Microbiological criterion and value of sampling

Dr. V. Sudershan Rao

National Institute of Nutrition (ICMR)

Hyderabad

Microbiological Criteria

A microbiological criterion defines the limit above which a food is considered to be contaminated at an unacceptable level with a micro-organism, its toxin or metabolite and is therefore considered to be unsafe for consumption.

A microbiological criterion also contains the following components:

- the sampling plan (the number of samples of a food that should be taken)
- the laboratory method (the method which should be used to test the food)
- the stage in the food chain where the criterion applies
- the corrective action to be taken when the criterion is not met (the action to be taken when there are unsatisfactory results).

Types of microbiological criteria

- Process hygiene criteria: These criteria indicate if the production process is operating in a hygienic manner. They are applicable to foodstuffs at various stages throughout their production processes.

- Food safety criteria: These criteria define the acceptability of a food in terms of its microbiological safety. They are applicable to food placed on the market and throughout the shelf-life of the food.

Microbiological criterion under Indian regulations

Canned meat &meat products (2002)

Total Plate Count –	1000cfu/g
E. coli	0/25g
Salmonella	0/25g
Staph aureus	0/25g
Clostridum botulinum	0/25g
Clostridium perfringens	0/25g

Frozen mutton, goat, beef &buffalo meat (2002)

Total Plate Count	1,00,000cfu/g
Salmonella	0/25g
Listeria	0/25g
E. coli	100cfu/g
Staph aureus	100cfu/g
Clostridum botulinum	30cfu/g
Clostridium perfringens	30cfu/g

Microbiological criterion under Indian regulations

Spices(2006)

Salmonella		0cfu/25g

Frozen prawns, Raw (2005)

Total Plate count	Not more than	5,00,000 cfu/g
E. coli	Not more than	20 cfu/g
Staph aureus	Not more than	100 cfu/g
Salmonella		0 cfu/25g
Shigella		0 cfu/25g
Vibro cholerae		0 cfu/25g
Vibro parahaemolyticus		0 cfu/25g

Frozen prawns, Cooked (2005)

Total Plate count	**Not more than1,00,000 cfu/g**
E. coli	0 cfu/25g
Staph aureus	**0 cfu/25g**
Salmonella	**0 cfu/25g**
Shigella	**0 cfu/25g**
Vibro cholerae	**0 cfu/25g**
Vibro parahaemolyticus	0 cfu/25g

Carbonated beverages, ready to serve beverages
Fruit beverages (2005)

Total plate Count	Not more than	50cfu/ml
Yeast and Mould count	Not more than	2cfu/ml
Coliform		0/100ml

Yoghurt/Dahi(2006)

Total Plate Count	Not more than	10,00,000cfu/g
Coliform	*Not more than*	*10cfu/g*
E. coli		*0cfu/g*
Salmonella		*0cfu/25g*
Shigella		*0cfu/25g*
Staph aureus	*Not more than*	*100cfu/g*
Yeast & mould	*Not more than*	*100cfu/g*
Anaerobic Spore count		*0cfu/g*
Listeria monocytogens		*0cfu/g*

Components of Microbiological Criteria as per Codex

1. A statement of the organisms of concern and /or their toxins
2. The analytical methods for their detection and quantitation
3. A sampling plan, when and where sampling to be taken
4. Microbial limits considered appropriate to the food
5. The number of sample units that should conform to theses limits

What is sampling plan?

It is a statement of the criteria applied to a lot based on appropriate examination of a required number of sample units by specified methods. It should have a sampling procedure and decision criteria.

USFDA refusals on account of presence of *Salmonella*

Month	% consignments
August	7
July	26
June	24
May	9
April	17
March	15

False negative at the time of shipping and positive on arrival at US port

Could it be due to

- error in sampling ?
- Improper laboratory methods used ?

Impact

- Food safety objective is defeated
- Economic loss to the country
- Effect on the image of the country

A well designed sampling plan

can define the probability of detecting microorganism in lot

but no sampling plan ensure the absence of a particular organism

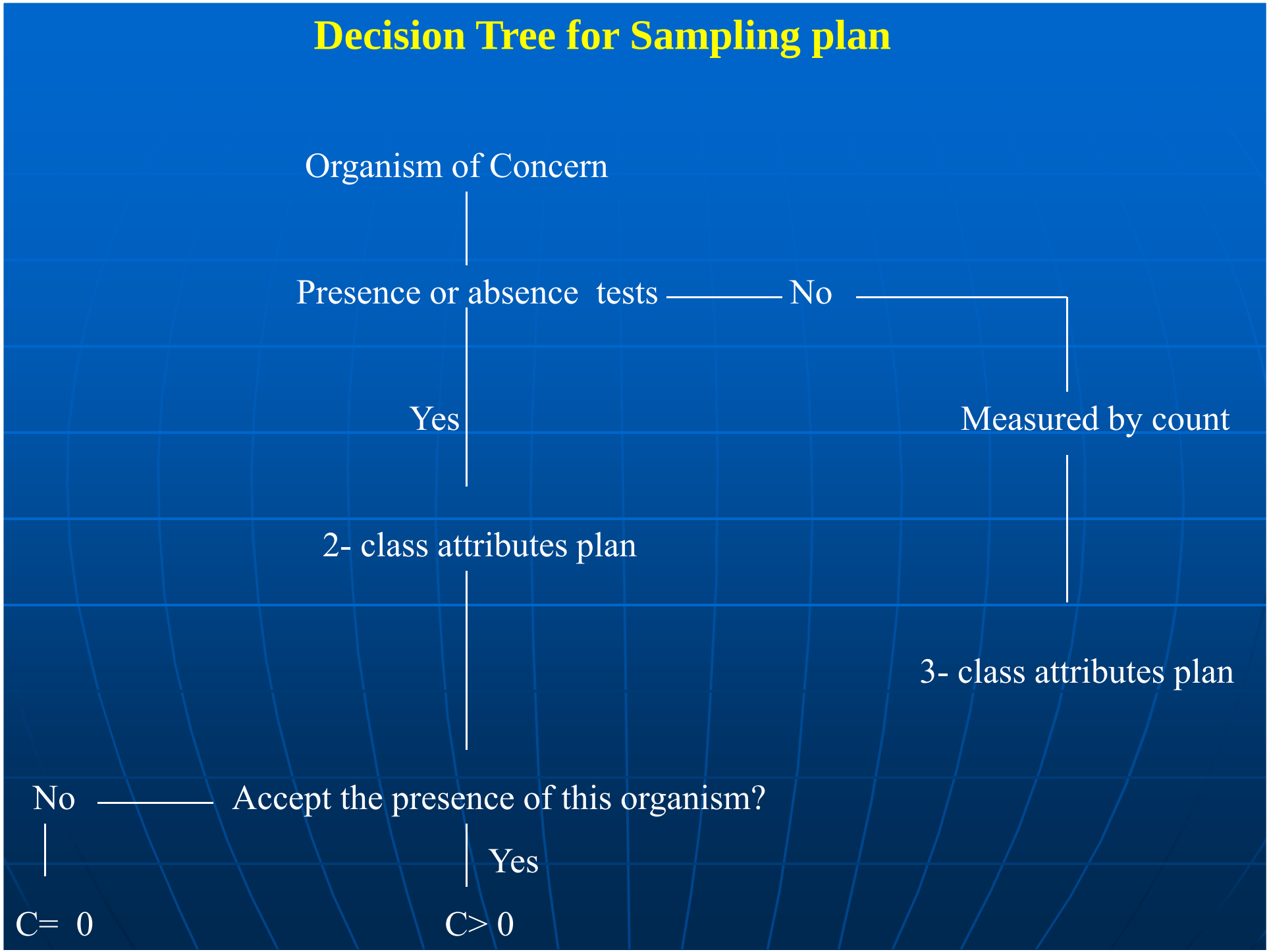
Choice of plan to should take into account

1.Risks to public health associated with hazard

2.Susceptibility of the target group of consumers

3.Heterogeneity of distribution of micro organisms when variable plans are employed

Decision Tree for Sampling plan



Essential elements of sampling plan

1.The microbe or group of microbes of concern or interest

2. Number of samples tested (n)

3. Testing methods (s)

4. Microbiological limit (s),

. Acceptable (< m)

. Marginally acceptable (>m and<M)

. Unacceptable (>M)

5. Number of samples which fall into each category of microbiological limits(ie acceptable /marginal/unacceptable)

Operating characteristic curve should accompany the sampling plan

Types of Sampling

Two class attributes plan

One limit

Two attributes	Less than or equivalent
	More than the limit

Three class attributes plan

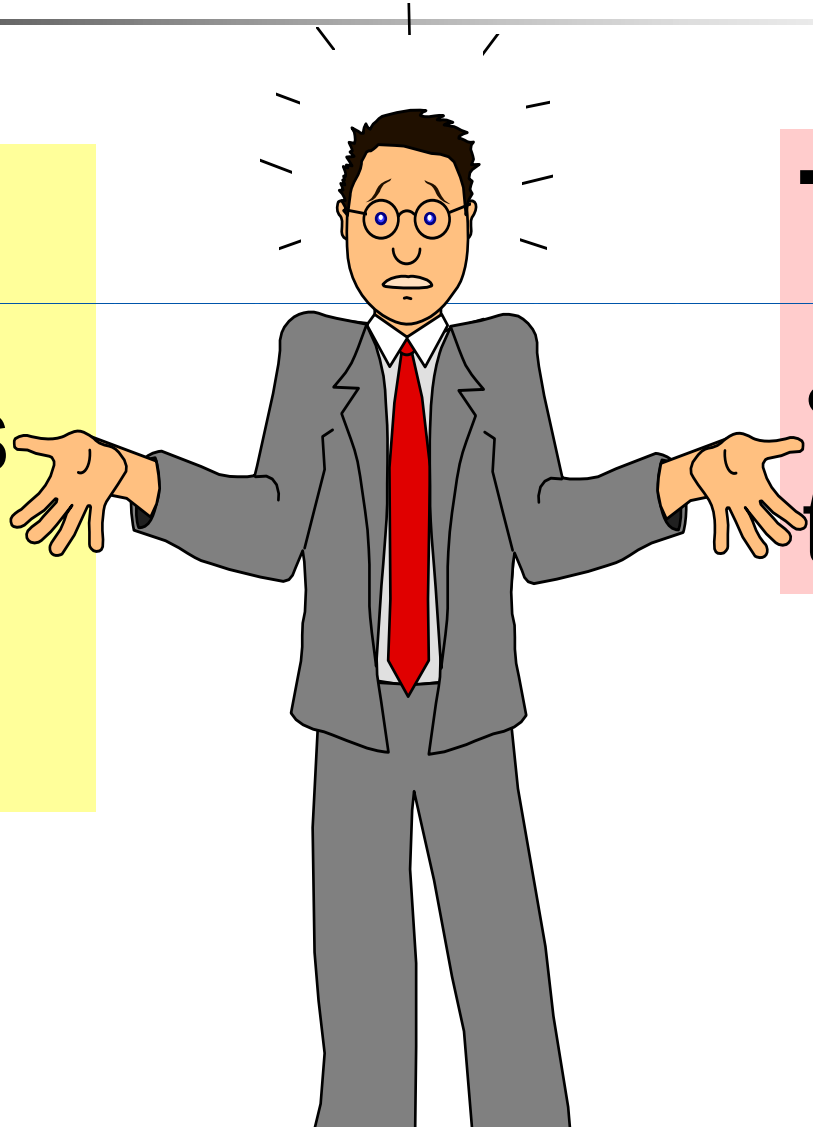
Two limits

Three attributes	Less than or equivalent GMP limit
	More than GMP but less than hazardous limit
	More than hazardous limits

SAMPLE SIZE

Too Big:

- Requires too many resources



Too small:

- Won't do the job

Binomial probability of detecting defective units with increasing sample units from a lot having 3% true defectives

Probability of detecting defective units

No of samples tested	0	1	2
5	0.86	0.133	0.008
10	0.74	0.228	0.032
20	0.54	0.336	0.099
50	0.22	0.337	0.256

Calculation of sample number based on expected levels of contamination

Binomial distribution: CI 95%, RP=20%

10%	864
15%	544
20%	384
25%	288
30%	224
35%	178
40%	144
45%	117
50%	96

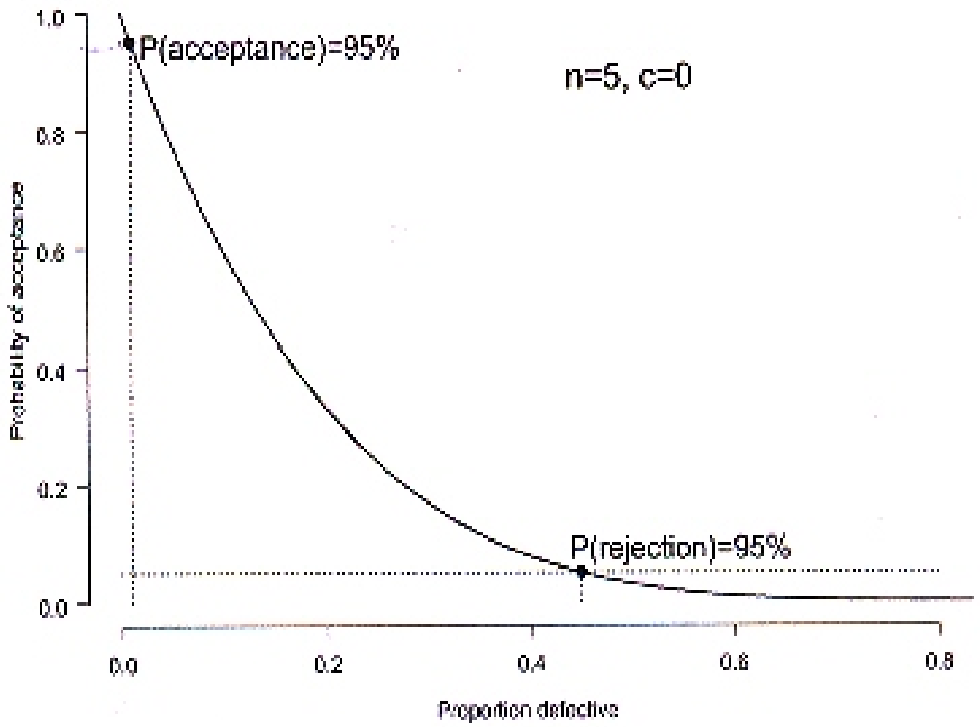


Figure 1 **OC-curve for a two-class sampling plan in relation to proportion defective**

Ref: Dahms S, Mitt.Lebensm, Hyg, 95, 32-44 (2004)

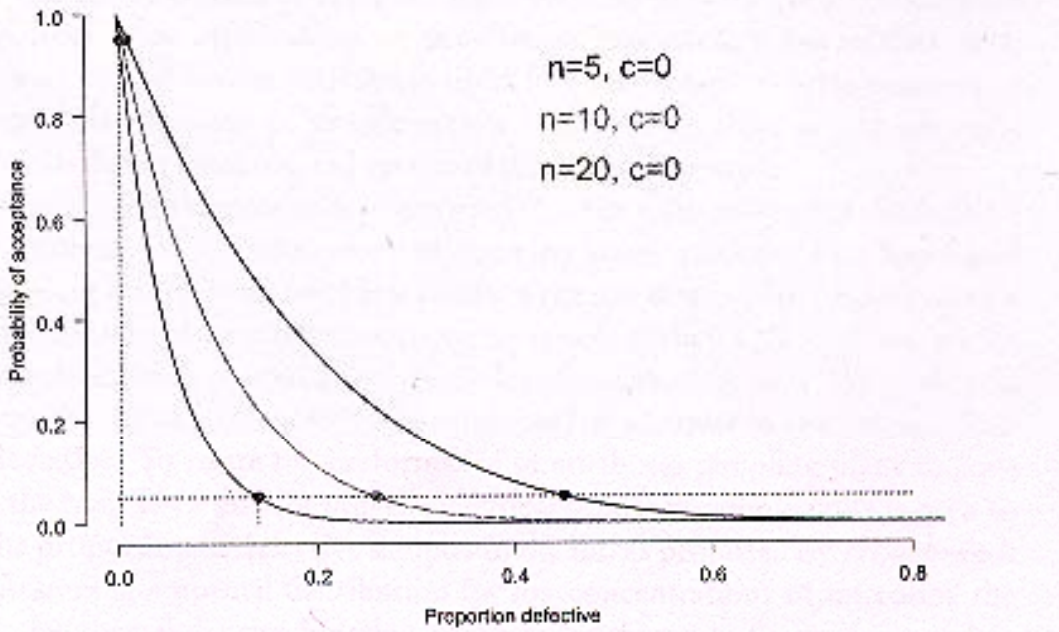


Figure 2 **OC-curves for two-class sampling plans in relation to proportion defective with varying number of sample units**

Ref: Dahms S, Mitt.Lebensm, Hyg, 95, 32-44 (2004)

Sampling Plan for *Salmonella (USFDA)*

Food Category I :- This includes the foods that would not normally be subjected to a process lethal to Salmonella between the time of sampling and consumption. they are intended for consumption by the aged, the infirm, and infants.

Food Category II :- This includes the foods that would not normally be subjected to a process lethal to Salmonella between the time of sampling and consumption

Food Category III :- Food that would normally be subjected to a process lethal to salmonella between the time of sampling and consumption

Sample size Category I 60 units

Category II 30 units

Category III 15 units

Foods under different categories

Category I &II All High risk foods, nuts and nut products, oils, coffee-tea candies and prepared salads

Category III Processed grains , fresh vegetables, vegetable oils and food additives

Two class plan

Salmonella in beef

n=20 c=0 m=0

All the samples must be negative

If one sample is positive, entire lot is rejected

To make more effective sampling plan increase the number

Sampling Plans

Microbiological limit in foods

Poultry products

	n	c	m	M
APC	5	3	10^4	10^5
S.aureus	5	1	10^2	10^4
E.coli	5	2	10	10^2
Salmonella	10	0	0	0

Market samples of Poultry products in Hyderabad

Levels of *Staphylococcus aureus* contamination

Food	n	$\geq 10^6$	$\geq 10^4$	$\geq 10^2$
Chicken fried rice	94	8	2	7
Chicken noodles	94	12	3	5

Levels of *Salmonella* contamination

Food	n	$\geq 10^6$	$\geq 10^4$	$\geq 10^2$
Chicken fried rice	94	0	0	0
Chicken noodles	94	1	0	0

Plan stringency in relation to 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
No direct health hazard			
Utility (e.g., general contamination, reduced shelf-life, and spoilage)	Case 1	Case 2	Case 3
Health hazard			
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

Source: ICMSF (16); copyright © 1986 by University of Toronto Press, used with permission.

Table 21–3 ICMSF Sampling Plans and Recommended Microbiological Limits

Products	*Tests*	*Case*	*Class Plan*	*N*	*c*	*m*	*M*	*Comments*
Precooked breaded fish	APC	2	3	5	2	5×10^5	10^7	
	E. coli	5	3	5	2	11	500	
	S. aureus	8	3	5	1	10^3	10^4	Products likely to be mishandled
Raw chicken (fresh or frozen), during processing	APC	1	3	5	3	5×10^5	10^7	In-plant processing
Frozen vegetables and fruit, pH 4.5	*E. coli*	5	3	5	2	10^2	10^3	*m* value is an estimate
Comminuted raw meat (frozen) and chilled carcass meat	APC	1	3	5	3	10^6	10^7	In-plant control
Cereals	Molds	5	3	5	2	10^2–10^4	10^5	*m* values are estimates
Frozen entrées containing rice or corn flour as a main ingredient	*S. aureus*	8	3	5	1	10^3	10^4	*m* value is estimated
Noncarbonated natural mineral and bottled noncarbonated waters	Coliforms	5	2	5	0	0	—	Not for use in infant formula or use by highly susceptibles
Roast beef	*Salmonella*	12	2	20	0	0	—	
Frozen raw crustaceans	*S. aureus*	7	3	5	2	10^3	10^4	
	V. parahaemolyticus	8	3	5	1	10^2	10^3	
	Salmonella[*]	10	2	5	0	0	—	
	APC[†]	2	3	5	2	5×10^5	10^7	
	E. coli[†]	5	3	5	2	11	500	
	S. aureus[‡]	8	2	5	0	10^3	—	

Note: Except where noted for in-plant use, they are intended primarily for foods in international trade and are cited here primarily to illustrate the assignment of products to case and limits on a variety of organisms. The ICMSF[8] should be consulted for methods of analysis and more details in general.

[*] Normal plans and limits.
[†] Additional tests where appropriate.

Ref: Modern Food Microbiology, Seventh edition, 2005

Example of effective use of Microbiological criteria and sampling design of ICMSF with HACCP

Rutgers Food Service Program

17 years experience

30 million meals

1600 food samples (1983-89)

1.24% contained pathogens

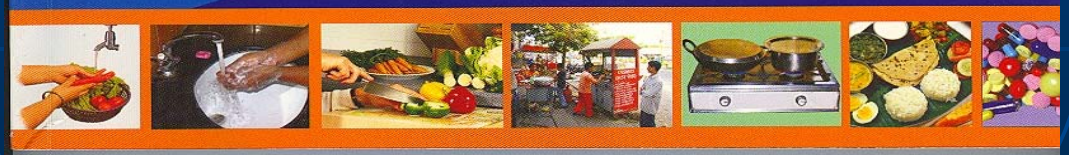
No foodborne illness

Ref : James Jay . Modern Food Microbiology 2005

KABP STUDY ON FOOD AND DRUG SAFETY IN INDIA - A REPORT

World Bank Assisted Capacity Building Project on
Food Safety and Quality Control of Drugs

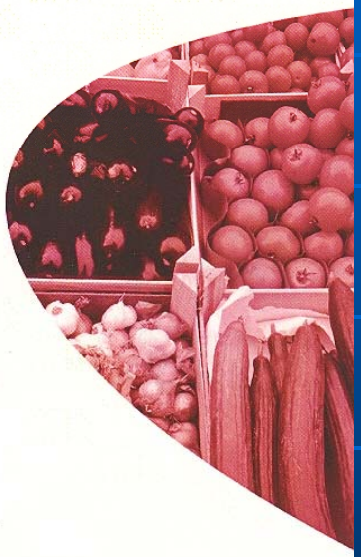
Food and Drug Toxicology Research Centre
NATIONAL INSTITUTE OF NUTRITION (ICMR)
Jamai-Osmania PO
Hyderabad.



ISSN 0034-6659
Volume 38 Number 2 2008

Nutrition & Food Science

International focus on foods



www.emeraldinsight.com

Emerald

The current issue and full text archive of this journal is available at
www.emeraldinsight.com/0034-6659.htm

Knowledge and practices of food safety regulators in Southern India

R.V. Sudershan, Pratima Rao and Kalpagam Polasa
Food and Drug Toxicology Research Centre, National Institute of Nutrition, Hyderabad, India
G.M. Subba Rao
Extension & Training Division, National Institute of Nutrition, Hyderabad, India, and
M. Vishnu Vardhana Rao
Division of Field Studies, National Institute of Nutrition, Hyderabad, India

Abstract

Purpose – To assess knowledge, perceptions and practices of grassroots-level food safety regulators.
Design/methodology/approach – Knowledge, attitude and practices (KAP) study using quantitative and qualitative methods for data collection. Quantitative data was collected using a pre-tested knowledge assessment questionnaire. Qualitative data was collected by conducting a focus group discussion (FGD) and six in-depth interviews among food safety regulators from all 23 districts of the South Indian state of Andhra Pradesh. Quantitative data were analysed using SPSS package (version 14.5). The FGD and in-depth interviews' recordings were transcribed verbatim and translated into English before compiling them into individual reports. These reports were read independently by a group of researchers before inferences were drawn.
Findings – The respondents' knowledge on basic food microbiology was limited. They attributed their inability to monitor all cases of food poisoning/adulteration to delay in receiving information and lack of laboratory facilities. They had sound knowledge of conventional adulterations, but were not equipped to check newer adulterations. Their knowledge on health/nutrition claims on food labels is almost nil. Orientation towards food safety issues other than adulteration is the need of the hour.
Originality/value – The results of the study can serve as the basis for developing an in-service training module for food safety regulators.

Keywords Food safety, Regulation, India
Paper type Research paper

Thank you for your kind attention