Why do we have so many different types of sampling plans ?

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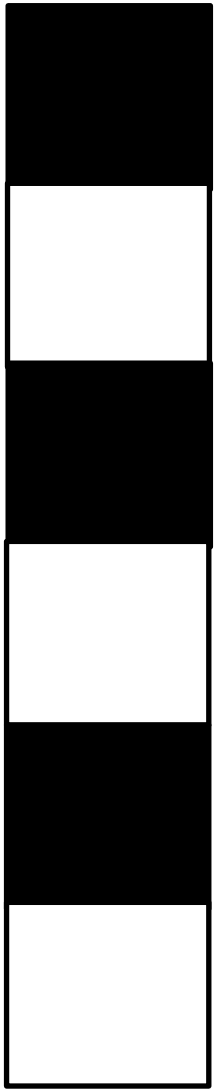
Why different types: it is not black and white



indicators / hygiene indicators

toxigenic organisms / infective organisms

target group: general population, infants, medicinal food

potential after sampling point (inactivation, stable, growth)

50 shades of red

Total Plate Count

Mesophiles

Enterobacteriaceae

Bacillus cereus

Campylobacter in raw poultry

Salmonella in raw poultry

Salmonella in RTE food

Salmonella in PIF

(Hygiene) Indicators

Inactivation after sampling point

Target group: infants

RTE= Ready to Eat

PIF = Powdered Infant Formula

Types of sampling plans

Qualitative
2-class
Food Safety Criteria

Quantitative
3-class
Process Hygiene Criteria

Types of sampling plans

Qualitative
2-class
Food Safety Criteria

Quantitative
3-class
Process Hygiene Criteria

Qualitative: +/-: 0/25g
Quantitative: ≤ 100 cfu/g or >100 cfu/g

cfu = colony forming units

Types of sampling plans

Qualitative
2-class
Food Safety Criteria

Quantitative
3-class
Process Hygiene Criteria

Qualitative: +/-: 0/25g
Quantitative: ≤ 100 cfu/g or >100 cfu/g

2-class: +/- or x≤100 cfu/g ; x>100 cfu/g
3-class: x<500 /g; 500<x≤5000; x>5000/g

Types of sampling plans

Qual/Quant	Qual	Quant	Quant	Qual/Quant
Class	2	2	3	3
Example	*Salmonella* in PIF	*Listeria* in no growth RTE	Mesophiles in PIF	3-class mixed

Food Safety Criterion
Process Hygiene Criterion

sampleplans2_10 - Excel

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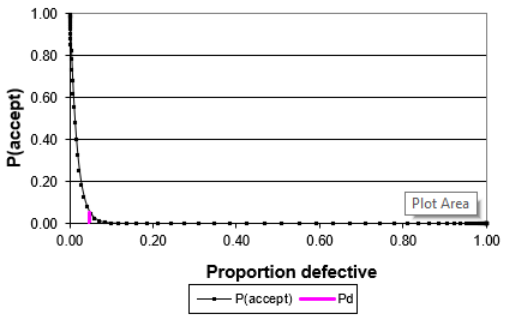
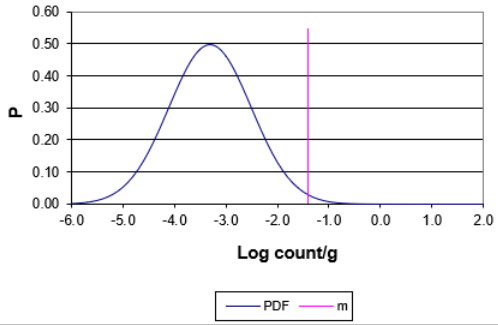
Cut Copy Format Painter Paste — Clipboard — Arial 10 — Font — Wrap Text Merge & Center — Alignment — Number — Conditional Formatting Format as Table — Styles — Insert Delete Format — Cells — AutoSum Fill Clear Sort & Filter Find & Select — Editing

n 60

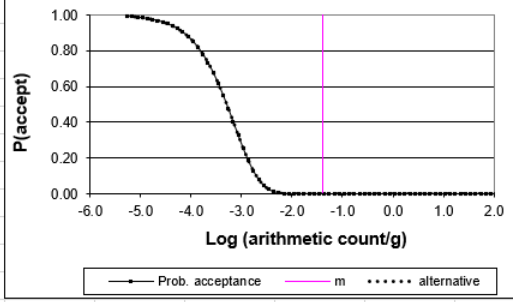
Operating characteristic curve for proportion defective, with n=60 and c=0



Probability density function (PDF) for log counts. Distribution mean = -3.31 and sigma = 0.80



Operating characteristic curve scaled to relate log arithmetic mean count to m



Lot acceptance for Pd

			P(accept)	
Pd	20	%	0.0	%
actualPd	4.9	%	5.00	%

INPUTS		
mean	-3.31	
sigma	0.80	
m	-1.40	
n	60	
c	0	
amount	25	g

P(accept)		
Computed	5.00	%
Desired	5	%

Find mean that gives desired P(accept)

Find n that gives desired P(accept) or better (less)

P(reject) 95.00 %

ALTERNATIVE n AND c			P(accept)		
mean	-3.31		Computed	5.00	%
sigma	0.80		Target, left	5.00	%
m	-1				
n	60				
c	0				
amount	25.0	g			

For any value of n and c imputed find the m that gives the same P(accept) as the model on the left

Sandbox: for your own calculations

FSO	-1		
complient	0.998046	not comply	0.001954
%	99.80461	%	0.195395

Means

	Arithmetic (=Average)			Geometric (=Median)	
	0.0027	cfu/g		0.0005	cfu/g
one cfu in	372.9	grams	one cfu in	2034.2	grams
	-2.57	log cfu/g		-3.31	log cfu/g

Implied Acceptance level

Percentile	z-score	Concentration at this percentile
99.9	3.10	-0.83
FSO	P(exceedance)	target level
-0.83	0.000973	-3.308402

This sampling plan would provide 95 % confidence that a lot of food containing a geometric mean concentration of 1 organism in 2,034.2 g and an arithmetic mean concentration of 1 organism in 372.9 g (and having a standard deviation of 0.80 log cfu/g), would be rejected (i.e. more than 0 out of 60 samples of 25 grams giving detection of the organism)

Types of sampling plans

Qual/Quant	Qual	Quant	Quant	Qual/Quant
Class	2	2	3	3
Example	*Salmonella* in PIF	*Listeria* in no growth RTE	Mesophiles in PIF	3-class mixed

2-class enrichment | 2-class counts | 3-class counts | 3-class mixed

Sampling plan: Food Safety Criterion

Food category: powdered infant formulae (PIF)

Microorganism	Sampling plan		Sample weight (g)	Analytical method
	n	*c*		
Salmonella	60	0	25	ISO 6579

CODEX Code of hygienic practice for powdered formulae for infants and young children CAC/RCP 66-2008

2-class enrichment | 2-class counts | 3-class counts | 3-class mixed

Qualitative, 2-class, *c*=0

Sampling plan: Process Hygiene Criterion

Food category: powdered infant formulae (PIF)

Micro-organism	Sampling plan		*m*	*M*	Analytical method
	n	*c*			
Enterobacteriaceae	10	2	0/10 g	-	ISO 21528-1/21528-2

CODEX Code of hygienic practice for powdered formulae for infants and young children CAC/RCP 66-2008

2-class enrichment | 2-class counts | 3-class counts | 3-class mixed

Qualitative, 2-class, $c \neq 0$

Sampling plan: Food Safety Criterion

Ready-to-eat foods from the end of manufacture or port of entry (for imported products), to the point of sale

Micro-organism	Sampling plan		*m*	*M*	Analytical method
	n	*c*			
Listeria monocytogenes	5	0	100 cfu/g	-	ISO 11290-2

2-class enrichment | **2-class counts** | 3-class counts | 3-class mixed

Quantitative, 2-class, $c=0$

Sampling plan: Process Hygiene Criterion

Campylobacter on broilers

Micro-organism	Sampling plan		*m*	*M*	Analytical method
	n	*c*			
Campylobacter spp.	50	15*	1000 cfu/g	-	ISO 10272-2

* *c*-value increased stringency: 2018: *c*=20; 2020: *c*=15; 2025: *c*=10
EC regulation 2073/2005

2-class enrichment | **2-class counts** | 3-class counts | 3-class mixed

Quantitative, 2-class, $c \neq 0$

Sampling plan: Process Hygiene Criterion

Food category: powdered infant formulae (PIF)

Micro-organism	Sampling plan		*m*	*M*	Analytical method
	n	*c*			
Mesophiles	5	2	500/g	5000/g	ISO 4833

CODEX Code of hygienic practice for powdered formulae for infants and young children CAC/RCP 66-2008

2-class enrichment | 2-class counts | **3-class counts** | 3-class mixed

Quantitative, 3-class, $c \neq 0$

Sampling plan: Food Safety Criterion

Potential criterion for *Listeria monocytogenes* in RTE food*

Micro-organism	Sampling plan		*m*	*M*	Analytical method
	n	*c*			
Listeria monocytogenes	5	1	0/25 g	100 cfu/g	ISO 11290-1 ISO 11290-2

2-class enrichment | 2-class counts | 3-class counts | **3-class mixed**

*Alternative approaches to the risk management of *Listeria monocytogenes* in low risk foods. Farber et al. Food Control 2021

Conclusions

- Information for producers / governments
- Safety / Hygiene / Spoilage
- Focus at different places (ingredients, environment, end product)
- Different types (2/3-class; qual/quant)
- Combination especially within a FSM systems gives confidence