

Indicators of food quality and safety



Indicators

- ❑ Origin of strategy – water microbiology
- ❑ A wide range of water-borne diseases (faecal pollution)

Disease		Organisms
Viral	Gastroenteritis	Enterovirus
	Hepatitis	Hepatitis A virus
Bacterial	Typhoid fever	Salmonella typhi
	Paratyphoid	Salmonella paratyphi
	Cholera	Vibrio cholerae
	Bacillary dysintery	Shigella dysinteriae
Protozoal	Amoebic dysintery	Entamoeba hystolytica
	Giardiasis	Giardia lamblia

Indicators

- ❑ To detect a small number of pathogen cells in big water volumes is impossible



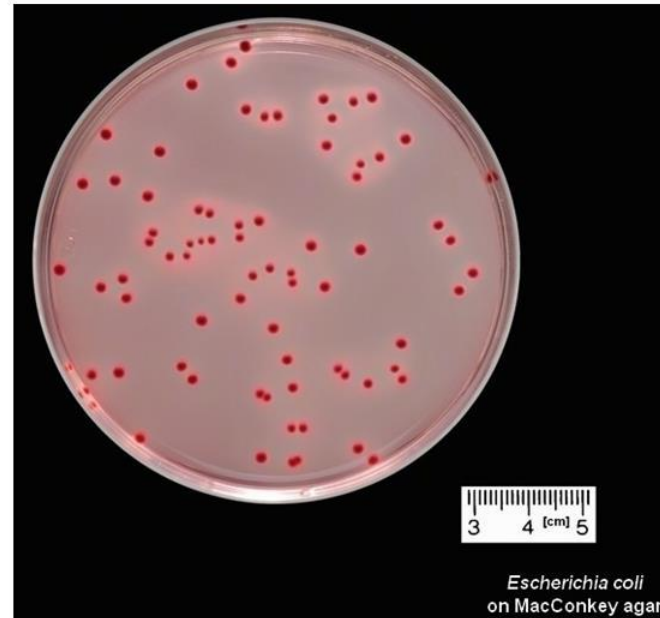
- ❑ Alternative – analysis for an organism which indicates whether water is polluted with faeces → indicator for a potential health hazard

Indicators

- ❑ To be chosen as an indicator, an organism should
 - Be present in faeces in large numbers so that faecal pollution is easily detected
 - Only be found in faeces and no other habitat unless faecal pollution has taken place
 - Be present in faeces when the pathogen is present
 - Survive in the polluted environment for a similar period as the pathogen
 - Respond to any disinfection systems (e.g. chlorination) in a similar way to the pathogen
 - Be quick and easy to isolate and identify in the laboratory

Indicators

- ❑ *Escherichia coli* – indicator for water supplies
- ❑ Natural habitat – guts of humans and other animals

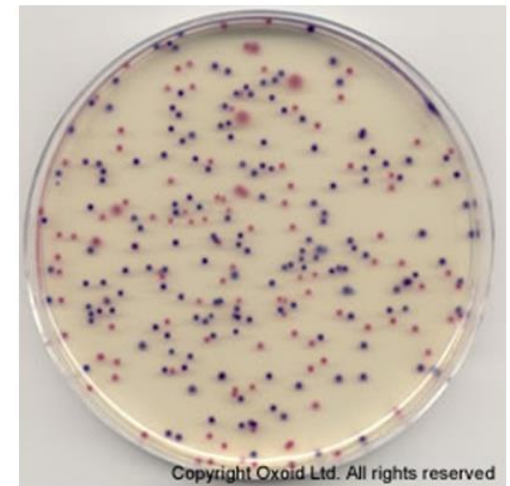


Indicators

- ❑ **Coliforms** (a working term) - MO which ferment lactose in peptone broth to give acid and gas within 48 h at 37°C in the presence of bile salts or a synthetic surfactant
- ❑ Coliforms – *E. coli*, *Enterobacter spp*, *Klebsiella spp* and *Citrobacter spp*
- ❑ Various habitats, incl. gut, soil, and in association with plants

Table 1: expected results, using *Brilliance E. coli/coliform Selective Agar*

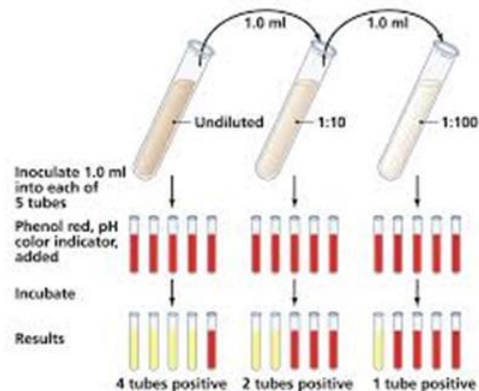
Organism	β- glucuronidase	β- galactosidase	Colony colour
<i>Escherichia coli</i>	+	+	Purple
Coliforms		+	Pink
Other organisms	-	-	Colourless or Blue
	+	-	



Indicators

❑ Most probable number (MPN) analysis

- Absence in 100 ml samples; for bottled water – absence in 250 ml



- ❑ For conclusive results – more environmentally resistant indicators – *Streptococcus faecalis* and *Clostridium perfringens*

Indicators

- ❑ *E. coli* and coliforms – faecal indicators in food quality control? – yes, with reservations
 - Numbers found may not bear information on the initial level of contamination (growth in foods, decline after freezing, etc.)
 - Coliforms may not be of faecal origin and in some cases not related to food hygiene (e.g. *Enterobacter spp.* are part of the natural plant flora – can not be used as indicator in fresh vegetables)
 - In some foods *E. coli* contamination is impossible to prevent
 - Some strains of *E. coli* may not be detected by traditional methods

Coliforms as indicators

- ❑ General hygiene indicators for heat-treated foods (heat sensitive)
- ❑ Presence after mild heat treatment (e.g. pasteurization) indicates post-process contamination
- ❑ Depending on product – poor process hygiene, temperature abuse (T allowing mesophilic growth)
- ❑ Level of significance depends on what happens to the product after the heat treatment

E. coli as indicator

- ❑ Presence in heat-treated food or when contamination is not inevitable indicates **possible faecal contamination** → **possible pathogen hazard**
- ❑ *E. coli* is more specific as indicator than coliforms → more stringent criteria for *E. coli*
- ❑ Significance as indicators in different foods should be considered



E. coli as indicator

- ❑ **Fresh meat** – liable to contamination with coliforms, faecal coliforms and *E. coli* from slaughterhouse environment
- ❑ Large numbers of *E. coli* may indicate poor slaughterhouse practice
- ❑ **Regulation 2073/2005** – *E. coli* is an indicator for faecal contamination of minced meat, mechanically separated meat and meat preparations



E. coli as indicator

- ❑ **Raw milk** –contamination with coliforms or *E. coli* is impossible to prevent
- ❑ Large numbers of coliforms – poor hygiene before heat treatment
- ❑ *E. coli* - udder infection
- ❑ **Regulation 2073/2005** – *E. coli* is an indicator for level of hygiene for butter and cream made from raw milk



E. coli as indicator

- ❑ **Pasteurized milk** – pasteurization kills coliforms or *E. coli*
- ❑ Coliforms – introduced from air near filler, contaminated bottles/cups, contaminated filler machine (post-process contamination) → **potential hazard**
- ❑ **Regulation 2073/2005** – *E. coli* is an indicator for level of hygiene for cheeses made from heat treated milk or whey



E. coli as indicator

- ❑ **Fresh vegetables** – non-faecal coliforms (*Enterobacter spp*)
– part of natural flora, no value as indicator
- ❑ *E. coli* may be introduced from manured soils, handling or washing with contaminated water → **potential hazard (e.g. *Salmonella*)**
- ❑ **Regulation 2073/2005** – *E. coli* is an indicator in pre-cut fruits and vegetables, unpasteurised fruit and vegetable juices



E. coli as indicator

- ❑ **Cooked frozen crustaceans** – may be contaminated with coliforms or *E. coli* if harvested from polluted waters
- ❑ A number of opportunities for post-process contamination after cooking
- ❑ **Regulation 2073/2005** – *E. coli* is an indicator for shelled and shucked products of cooked crustaceans and molluscan shellfish



Faecal coliforms

- ❑ Organisms fermenting lactose in bile salt peptone broth at 44-45.5°C to give acid and gas
- ❑ Population consists primary of *E.coli*, some strains of *Klebsiella* and *Enterobacter* could also ferment at elevated temperatures
- ❑ Testing for *E. coli* was relatively time consuming and expensive → often substituted by a single test for faecal coliforms

Enterobacteriaceae

- ❑ A wide spectrum of organisms that may be associated with poor hygiene
- ❑ Testing for coliforms substituted by analysis for **total** *Enterobacteriaceae*
- ❑ Possible detection of pathogenic *E. coli* and the lactose-negative *Salmonella* and *Shigella*

Enterobacteriaceae

❑ Regulation 2073/2005

- carcasses of cattle, sheep, goats, horses, pigs
- pasteurised milk, milk powder & whey powder, ice cream, dried infant formula
- egg products



Indicators

