ICMSF Guidance on Microbiological Sampling and Testing for Key Commodities

Dr. Wayne Anderson,
Food Safety Authority of Ireland
Member of the ICMSF

IAFP Europe Symposium
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Discussion Topics

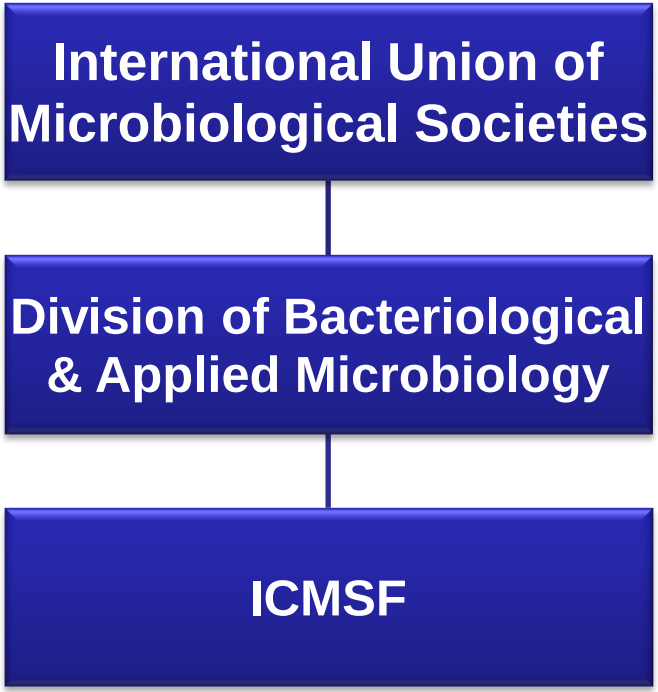
ICMSF background

ICMSF Book 8 Use of data for process control and product acceptance

- Different tests serve different purposes
- Testing for maximum value

WWW.ICMSF.ORG

International Commission on Microbiological Specifications for Foods – ICMSF



Founded in 1962 through the International Union of Microbiological Societies (IUMS)

Goal – to provide timely, science-based guidance to government and industry on appraising and controlling the microbiological safety of foods.

The primary objectives of ICMSF include:

1. Providing the scientific basis for microbiological criteria and to promote principles for their establishment and application.
2. Overcoming the difficulties caused by nations' varying microbiological standards and analytical methods.

How ICMSF Works

Annual meeting location varies

Members' experience includes research, process development, public health, food technology, quality control and education

All work is voluntary and without honoraria

Partners with FAO, WHO, IUFoST, IAFP etc.

2018 ICMSF Membership

7 Academia, 6 Industry, 4 Government, **14 Countries**

Dr. Martin Cole, CSIRO, Australia (Chair)

Dr. Jeffrey Farber, University of Guelph, Canada (Treasurer)

Dr. Katherine Swanson, KMJ Swanson Food Safety Inc., USA (Secretary)

Dr. Wayne Anderson, Food Safety Authority of Ireland, Ireland

Dr. Lucia Anelich, Anelich Consulting, South Africa

Dr. Kiran Bhilegaonkar, Indian Veterinary Research Institute, India

Mr. Suchart Chaven, Pepsi-Co International, Ltd, UAE

Dr. Roger Cook, Ministary of Primary Industries, New Zealand

Dr. Paul Cook, Food Standards Agency, UK

Dr. Ratih Dewanti-Hariyadi, Bogor Agricultural University, Indonesia

Dr. John Donaghy, Nestle Ltd, Switzerland

Dr. Leon Gorris, Unilever, The Netherlands

Dr. Fumiko Kasuga, National Institute of Environmental Studies, Japan

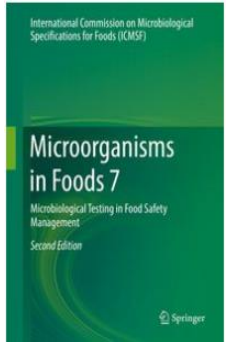
Dr. Peter McClure, Mondelez International, UK

Dr. Tom Ross, University of Tasmania, Australia

Dr. Marta Taniwaki, Instituto de Tecnologia de Alimentos, Brazil

Dr. Marcel Zwietering, Wageningen University, The Netherlands

ICMSF books



Book 1: Methods 1968

Book 2: Sampling Plans 1st ed 1974

Book 3: Microbial Ecology 1st ed 1980

Book 2: Sampling Plans 2nd Ed 1986

Book 4: HACCP 1988

Book 5: Pathogens 1996

Book 6: Microbial Ecology 1998

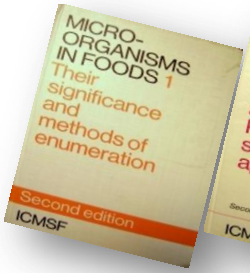
Book 7 MRM metrics/FSO 2002

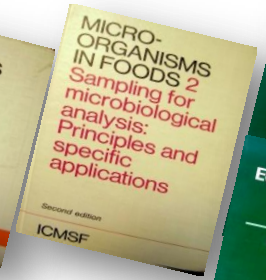
Book 6: 2nd 2005

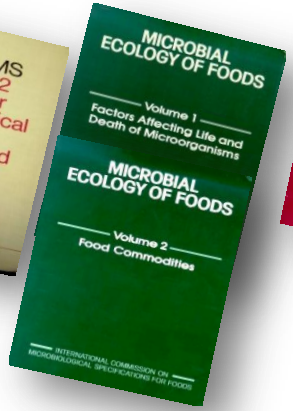
Book 8: Testing 2011

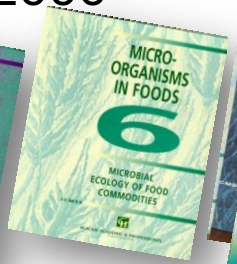
Book 7 2nd ed

1960 1970 1980 1990 2000 2010 2020

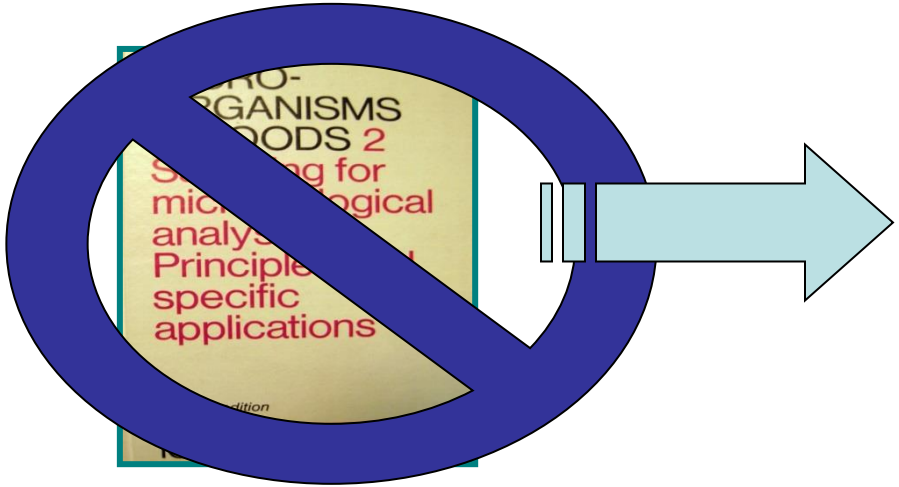


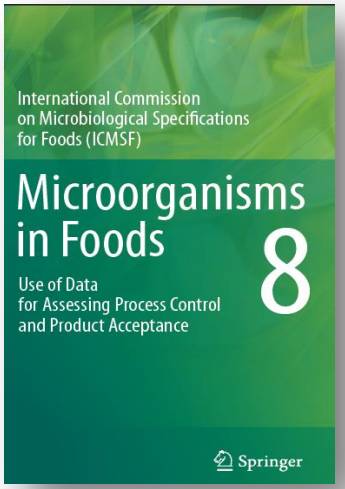






Microorganisms in Foods 8: Use of Data for Assessing Process Control and Product Acceptance





Update previously recommended end-product testing criteria

Add other useful tests for specific product types

Include microbial food safety and quality

Book 8 – Part 1: Principles

- Utility of microbial testing for safety & quality
- Validation of control measures
- Verification of process control
- Verification of environmental control
- Corrective action to re-establish control
- Microbial testing in customer-supplier relationships

Book 8 – Part 2: Products

Meats

Poultry

Seafood

Feed & pet food

Vegetables

Fruits

Spices, dried soups, flavorings

Cereals

Nuts, oilseeds, dried legumes

Cocoa and confectionery

Oil based foods

Sugar, syrups, honey

Beverages

Water

Dairy products

Eggs

Shelf stable, heat treated foods

Dry foods for infants

Combination foods

PART 1:
Different Tests Serve Different Purposes

Microbiological Testing Can Assess:

- If a food is unsafe (but not if a food is safe)
- Validation and verification procedures in HACCP
- Adherence to GMP/GHP
- The suitability of a food or ingredient for a particular purpose
- The keeping quality (shelf-life) of certain perishable foods

When & Where to Test

When there is good evidence that:

- There is a microbiological problem
  - Food safety or quality
  - Historical or current

AND

- Testing will help to control the problem

The purpose of a test determines:

The target	Indicator or pathogen
The method	Time to results, accuracy, repeatability, etc.
The sample	Environment, line residue, end product, location collected, size/ number of samples
The frequency	Daily, weekly, monthly, etc. or event triggered
The interpretation	Investigational, routine, regulatory, etc.
The action	Rejection, process adjustment, recall, outbreak investigation, etc.

Target Organism Examples

ICMSF Hazard Categories

Utility	Spoilage, reduced shelf life, no health concern	Aerobic colony counts, yeast, mold, etc.
Indicator	Measure of GHP	Enterobacteriaceae, generic *E. coli*
Moderate hazard	Not life threatening, short duration, self limiting, no sequelae	*S. aureus*, *B. cereus*, *C. perfringens*, *V. parahaemolyticus*
Serious hazard	Incapacitating, usually not life threatening	Salmonellae
Severe hazard	Life threatening, chronic sequelae, or long duration OR Designed for sensitive sub-population	*E. coli* O157:H7, *C. botulinum* toxin or *Cronobacter* (infants) *L. monocytogenes* (sensitive populations)

ICMSF Suggested Sampling Plans

FOR LOT ACCEPTANCE

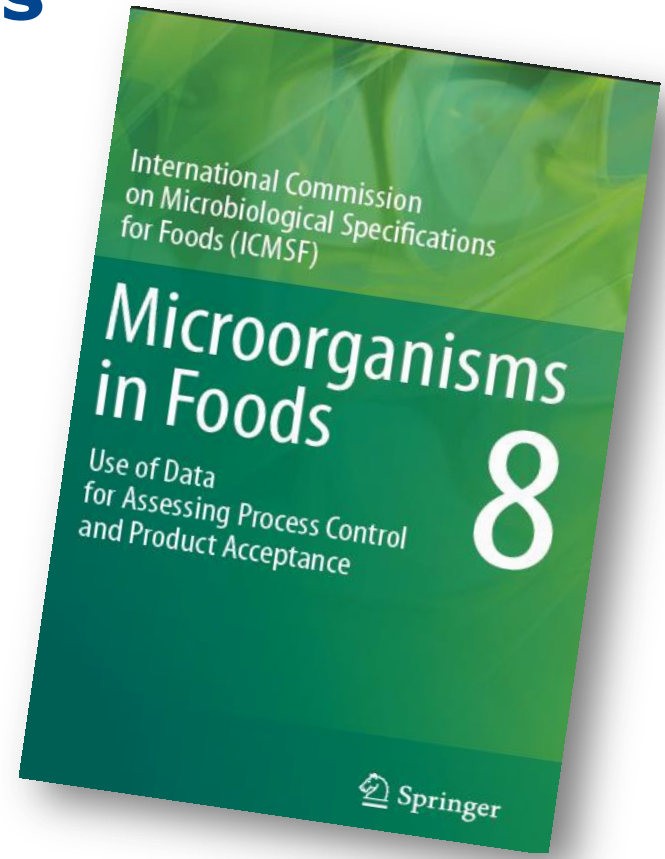
Hazard Group	Likely Change Before Consumption		
	Reduce	No Change	Increase
Utility	Case 1 n=5, c=3	Case 2 n=5, c=2	Case 3 n=5, c=1
Indicator	Case 4 n=5, c=3	Case 5 n=5, c=2	Case 6 n=5, c=1
Moderate	Case 7 n=5, c=2	Case 8 n=5, c=1	Case 9 n=10, c=1
Serious	Case 10 n=5, c=0	Case 11 n=10, c=0	Case 12 n=20, c=0
Severe	Case 13 n=15, c=0	Case 14 n=30, c=0	Case 15 n=60, c=0

Analytical unit often 25g

PART 2:
Testing for Maximum Value

Testing Considerations

- Primary production
- Ingredients
- In-process
- Processing environment
- Shelf life
- End product



Primary Production

Included when production conditions have a major influence on the microbial quality or safety

- Fruits, vegetables, spices, meat, poultry and fish products

Examples of samples to consider

- Irrigation water
- Fertilizer
- Feed
- Other on-farm practices

E.g.: Agricultural Waters

Use	Impor-tance	Hazard or Indicator	Testing method / Analytical Unit	n	c	m	M
Irrigation of raw produce	High	*E. coli*	ISO 9308-1 100 ml	3	1	10	10^2
Irrigation of produced to be cooked	Medium	*E. coli*	ISO 9308-1 100 ml	3	1	10^2	10^3
Pesticide, cleaning, etc.	High	*E. coli*	ISO 9308-1 100 ml	5	0	Absence in 100 ml	NA

Ingredient Testing

May be useful for some applications and not others

Example - cocoa powder:

- ☑ Used in chocolate, no heat treatment
- ? Used in ice cream mix that is subsequently pasteurized

Question

- Is control at the ingredient step necessary?

In-Process Testing

Verify a kill step or predict potential re-contamination

Examples

- Intermediate product, line residues, tailings, wash water
- Typically indicators with quantitative results

Questions:

- Is the process needed to control a microbial concern?
- Is testing needed to verify:
  - the process is functioning as intended or
  - contamination is not occurring in the process?

E.g. Chocolate Confectionary

Test	Impor-tance	Hazard or Indicator	Testing method	Typical limits encountered
Critical Ingredients: Cocoa powder, milk powder	High	*Salmonella*	ISO 6579	absent
In-Process: cocoa powder product	Medium	*Salmonella* Enterobacteriaceae ACC Osmophilic yeasts and xerophilic moulds (a_W>0.6)	ISO 6579 ISO 21528-1 ISO 4833 ISO 21527-2	absent ≤10 cfu/g FBO limits ≤10 – 10^2 CFU/g
In Process: Product residues from contact surfaces	High	*Salmonella* Enterobacteriaceae ACC	ISO 6579 ISO 21528-1 ISO 4833	absent ≤10 cfu/g FBO limits

Processing Environment Testing

Use to verify that the environment is under appropriate hygienic control

Examples

- Swabs or sponges for equipment or in the environment
- Rapid testing to verify cleaning & sanitation adequacy

Identify harborage sites that can contaminate end product

Frequently, earlier detection of issues than end product testing

Questions considered:

- Does the environment need to be controlled to prevent contamination?
- Will testing be beneficial to verify control?

E.g. Dried cereal products

Test	Impor-tance	Hazard or Indicator	Testing method	Typical limits encountered
Process environment: line residues	High	Salmonella	ISO 6579	Absence in 25g
Process environment: line residues	Medium	Enterobacteriaceae	ISO 21528-1	$\leq 10^2 - 10^3$ CFU/g

Shelf Life Testing

Relevant for products subject to microbial spoilage

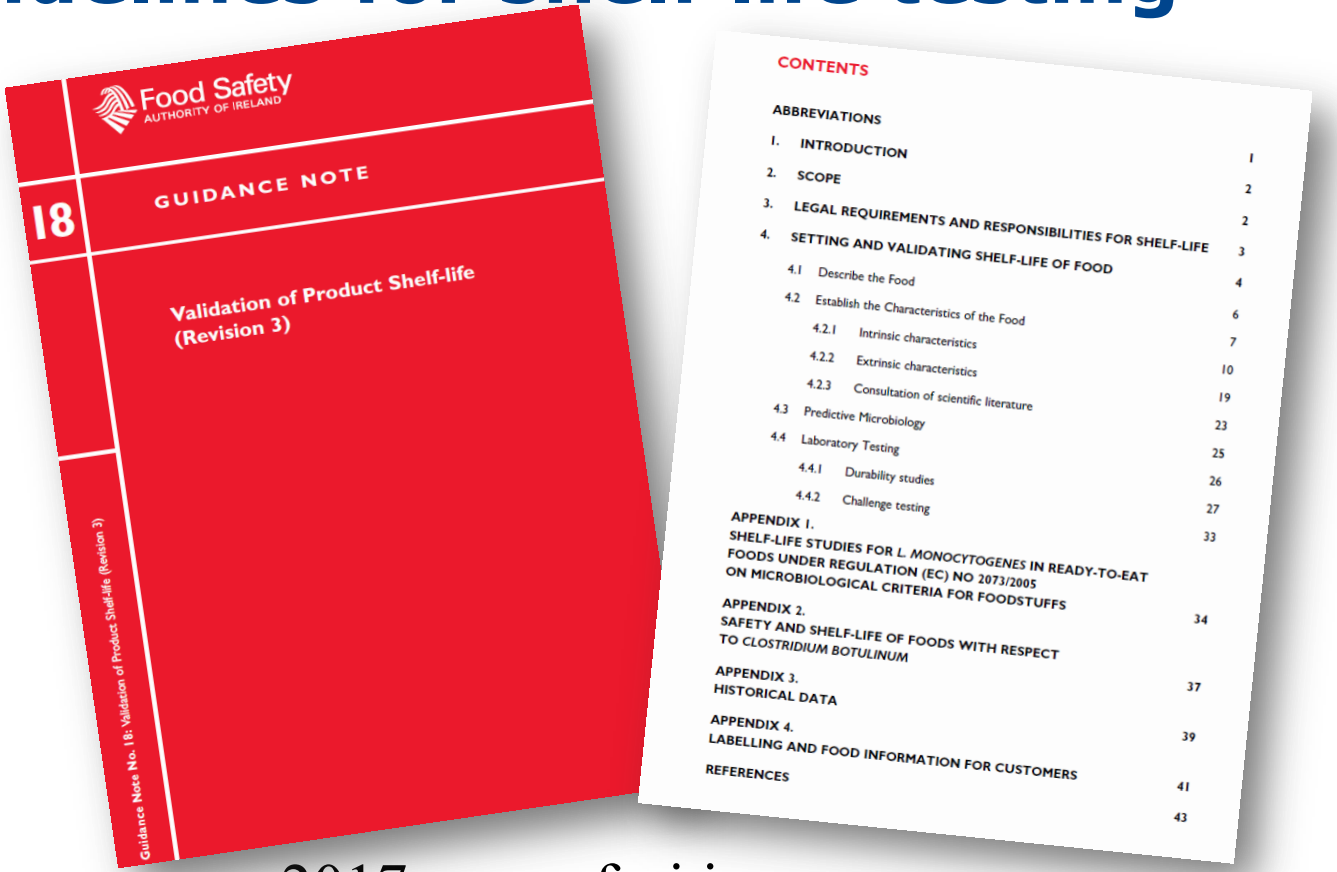
Purpose – verify microbial stability for the product life cycle

May predict issue before they are experienced in the market place

Questions considered:

- Is shelf life limited by a microbiological safety or quality concern?
- Is shelf life testing feasible?
- Is there a legislative requirement?

Guidelines for shelf life testing



2017: www.fsai.ie

End Product Testing

Demonstrate successful application of controls or assess the status of a lot when no other information exists.

Alternative sampling plans may be appropriate, for example:

- Fewer samples for on-going surveillance activity
- More samples when investigating significant process deviations or outbreaks.

Questions considered:

- Is end product testing necessary to verify the overall manufacturing process?
- Is end product testing relied upon for ensuring the safety or quality of the lot?

E.g: Comminuted Meat

Relative importance		Useful testing
End product	Medium	Test for indicators for on-going process control and trend analysis of freshly packaged product using internally developed guidelines. Levels developed for processing do not apply during distribution or at retail.

Product	Microorganism	Analytical method	Sampling plan & limits/g				
			Case	n	c	m	M
Raw comminuted meat	E. coli	ISO 16649-2	4	5	3	10	10^2

		Routine testing is not recommended for salmonellae on raw comminuted meat products. In regions where ground beef is a continuing source of E. coli O157:H7 illness, the following criteria are recommended.
End product	Medium	

Product	Microorganism	Analytical method	Sampling plan & limits/25g*				
			Case	n	c	m	M
Ground beef	*E. coli* O157:H7 (STEC)	ISO 16654 (ISO/TS 13136:2012)	14	30[a]	0	0	NA

[a] individual 25g analytical units

E.g: Dried Ready-to-Eat Cereal

Relative importance		Useful testing							
End product	High	Testing for Enterobacteriaceae is recommended to verify process control							
		Product	Microorganism	Analytical method	Sampling plan & limits/g				
					Case	n	c	m	M
		Dried Cereal	Enterobacteriaceae	ISO 21528-2	2	5	2	10	10^2
	Low	Testing for pathogens is not recommended during normal operation when GHP and HACCP are effective as confirmed by above tests. When above testing or process deviations indicate a possible safety issue, testing for Salmonella is recommended.							
		Product	Microorganism	Analytical method	Sampling plan & limits/25g*				
					Case	n	c	m	M
		Dried Cereal	*Salmonella*	ISO 6579	11	10[a]	0	0	NA

[a] individual 25g analytical units

E.g: Fresh cut RTE vegetables

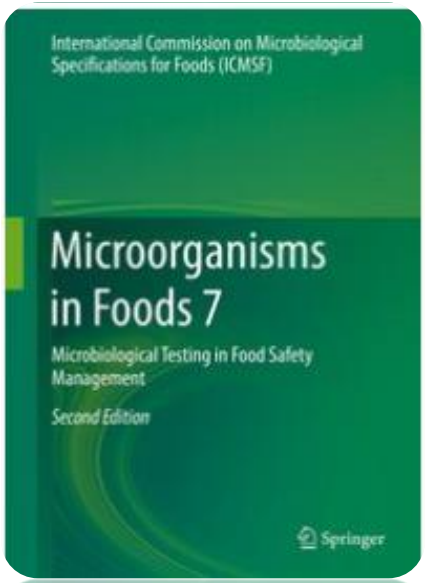
Relative importance		Useful testing							
End product	High	Routine microbiological testing is not recommended but periodic testing for specific indicators using internal standards or those below may be useful for verifying process control and trend analysis							
		Product	Microorganism	Analytical method	Sampling plan & limits/g				
					Case	n	c	m	M
		Fresh cut vegetables	*E. coli*	ISO 7251	6	5	1	10	10^2
	Low	Routine microbiological testing for pathogens is not recommended. Test for pathogens only when other data indicate potential for contamination.							
		Product	Microorganism	Analytical method	Sampling plan & limits/25g*				
					Case	n	c	m	M
		Fresh cut vegetables	*Salmonella*	ISO 6579	12	20[a]	0	0	NA
			E.coli O157:H7 *(STEC)*	ISO 16654 (ISO/TS 13136:2012)	15	60[a]	0	0	NA
			L. monocytogenes	ISO 11290-1	N/A	5[a]	0	0	NA

[a] individual 25g analytical units

Microbial Sampling Summary

- Testing safety “into” products usually does not work because of sampling probability
- Testing is recommended to generate meaningful data
  - Impact quality or safety
  - Verify appropriate controls or direct corrective action
- Focus on verification of process control preferred
  - Environmental monitoring
  - Selected sampling tailored to the line to verify control

http://www.springer.com/la/book/9783319684581



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