ENVIRONMENTAL AND FOOD TOXICOLOGY

Welcome to The World of Poisons !

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ENVIRONMENTAL AND FOOD TOXICOLOGY

Credit : 2

Lecturers:
BUD, ITA

Evaluation:

Assignment	: 20 %
Midterm Exam	: 40 %
Final Exam	: 40 %

Learning Resources:

BOOKS

Klaasen, C.D. (2001). Casarett and Doull's Toxicology – The Basic Science of Poisons. 6th Ed. McGraw-Hill.New York.

Půsa, T. (2008). Principles of Food Toxicology. CRC Press. Boca Raton.

Van Leeuwen, C.J. & J.L.M. Hermens (eds.) (1995). Risk Assessment of Chemicals: An Introduction. Kluwer Acad. Publ. Dordrecht.

ARTICLES OF SCIENTIFIC JOURNALS

MATERIALS FROM INTERNET

(articles, databases, regulations, public information etc)

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TOPICS

1. Scope & Relevance (1 x) BUD
2. Classes of Toxic Substances (2 x) ITA
3. Emission of Toxic Substances (1 x) ITA
4. Transport, Accumulation & Transformation of Toxic Substances (2 x) ITA
5. Toxic Substances in Food (1 x) ITA

UTS

6. Effects of Toxic Substances (1x) BUD
7. Toxicity & Human Health (1 x) BUD
8. Models in Toxicology (1 x) BUD
9. Toxicity Evaluation (1 x) BUD
10. Risk Assessment (1x) BUD

EVOLUTION OF TOXICOLOGY

Human – Environment Coevolution

Humans have been dealing not only with the safe but also with the unsafe situations.
[Hazardous Materials ~ poisons/toxicants]

Survival of human species:
Ability to avoid & (to some extent) to tolerate poisons –THRESHOLD CONCEPT in toxicology

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Toxicology is a borrowing science that has evolved from ancient poisoners!

Knowledge on Poisons is as old as human civilization

TOXICOLOGY
The science of Poisons

The oldest scientific publications on poisons:

De Venenis (1472) by Pietro d'Abano (1250-1315)

Drey Bucher (1564) by Paracelsus (1493-1541)
["Dosis sola facit venemum" ~ only dose determines toxicity]

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Was is dast nit gifft ist? Alle ding sind gifft/ und nicht on gifft/Allein die dosis macht ein ding kein gifft ist.

What is there that is not poison? All things are poison and nothing (is) without poison. Solely, the dose determines that a thing is not a poison.

***Paracelsus* (1493-1541)**

Until early of the 19th century:
Toxicology was still belong to Medicine and Pharmacology

Bonaventura Orfila in "*Traité des poisons*" (1814-1815) showed Toxicology as a subject of its own

⇨ Orfila : the "Father" of Toxicology

*** Effects of toxic substances were determined merely based on clinical observation on animal or human**

It took a century to gain the ability for detecting toxic substances in excreta or tissues of the victim.

Toxicology

- **Fast growing & become a study of the interface between Chemistry and Biology**
- **More predictive (from description to prediction of effects)**

In the 20th Century:

Toxicology had developed into several branches :

- **Environmental Toxicology**
- **Ecotoxicology**
- **Industrial Toxicology**
- **Human (Health) Toxicology**
- **Developmental Toxicology**
- **Clinical & Veterinary Toxicology**
- **Food Toxicology** **etc.**

GENERALLY REGARDED AS SAFE (G R A S)

TOXICANT OR POISON

a chemical substance that, after entering an organism, is capable of causing smaller or larger adverse changes in the functioning of cells, tissues, or even the whole organism, perhaps resulting in the death of the organism.

TOXICANT: a synthethic substance causing adverse health effects

TOXIN: any proteinaceous poison produced by living organisms, especially microorganisms such as bacteria in the body of a host.

VENOM: a poisonous matter secreted by snakes,scorpions, bees etc

XENOBIOTICS: foreign substances faced by human – produced during or due to diverse human activities

TOXICITY

1. The capacity of a chemical substance to cause adverse or deleterious effects on living (ecosystem-population) organism or on a part of it.

2. The degree to which a substance is toxic.

TOXICITY depends on

1. Chemical structure of the compound
2. Route of administration (applied to skin, ingested, inhaled or injected)
3. Time of exposure (brief or long-term)
4. Number of exposures (single or multiple doses)
5. Physical form of the toxicant (solid, liquid, or gas)
6. Genetic constitution of an individual, an individual's overall health etc

ENVIRONMENTAL TOXICOLOGY

Transport, Fate and Effects of toxic substances in the environment

FOOD TOXICOLOGY

The Presence of toxic substances in food and their Implications on Food Safety

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ENVIRONMENTAL TOXICOLOGY

Release

↓

Distribution

↓

Degradation, Transformation

↓

Uptake, Accumulation, Elimination & Effects on Organisms (incl. Human)

TOXIC SUBSTANCES

DAUR SENYAWA PENCEMAR

Pelepasan senyawa pencemar

Perubahan fisik-kimia

Menetap pada medium tertentu

Paparan pada mahluk hidup (manusia)

DAMPAK

Toksikologi Lingkungan

Transpor, “nasib” dan dampak
(*transport, fate, effect)* senyawa pencemar
di lingkungan

Pemahaman daur senyawa pencemar:
Sebagai titik awal manajemen mutu lingkungan

- **penentuan status mutu lingkungan/keamanan pangan**
- **pilihan modus intervensi**

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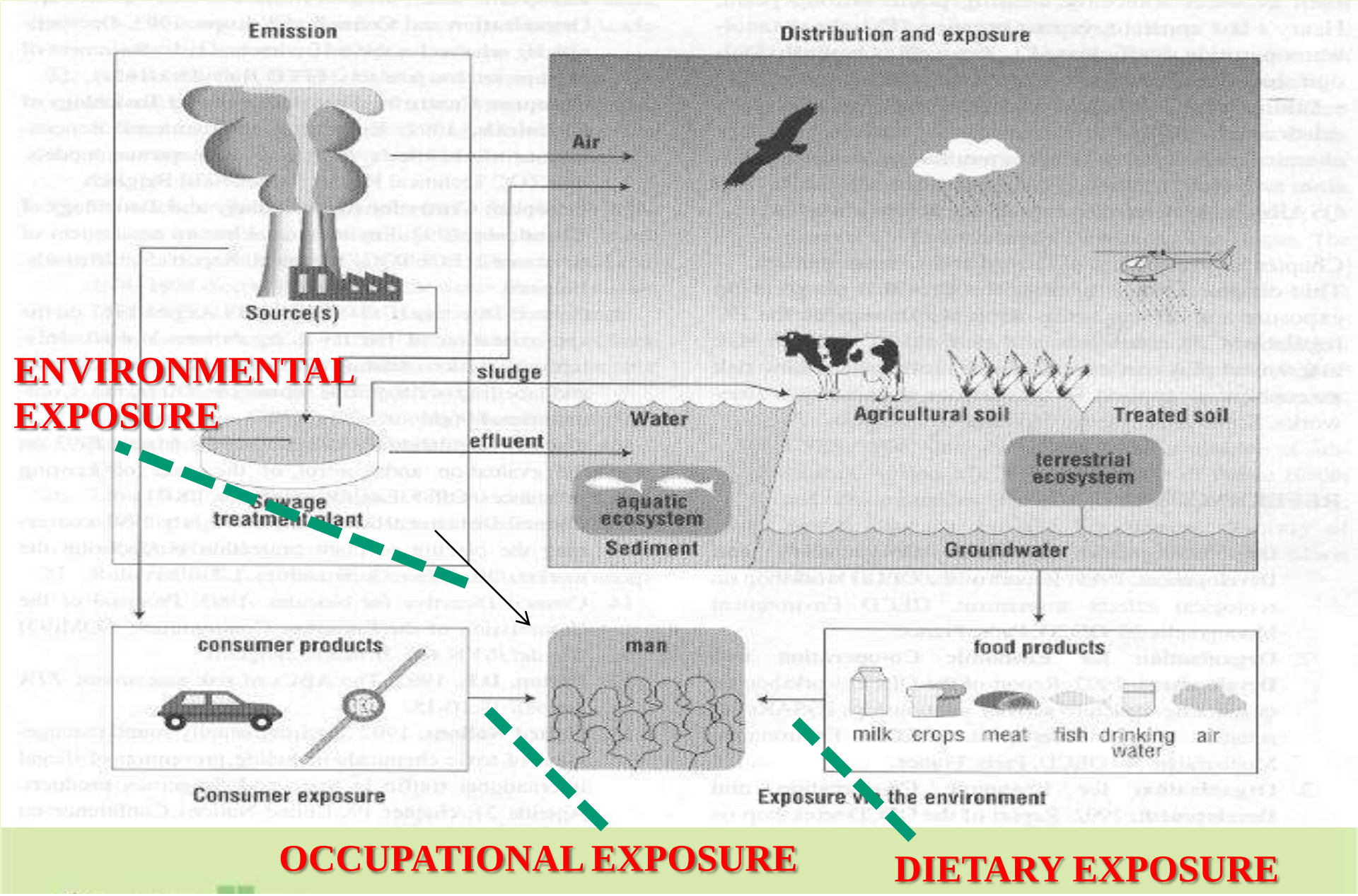
Sumber dan Pelepasan Senyawa Pencemar

- **Sumber pencemaran: proses alam dan kegiatan manusia**
- **Industri sebagai sumber senyawa-senyawa pencemar**

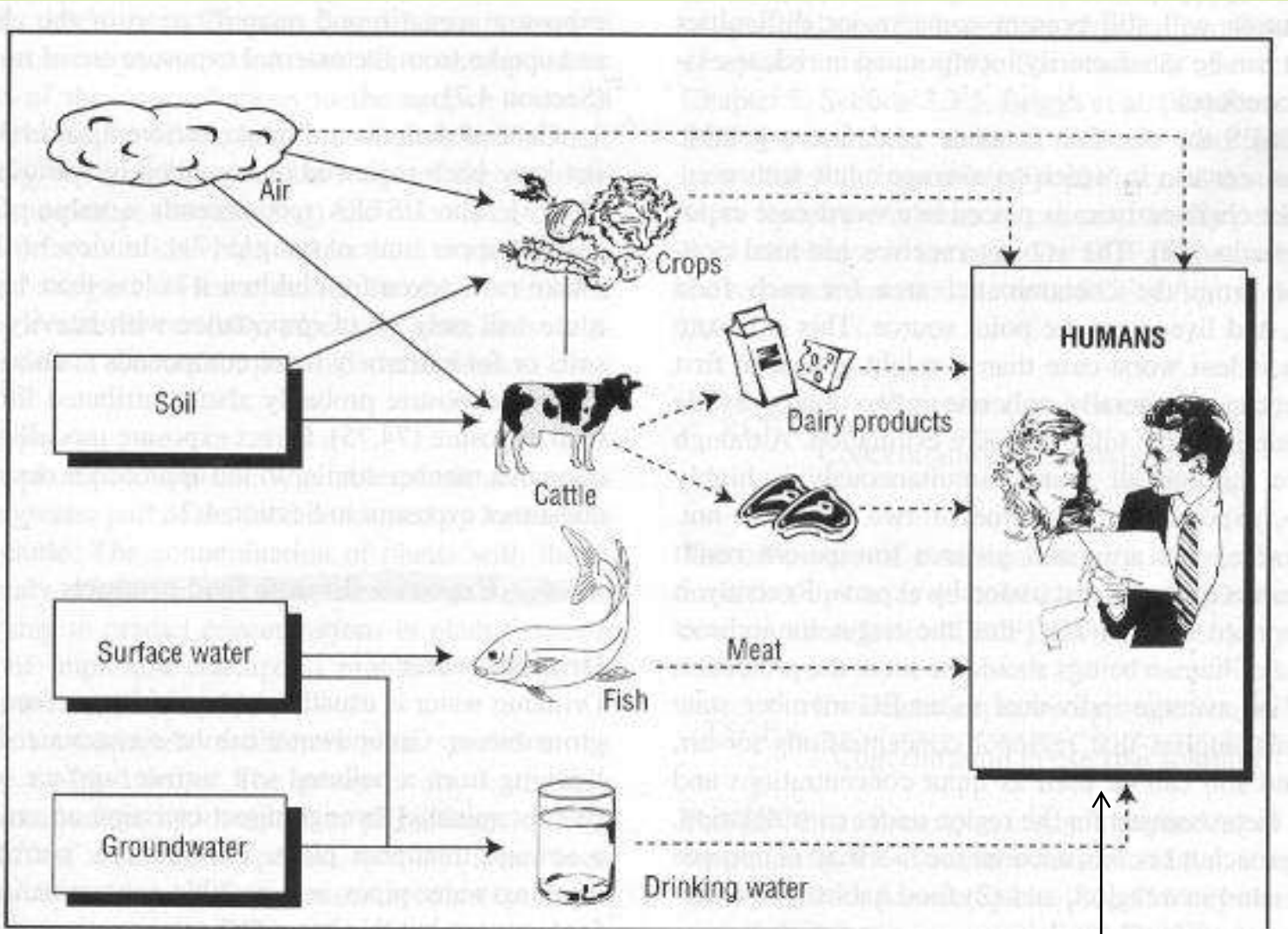
  Senyawa beracun dari masing-masing jenis industri ini perlu diidentifikasi => formulasi langkah-langkah penanganan limbah

- **Industri bukan satu-satunya sumber**

  Contoh: kegiatan rumah tangga (cuci-mencuci) – limbah deterjen



Gambar 4. Route Paparan Senyawa Pencemar (van Leeuwen & Hermens, 1995)



Gambar 5. Route Paparan Senyawa Pencemar melalui Makanan dan Minuman (van Leeuwen & Hermens, 1995)

Food Additives

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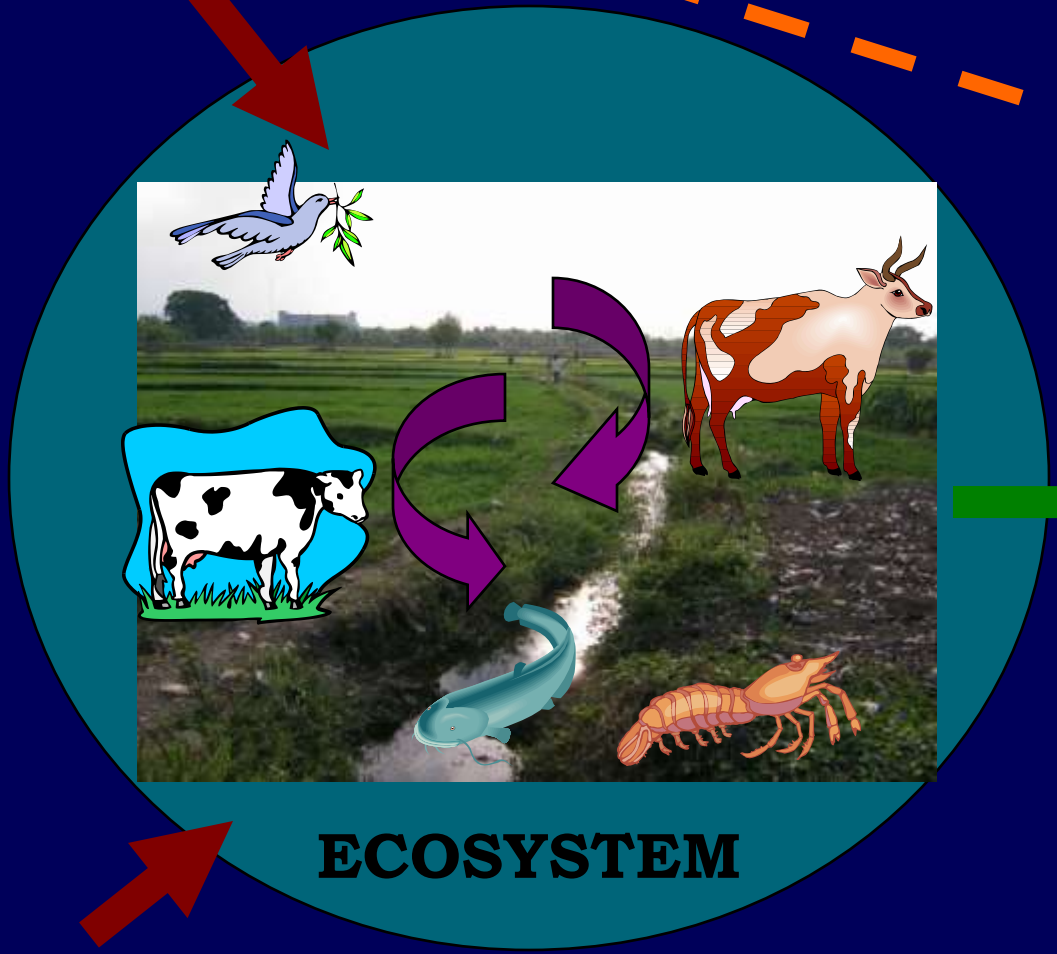
POLLUTION

QUALITY



ECOSYSTEM

FOOD

SAFETY

POLLUTION

LIVESTOCKS FARMING ON THE GARBAGE'S DISPOSAL SITE

Table 2 Metal content (ppm, dw) in meat and viscera of cattle cultivated in the final waste disposal site of Semarang

Tissue	Cr	Cd	Co	Fe	Zn	Pb
Meat	0.838	1.165	0.163	119.72	155.76	10.64
Liver	0.855	1.741	0.287	531.623	144.743	–
Rumen, Abomasum	3.120	1.705	0.291	616.955	119.941	–
Jejunum	0.034	–	0.186	196.553	34.743	–
MRL (UK)	0.02-0.56	0.01-0.09	1.94	34	33.0	–

Source: Purwandari (2003) & Wibowo (2003) cited in Widianarko *et al.* (2003)
(MRL = the maximum residue limit)

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From TOXICOLOGY to FOOD SAFETY

TOXICANT
TOXIN
VENOM
XENOBIOTICS

} HAZARD

RISK = EXPOSURE* X HAZARD

* dietary exposure

HAZARD = a biological, chemical or physical agent with the potential to cause an adverse health effect (e.g. Salmonella could be in food and it could make someone ill) .....CODEX definition

RISK = the likelihood of an adverse event (e.g. a consumer gets food-borne illness) and the severity of that event

RISK ≠ HAZARD

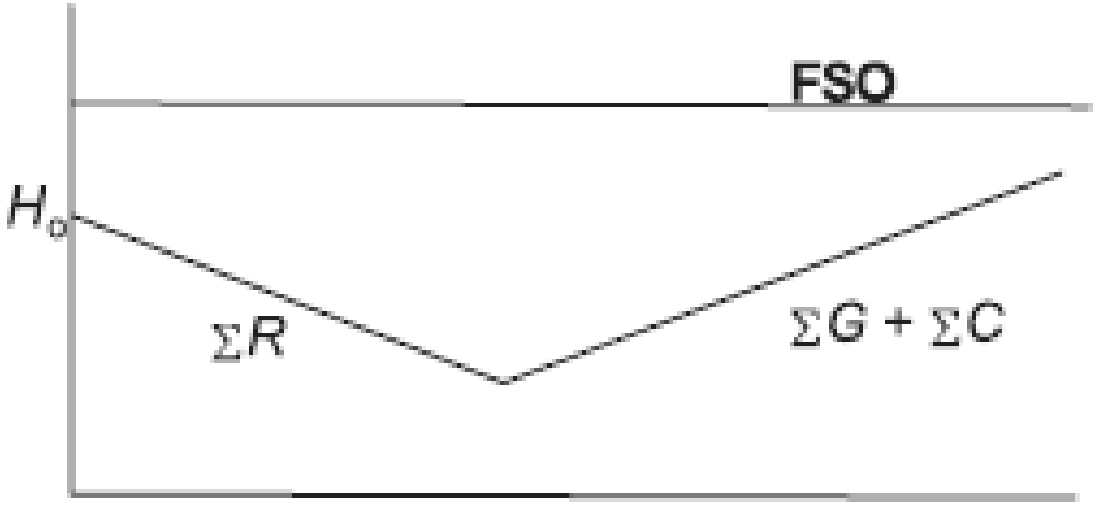
FOOD SAFETY EQUATION

$$(H_0 - \Sigma R + \Sigma I) \leq PO \text{ (or FSO)}$$

H0 = The Initial Contamination Level
∑R = The Sum of Reductions of Contaminant along the process (*from farm to fork*)
∑I = The Sum of Increases of Contaminant along the process (*from farm to fork*)
PO = Performance Objective
FSO = Food Safety Objective

ICMSF

$$H_o - \Sigma R + \Sigma G + \Sigma C < FSO$$



FSO: Food Safety Objective (cfu/ g or prevalence)

Fig. 1. Schematic representation of the FSO-concept.

ICMSF = International Commission on Microbiological Specification for Foods

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