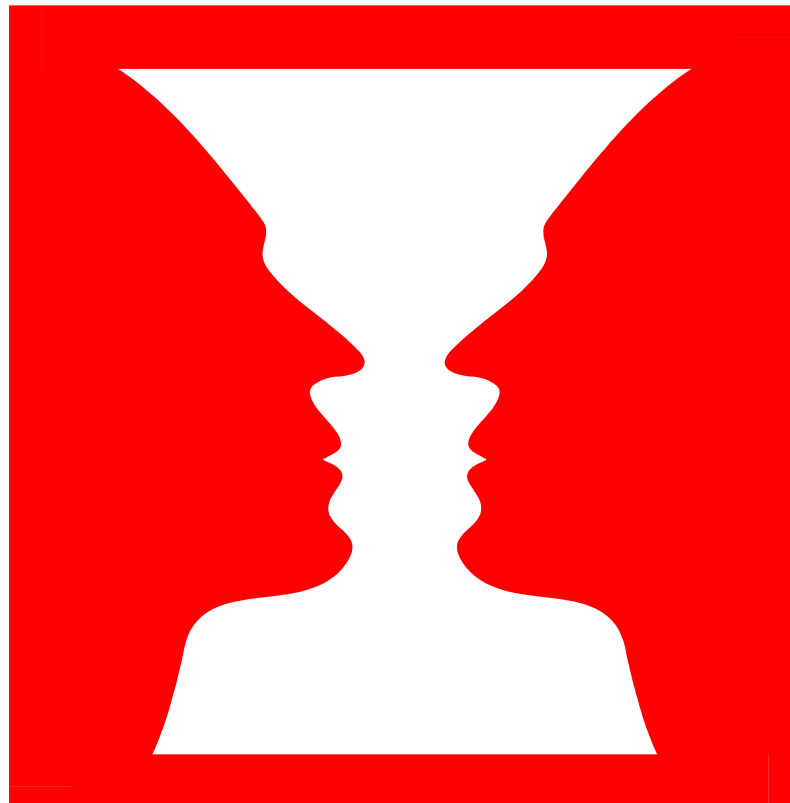


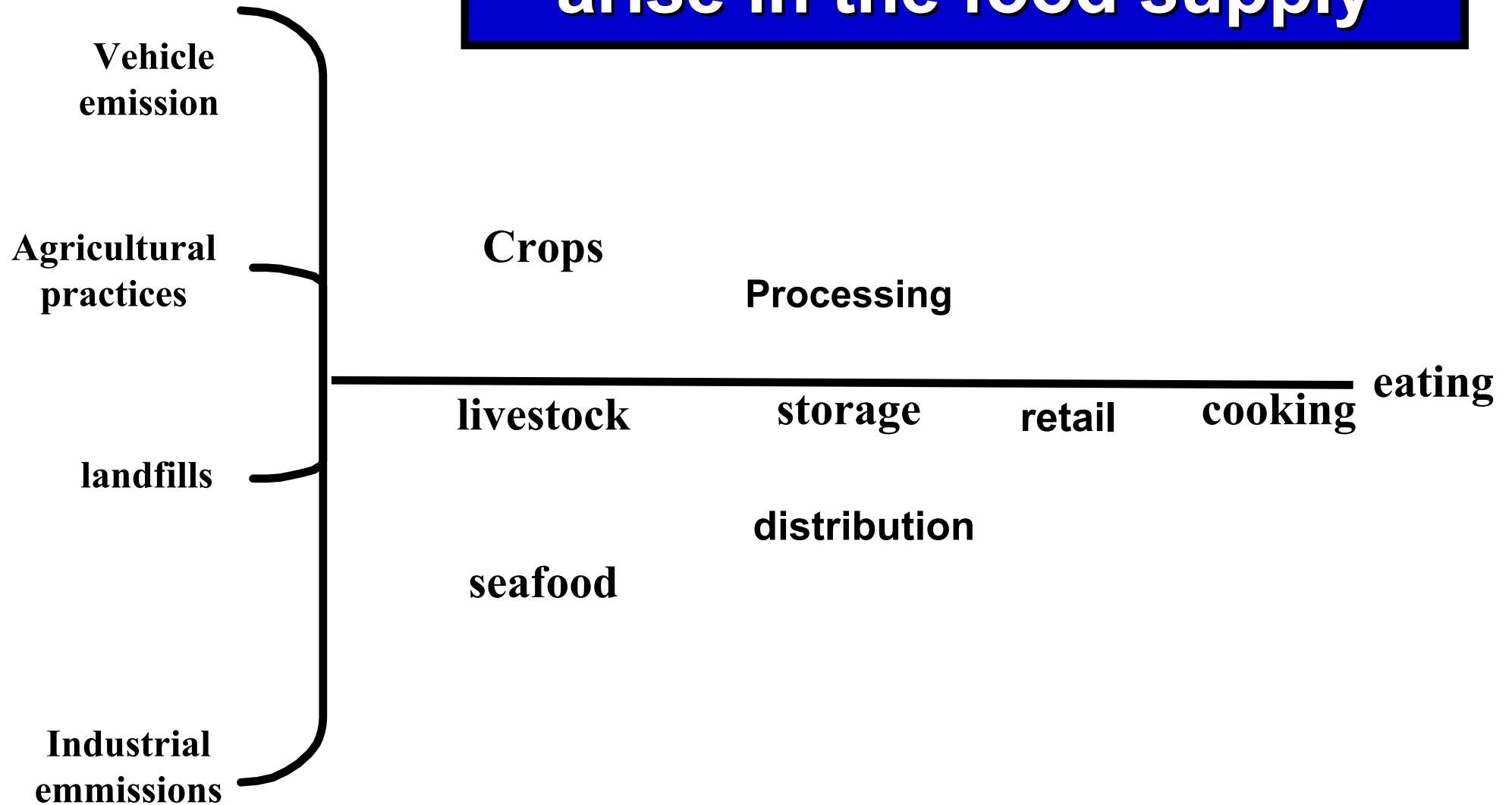
Module 02 - lecture 02

Chemical and physical hazards in food

Perception of chemical hazards in food



Where chemical hazards arise in the food supply



Chemical hazards in food

- **Industrial and environmental contaminants**
- **Biologically derived contaminants**
- **Contaminants produced during processing**
- **Improperly used agrochemicals**
- **Improperly used additives**

Contaminants of industrial and environmental origin

<i>Chemical</i>	<i>Main source</i>	<i>Associated food</i>
PCBs	Transformers	Fish, animal fat
Dioxins	By-product	Fish, animal fat
Mercury	Chlor - alkali	Fish
Lead	Vehicle emission, smelting, paint, glazes, solder	Canned food, acidic foods, drinking water
Cadmium	Sludge, smelting	Grains, molluscs
Radionuclides	Accidental release	Fish, mushrooms
Nitrate / nitrite	Fertilizers	Vegetables, drinking water

Inherent plant food toxicants

Chemical

Oxalates

Glycoalkaloids

Cyanoglycosides

Phytohaemagglutinin

Various carcinogens

Associated Food

Rhubarb, tea, cocoa, spinach, beet

Green potato

Lima bean, cassava

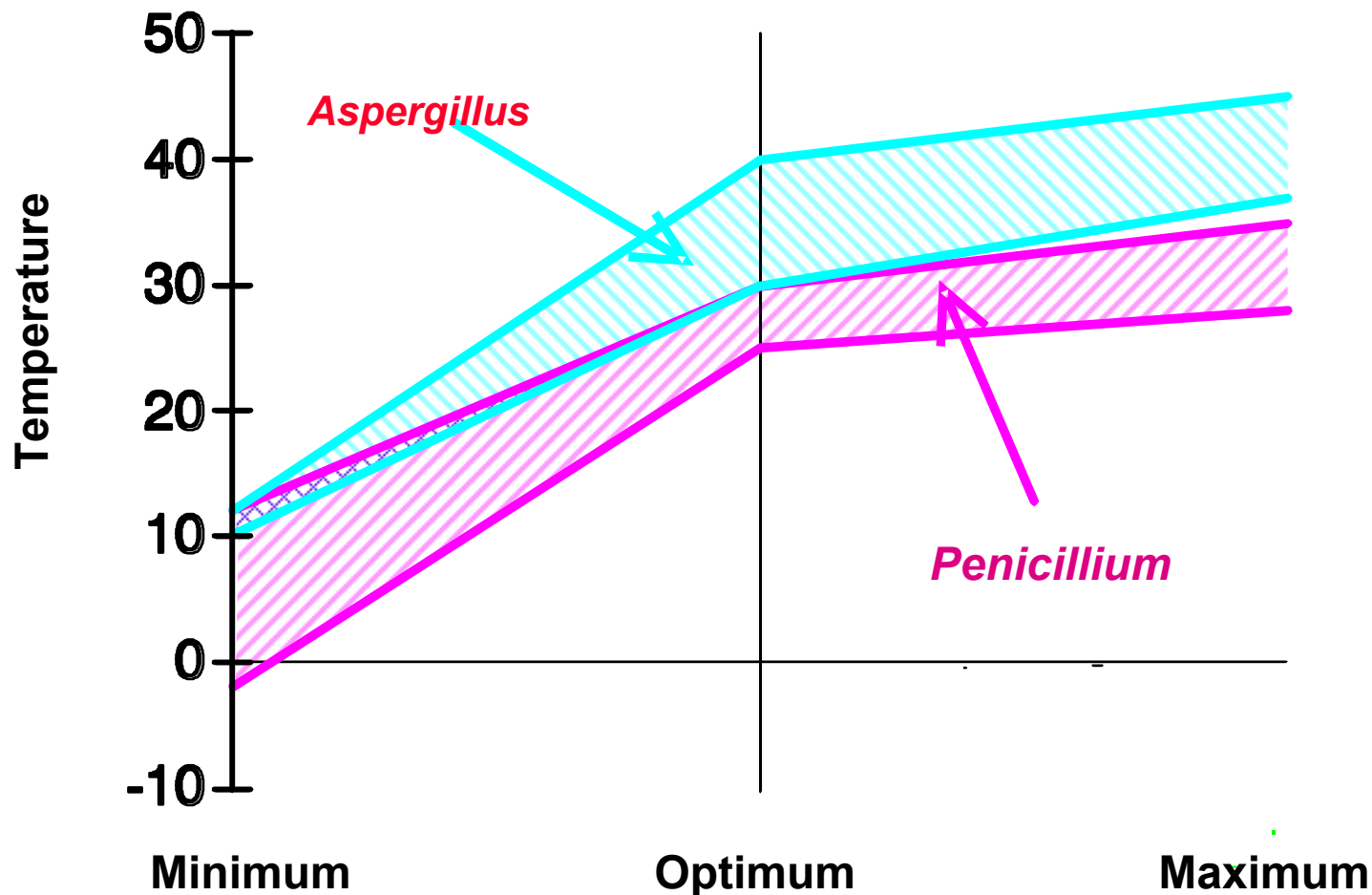
Red kidney beans and other beans

Spices and herbs

Mycotoxins

<i>Chemical</i>	<i>Source</i>	<i>Associated Food</i>
Aflatoxins	<i>Aspergillus flavus</i> and <i>A. parasiticus</i>	Corn, peanuts, tree nuts, milk
Trichothecenes	Mainly <i>Fusarium</i>	Cereals and other foods
Ochratoxin A	<i>Penicillium verrucosum</i> <i>A. ochraceus</i>	Wheat, barley, corn
Ergot alkaloids	<i>Claviceps purpurea</i>	Rye, barley, wheat
Fumonisin	<i>Fusarium moniliforme</i>	Corn
Patulin	<i>P. expansum</i>	Apples, pears
Zearalenone	<i>Fusarium</i> spp.	Cereals, oil, starch

Temperature range for growth of toxigenic moulds



Minimum water activity for growth of toxigenic moulds

Mould

Minimum Water Activity

Aspergillus ochraceus

0.78

Penicillium verrucosum

0.79

Aspergillus flavus

0.80

Fusarium moniliforme

0.87

Stachybotrys atra

0.94

Target organs of some mycotoxins

Mycotoxin

Target

Aflatoxin

Liver

Ochratoxin A

Kidney

Trichothecenes

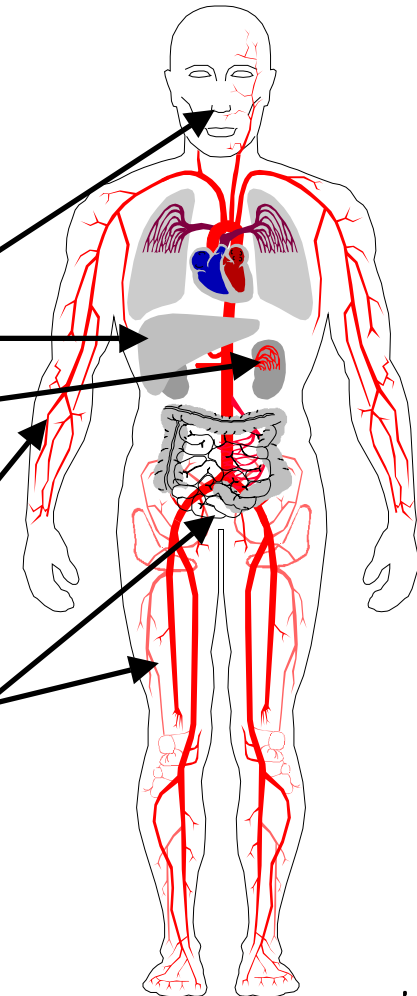
Mucosa

Ergot alkaloids

Peripheral vascular system

Zearalenone

Uro-genital tract



Contaminants of biological origin

Regulatory limits for mycotoxins in foods

<i>Mycotoxin</i>	<i>Limit (µg/kg)</i>	<i>Commodities</i>	<i>No. of Countries</i>
Aflatoxins B+G	0 - 50	Corn, peanuts, other foods	48
	0 - 1000	Animal feeds	21
Aflatoxin M ₁	0.05 - 1.0	Milk, dairy	17
Ochratoxin A	1 - 300	Rice, corn, barley, beans, pork kidney	6
Deoxynivalenol	1000 - 4000	Wheat	5
Patulin	20 - 50	Apple juice	10
Zearalenone	30 - 1000	All foods	4

Risk assessment for mycotoxin in foods

Mycotoxin

JECFA Benchmark

Aflatoxin B₁

**0.01 - 3 cancers per year
per 100.000 people
per μg of aflatoxin B₁
per kg bw/day**

Patulin

0.4 $\mu\text{g}/\text{kg}$ bw/day

Ochratoxin A

0.1 $\mu\text{g}/\text{kg}$ bw/day

Regulatory limits for aflatoxins in some Asian and Pacific countries

Country	Limit ($\mu\text{g}/\text{kg}$)	Commodity
Australia/New Zealand	15 (T) 5 (T)	Peanuts Other foods
China	20 (B_1)	Maize, peanut
India	30 (B_1)	All
Japan	10 (B_1) 5 (B_1)	Rice Other grains
Malaysia	35 (T)	All
Philippines	20 (B_1)	Coconuts, peanut products (export)
Singapore	Absence (B_1)*	All
Sri Lanka	30 (T)	All
Thailand	20 (T)	All

B_1 = Aflatoxin B_1
T = Total Aflatoxins



Other toxicants of biological origin

<i>Toxicant</i>	<i>Source</i>	<i>Associated Food</i>
Ciguatera	Dinoflagellates	Tropical fish
Shellfish toxins: paralytic neurotoxic diarrhoeic amnesic	Dinoflagellates	Shellfish
Pyrrolizidine alkaloids	Various toxic plants	Cereals, honey
Histamine	Spoilage bacteria	Fish, cheese

Contaminants produced during processing

Polynuclear aromatic hydrocarbons

Heterocyclic amines, nitropyrenes

Nitrosamines

Ethyl carbamate (urethane)

Chloropropanols

Improperly used agrochemicals

Insecticides :

**Organochlorine insecticides
Organophosphorus insecticides
Carbamate insecticides**

Animal Drugs :

**Antimicrobials
Growth promotants
Anthelmintics
Therapeutics**

Fumigants

Fungicides

Herbicides

Fertilizers

Plant growth regulators

Rodenticides

Nematocides

Molluscicides

Improperly used additives

Direct Food Additives

Anti-caking agents

Antimicrobial agents

Antioxidants

Colours

Curing and pickling agents

Emulsifiers

Enzymes

Firming agents

Flavour enhancers

Flavouring agents

Humectants

Leavening agents

Release agents

Non-nutritive sweeteners

Nutrient supplements

Nutritive sweeteners

Oxidizing and reducing agents

pH control agents

Propellants and gases

Sequestrants

Solvents and vehicles

Stabilizers and thickeners

Surface-active agents

Texturizers

Improperly used additives

Indirect Food Additives

Processing Aids

**Ion-exchange resins, filter aids
Enzyme preparations
Microorganisms
Solvents, lubricants, release agents
Specific function additives**

Food Contact Materials

**Utensils
Working surfaces
Equipment**

Packaging Materials

Metal, plastic, paper, wood, etc.

Cleaning Agents

**Detergents
Sanitizers**

Improperly used additives

Adulterants

- **Borax**
- **Boric acid**
- **Formaldehyde**
- **Water**
- **Unapproved colouring agents**

Improper use of food additives

Illegal use in Indonesia

Pom Aceh - 2734 sauce bottles - Rhodamine-B

Red drinks containing Rhodamine-B :

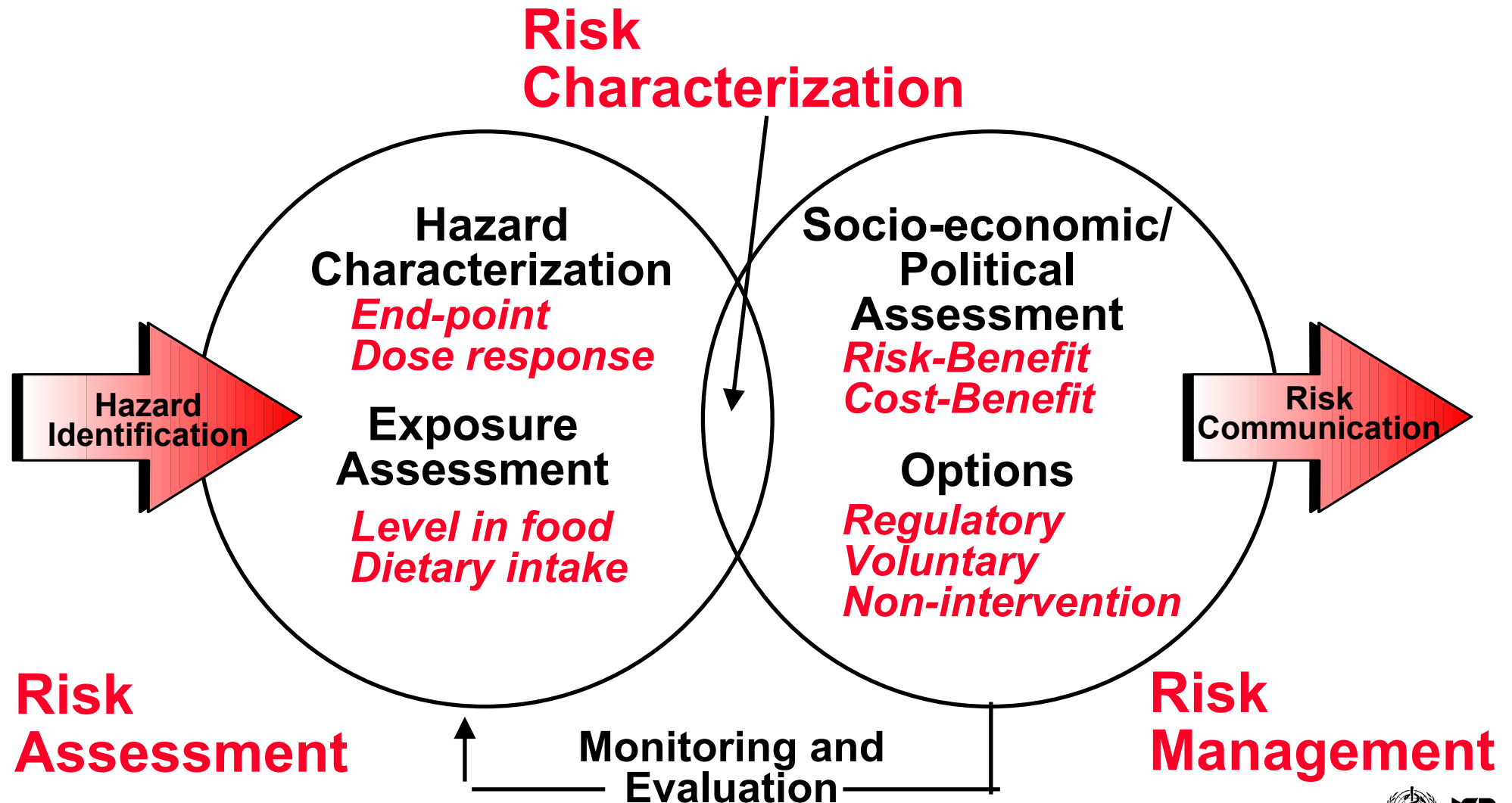
Bogor	15 %
Djakarta	8 %
Rankasbitung	17 %
Pacet	17 %
Cikampek	24 %

Semarang

55% red drinks contained Rhodamine-B

**31% food samples contained Rhodamine-B,
Methanyl yellow or orange-RN**

Risk analysis of chemicals in foods



Monitoring points for chemical hazards

- **Point source**
- **Environmental compartments**
- **Primary production**
- **Import / export**
- **Production and processing**
- **Wholesale outlets and markets**
- **Biomonitoring**

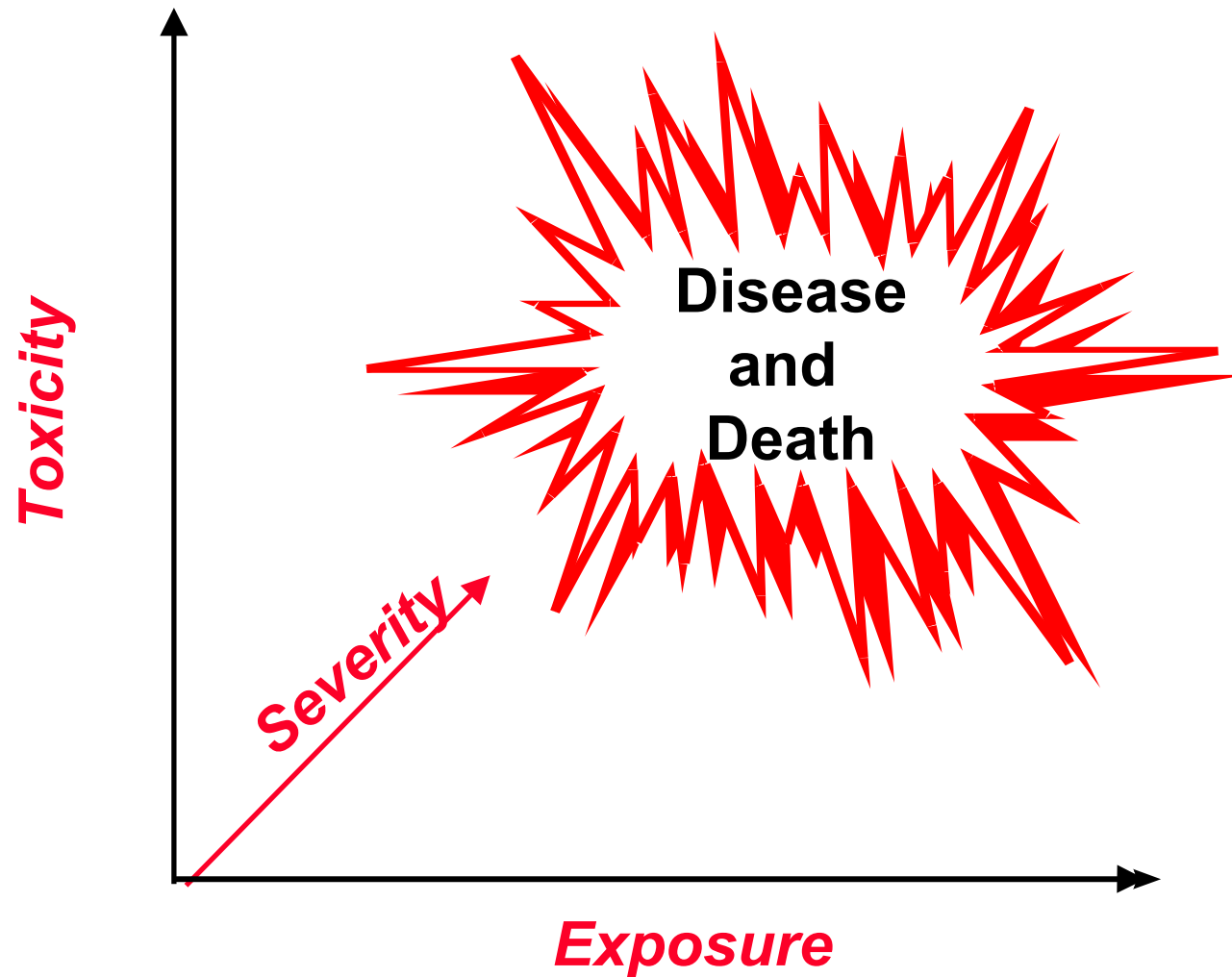
Criteria for establishing priorities

- **Severity of potential effects on health**
- **Levels in individual foods and the diet**
- **Size and susceptibility of the exposed population**
- **Significance in domestic and international trade**
- **Nature and cost of management options**

Chemical hazards in the home

- **Metal cookware contaminated with heavy metals**
- **Ceramic or enamelled serving dishes with toxic glazes**
- **Leaded crystal used with acid foods**
- **Copper pans and utensils**
- **Miscellaneous home-use chemicals**

Chemical hazards in food



Potential physical hazards

- **Glass**
- **Slime or scum**
- **Metal**
- **Bone**
- **Plastic**
- **Stones and rocks**
- **Capsules or crystals**
- **Pits or shell**
- **Wood**
- **Paper**
- **Human and animal hair**

Potential physical hazards

Distribution of Complaints of Foreign Objects in Food

Soft drinks	19 %
Infant foods	16 %
Bakery	14 %
Chocolate and cocoa products	7 %
Fruits	7 %
Cereals	5 %
Vegetables	4 %
Fish	3 %
Others	25 %

Potential physical hazards

Possible Control Measures

- **Visual inspection**
- **Filters or sieves**
- **Metal detectors**
- **Magnets**
- **Separation by density**
- **Personnel precautions (hair net, gloves)**