

Sampling and Sampling plan

Sampling and Sampling plan

▶ Why do we have to set the sampling plan and collect samples?

▶ Control of microbiological hazard in foods

▶ Education and training

▶ Inspection of facilities and operations

▶ minimize hazard

▶ Sampling for microbiological analysis

▶ sampling plan → quality of batch → release safe food

Sampling plan

Sampling plan: a statement of criteria of acceptance applied to a lot (batch) based on appropriate examinations of a required number of sample units by specific methods

- ▶ Number of units
- ▶ Sampling procedure
- ▶ Decision criteria (Microbiological criteria)
- ▶ two or three class plan

Microbiological criteria

▶ Mandatory criterion

▶ Microbiological std.

- ▶ Limit for pathogens of public health significance
- ▶ Limit for non-pathogens

▶ ICMSF (International Commission on Microbiological Specifications for Foods)

- ▶ Std. is part of a law and regulation
- ▶ Enforceable by regulatory agencies

▶ Advisory criterion

▶ Microbiological end product specification

- ▶ Increase assurance of product hygiene

▶ Microbiological guideline

- ▶ During or after processing to monitor hygiene

Microbiological criteria

- ▶ Codex
- ▶ Consists of 5 components:
 - ▶ The organisms of concerns and/or toxins
 - ▶ The analytical methods for detection and quantitation
 - ▶ A sampling plan
 - ▶ When and where samples are to be taken
 - ▶ Microbiological limits
 - ▶ The number of sampling units

Valid samples

- ▶ Representative
 - ▶ representative of the batch/lot of products
 - ▶ batch? →
 - ▶ lot? →
 - ▶ Representative samples depend on ? →
- ▶ Aseptically collected
- ▶ Sterile equipment
- ▶ Stored properly

Equipment and reagents


Equipment	Reagents
<ul style="list-style-type: none">▶ Instrument for opening▶ Transfer instrument▶ Sample container▶ Thermometer▶ Label supplies▶ Shipping container▶ Balance▶ Blender and mixers	<ul style="list-style-type: none">▶ Microbicide▶ Agent for dilution

How large a sample is required?

- ▶ Physical limitation
 - ▶ How many samples can be tested per day
- ▶ Population
 - ▶ types of samples
 - ▶ Heterogeneous
 - ▶ Homogeneous
- ▶ Estimation → lot size

$$\sqrt{\text{Number of unit} + 1}$$

Microbiological limit

- ▶ Defect acceptability limit
 - ▶ Based on microbiological testing
 - ▶ Consumer risk:
 - ▶ The risk that the consumer takes
 - ▶ lot does not conform the requirement accepted
 - ▶ normally 10%
 - ▶ Producer risk:
 - ▶ the risk that the producer takes
 - ▶ lot conform the requirement  rejected
 - ▶ normally 5%

Steps for choosing sampling plan

- ▶ Select the measurement
- ▶ Define the sampling unit
- ▶ Determine: consumer or producer risk to ensure the lot quality
- ▶ Obtain an estimate process
- ▶ Select a plan that meet the risk and lot quality
- ▶ Calculate operating characteristic curve (probability of acceptance)
- ▶ Apply the plan on the lot
- ▶ Maintain record on process or make change the plan if necessary

Sampling plan

- ▶ Variable sampling plan

- ▶ The probability distribution is required (normal distribution)
- ▶ Fewer samples are required

- ▶ Attribute sampling plan

- Two class plan

- Three class plan

- ▶ Do not know the distribution
- ▶ Larger samples are required

Two class plan

- ▶ Simple plan used to designate acceptable or unacceptable batch/lot of food
- ▶ Specification: n, c, m
 - ▶ n = the number of sampling units from the lot
 - ▶ c = the maximum allowance number of sample units that exceed the microbiological criterion
 - ▶ m = the maximum number or level of relevant bacteria (CFU/gm or ml) (std. acceptable criteria)

Two class plan

- ▶ Sampling plan in beef

Salmonella	$n=20$	$c=0$	$m=0$
Coliform	$n=5$	$c=2$	$m=10^2$

- ▶ More stringent plan

- ▶ increasing number of unit (n)
- ▶ reducing the maximum allowance number (c)

Two class plan

- ▶ Salmonella $n=20$ $c=0$ $m=0$
 - ▶ All samples must be negative
 - ▶ If one sample is positive, entire lot should be rejected
 - ▶ To make more effective sampling plan
 - ▶ increasing number of unit (n)

Three class plan

- ▶ Used to designate acceptable/marginally acceptable/unacceptable food
- ▶ Specification: n, c, m, M
 - ▶ n = the number of sampling units from the lot
 - ▶ c = the maximum allowance number of sample units that exceed the microbiological criterion
 - ▶ m = the maximum number or level of relevant bacteria (CFU/gm or ml) (Threshold value)
 - ▶ M = the maximum number that use to separate marginally acceptable/unacceptable quality food (Maximum permitted microbial level)

Three class plan

▶ Sampling plan in raw chicken

APC	$n=5$	$c=5$	$m=5 \times 10^5$	$M=10^7$
<i>E. coli</i>	$n=5$	$c=2$	$m=11$	$M=5 \times 10^2$

- ▶ Acceptable: C samples have M/O level between m and M , other samples have level of M/O less than m
- ▶ Satisfactory: All samples have M/O level less than M
- ▶ Unacceptable: If one or more samples have level of M/O more than M

Three class plan

Aerobic plate count (APC)

$$n=5 \quad c=5 \quad m=5 \times 10^5 \quad M=10^7$$

- ▶ None of the unit n more than M
- ▶ If any sample more than, entire lot is rejected
 - ▶ unacceptable
- ▶ c units can more than m
 - ▶ acceptable
 - ▶ marginally acceptable (Satisfactory)
- ▶ To make more effective sampling plan
 - ▶ increase n
 - ▶ reduce m

Sampling plans and microbiological limit in foods

ICMSF

Products	Tests	Case	Class plan	<i>n</i>	<i>c</i>	<i>m</i>	<i>M</i>
Precooked breaded fish	APC	2	3	5	2	5×10^5	10^7
	<i>E. coli</i>	5	3	5	2	11	500
	<i>S. aureus</i>	8	3	5	1	10^3	10^4
Raw chicken (fresh or frozen), during processing	APC	1	3	5	3	5×10^5	10^7
Frozen vegetables and fruit, pH 4.5	<i>E. coli</i>	5	3	5	2	10^2	10^3
Comminuted raw meat (frozen) and chilled carcass meat	APC	1	3	5	3	10^6	10^7
Cereals	Molds	5	3	5	2	10^2-10^4	10^5
Frozen entrées containing rice or corn flour as a main ingredient	<i>S. aureus</i>	8	3	5	1	10^3	10^4
Noncarbonated natural mineral and bottled noncarbonated waters	Coliforms	5	2	5	0	0	–
Roast beef	<i>Salmonella</i>	12	2	20	0	0	–
Frozen raw crustaceans	<i>S. aureus</i>	7	3	5	2	10^3	10^4
	<i>V. parahaemolyticus</i>	8	3	5	1	10^2	10^3
	<i>Salmonella</i> ^a	10	2	5	0	0	–
	APC ^b	2	3	5	2	5×10^5	10^7
	<i>E. coli</i> ^b	5	3	5	2	11	500
	<i>S. aureus</i> ^b	8	2	5	0	10^3	–

Sampling plans and microbiological limit in foods

Poultry product

	n	c	m	M
▶ APC	5	3	10^4	10^5
▶ <i>S. aureus</i>	5	1	10^2	10^4
▶ <i>E. coli</i>	5	2	10	10^2
▶ Salmonella	10	0	0	-

Dried milk

▶ Mesophilic count	5	2	5×10^4	2×10^5
▶ Coliform	5	1	10	10^2
▶ Salmonella	15	0	0	-

Degree of health hazard and conditions of use

Type of Hazard	Conditions in Which Food Is Expected to Be Handled and Consumed after Sampling		
	Reduce Degree of Hazard	Cause No Change in Hazard	May Increase Hazard
<i>No direct health hazard</i>			
Utility (e.g., general contamination, reduced shelf-life, and spoilage)	Case 1	Case 2	Case 3
<i>Health hazard</i>			
Low, indirect (indicator)	Case 4	Case 5	Case 6
Moderate, direct, limited spread	Case 7	Case 8	Case 9
Moderate, direct, potentially extensive spread	Case 10	Case 11	Case 12
Severe, direct	Case 13	Case 14	Case 15

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