

MICROORGANISMS AS INDICATORS OF WATER QUALITY

Cabelli (1977) noted that the best indicator organism should be the one whose densities correlate best with health hazards associated with one or several given types of pollution sources. He also listed the requirements for an indicator as follows:

- i. The indicator should be consistently and exclusively associated with the source of the pathogens.
- ii. It must be present in sufficient numbers to provide an accurate density estimate whenever the level of each of the pathogens is such that the risk of illness is unacceptable.
- iii. It should approach the resistance to disinfectants and environmental stress, including toxic materials deposited therein, of the most resistant pathogen potentially present at significant levels in the sources.
- iv. It should be quantifiable in recreational waters by reasonably facile and inexpensive methods and with considerable accuracy, precision, and specificity.

These requirements provide a basis to compare available indicators for water quality monitoring.

The objective of this session is to give a brief description of the indicator organisms and their relations with pathogens. The organisms discussed include total and FC, *E. coli*, fecal *streptococcus*, and *enterococcus* which have been used as indicators in either EPA guidance or state water quality standards.

Total and Fecal Coliform (TC & FC)

The total Coliform (TC) group comprises all aerobic and facultative anaerobic, gram-negative, non spore-forming, rod-shaped bacteria that ferment lactose with gas and acid formation within 48 hours at 35°C.

Fecal Coliform (FC) are defined as those Coliforms which respond at an elevated temperature of 44.5°C.

Among the Coliform group, there are four genera in the Enterobacteriaceae family, *Escherichia*, *Klebsiella*, *Citrobacter*, and *Enterobacter* (Metcalf and Eddy, 1991).

Escherichia Coli

Escherichia coli are a member of the Coliform bacteria population that may be used to indicate **fecal sources**.

Fecal *Streptococcus*

The fecal *Streptococcus* (FS) group consists of a number of species of the genus *Streptococcus* (*Streptococcus bovis*, *Streptococcus equinus*) and presence of them is an indication of contamination of **fecal wastes**.

Enterococcus

The Enterococcus group includes two strains of the FS that is most human specific. These are *Enterococcus faecalis* and *Enterococcus faecium*, which are the only indicator for **marine waters** selected by EPA in its 1986 water quality criteria.