobacteriaceae?

Consequences of wet cleaning

How to control Salmonella or Enterobacteriaceae?

Low levels of EB can only be achieved in the total absence of water
Food Chain - Manufacturing

In processing testing

MANUFACTURE

Product / Semi-finished product

Line - Food contact surfaces including residues

Environment - Points close to remote from line

Line samples - Examples

Sampling of food contact surfaces - line samples
Environmental samples - Examples

Sampling of the processing environment
Environmental samples - Examples

Sampling of the processing environment

Environmental samples - Impact

Deviations in environmental samples such as

Positive *Salmonella* result

Enterobacteriaceae above an defined level

Abnormal situations - maintenance, cleaning, etc.

have an immediate impact on sampling frequencies of line samples and finished product samples.
How to model relationship between line and product samples?

Proportion of positive results $\Rightarrow C_{L,t}$

$n_2=4$

Line
(first powder, sieve output, first & last can)

Product
(can/soft pack)

$n_1=2$

How to model relationship between line, product and environmental samples?

Environment E1

$c_{E1,t} \sim N(???,???)$

$c_{L,t} \sim N(???,???)$

$c_{P,t}$

$\rho_{P,L}=???

$\rho_{P,E1}=???

Performance of processing line

$c_{L,t} \sim N(???,???)$

$c_{P,t}$

$\rho_{P,L}=???

$c_{E1,t} \sim N(???,???)$
Trend analysis to see effects or to detect impact of modifications or deviations

Trends of Enterobacteriaceae in high hygiene zone after the implementation of more stringent preventive measures

Trend analysis to see effects or to detect impact on finished product.
Trend analysis to see effects or to detect impact on finished product.

Comparison of sampling plans – Performance (Enterobacteriaceae)

- **Codex or EU**: n = 10, c = 0, m = 0 (10g) - FP
- **ICMSF**: n = 15, 30, 60
- **Boué (+environmental)**: n = 7 (+5), c = 0, m = 0 (10g) - FP + L
- **Boué**: n = 2; c = 0, m = 0 (10g) - FP
- **Nestec (CP-08.714)**: n = 12 (+10), c = 0, m = 0 (10g) - FP + L

Probability of acceptance vs. Concentration (cfu/g)
**Effective methods to test FP, L, E**

**Influence of temperature**

- **30°C**: Others, C. freundii, A. calco., E. coli, E. sakazakii, E. cloacae, E. agglomerans
- **37°C**: Others, C. freundii, A. calco., E. coli, E. sakazakii, E. cloacae, E. agglomerans
- **42°C**: Others, C. freundii, A. calco., E. coli, E. sakazakii, E. cloacae, E. agglomerans

*E. sakazakii* difficult (if at all) to find in environmental samples if competitive flora (EB) important.