Aquatic Microbiology

Definition

Aquatic microbiology is the study of microorganisms and their activities in fresh and marine water including rivers, lakes, springs and sea.

It is the study of microorganism's viruses, bacteria, algae, protozoa and microscopic fungi which inhabit these natural waters. Some of these microorganisms are indigenous to natural bodies of water other are entering to water from soil or from industrial or domestic wastes.

Importance

Aquatic microorganisms and their activities have great importance in many ways.

1. They may affect human health and other animal life. They are responsible for many diseases like typhoid, cholera, dysentery, campylobacter enteritis.
2. They occupy a high position in food chain by providing rich nourishment for the next higher level of aquatic life..
3. They are instrumental in the chain of biochemical reactions which involve recycling of element. e.g mineralization of organic compounds i.e. the dissimilation of organic compounds to carbon dioxide , water and various inorganic salts
4. The natural water is major food source.

Bacteriological evidences of pollution

Analysis of water sample on a routine basis is not possible. Each pathogen required detection .Therefore water is examined to detect E. coli the bacterium which indicate fecal pollution.

The coliform group of bacteria includes all aerobic and facultative anaerobic, gram negative, non spore forming bacilli that produce acid and gases from fermentation of lactose. These are normal inhabitants of large intestine of humans and other animals and are present in feces.

Thus presence of any of these bacterial species in water is evidence of fecal pollution of human and animal region. Both qualitative and quantitative methods are used for checking quality of water.

Qualitative analysis of water

Three basic tests to detect coliform bacteria in water are

- Presumptive test

- Confirmed test
- Completed test

- **Presumptive Test**

Presumptive test is screening test for detection of coliform bacteria. Measured portion of water to be tested are added to lactose fermentation broth containing an inverted glass vial (durum tube). Tubes of lactose media are inoculated with 10ml, 1ml and 0.1ml portions of water sample. Development of gas in any of tube in presumptive test is evidence of presence of coliform bacteria in sample.

If the presumptive test is negative, no further testing is performed, and the water source is considered microbiologically safe.

- **Confirmed Test**

It requires selective and differential media such as Brilliant green lactose bile media (BGLB)

and Eosin methylene blue.

Streak form a lacto positive broth tube obtained from presumptive test on Eosin methylene blue. E. coli produced dark small colonies almost black centered with greenish metallic shine. Enterobacter produce large pinkish colonies.

Brilliant green lactose bile media (BGLB)

This medium inhibits the growth of lactose fermenters other than coliforms. Thus gas fermentation in BGLB confirms that coliforms are present.

- **Completed test**

It is final analysis of water sample and isolated colony is picked from plate and inoculated in tube of lactose broth and streaked on nutrient agar slant to perform a gram strain.

RESULT

Fermentation of lactose broth and demonstration of gram negative bacilli shows a positive confirmatory test.

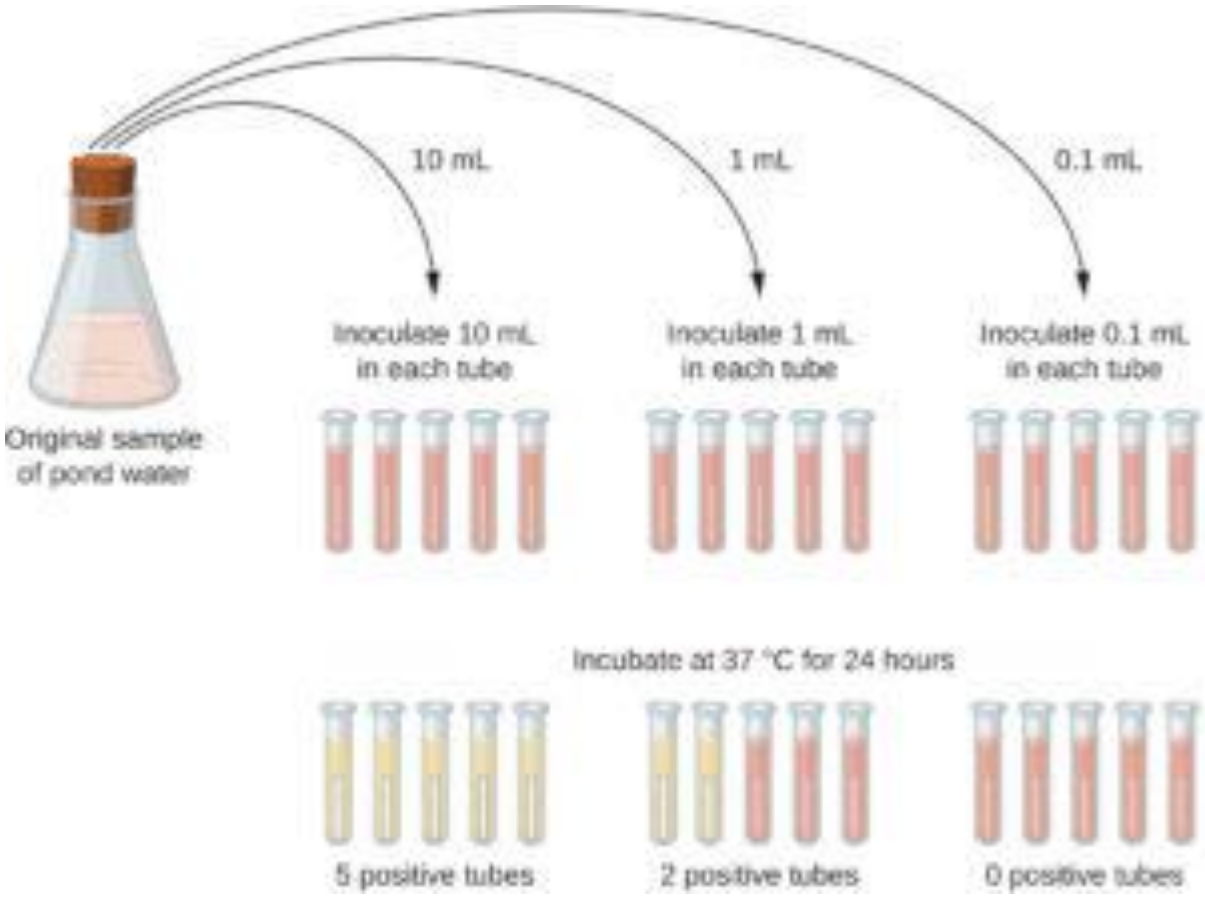
Quantitative analysis of water

Most Probable Number (MPN)is a method used to estimate the concentration of viable microorganisms in a sample by means of replicate liquid broth growth in ten-fold dilutions. It is commonly used in estimating microbial populations in soils, waters, agricultural products and is particularly useful with samples that contain particulate material that interferes with **plate count enumeration methods.**

Principle

Water to be tested is diluted serially and inoculated in lactose broth, coliforms if present in water utilize the lactose present in the medium to produce acid and gas.The presence of acid is indicated by color change of the medium and the presence of gas is detected as gas bubbles collected in the inverted durham tube present in the medium. The number of total coliforms is determined by counting the number of tubes giving positive reaction *(i.e both color change and gas production)* and comparing the pattern of positive results *(the number of tubes showing growth at each dilution)* with standard statistical tables.

Procedure of the test

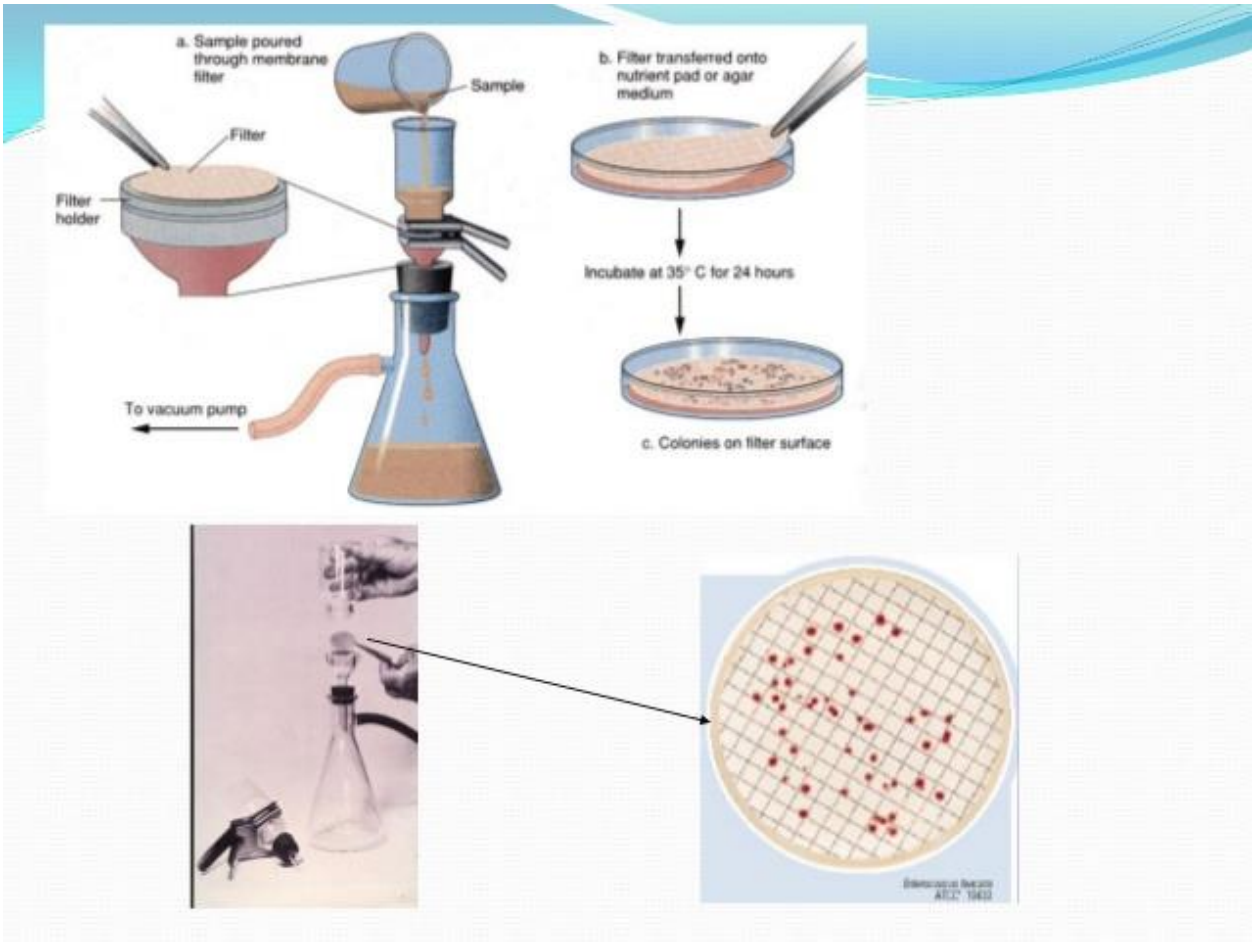


MPN values per 100 ml of sample and 95% confidence limits for various combinations of positive and negative results (when five 10-ml, five 1-ml and five 0.1 ml test portions are used)

No. of tubes giving a positive reaction :			MPN (per 100 ml)	95% confidence limits	
5 of 10 ml	5 of 1 ml	5 of 0.1 ml		Lower	Upper
0	0	0	<2	<1	7
0	1	0	2	<1	7
0	2	0	4	<1	11
1	0	0	2	<1	7
1	0	1	4	<1	11
1	1	0	4	<1	11
1	1	1	6	<1	15
2	0	0	5	<1	13
2	0	1	7	1	17
2	1	0	7	1	17
2	1	1	9	2	21
2	2	0	9	2	21
2	3	0	12	3	28
3	0	0	8	1	19
3	0	1	11	2	25
3	1	0	11	2	25
3	1	1	14	4	34
3	2	0	14	4	34
3	2	1	17	5	46

- **Membrane Filter Method**

A measured volume of water sample to be tested is drawn through the filter disc. The bacteria are retained on the surface of membrane. The filter containing trapped micro organism transferred to a sterile Petri dish containing media after incubation colonies will developed, count them. The number of colonies shows the number of bacteria in water sample.



Distribution of aquatic microorganisms

Microorganisms in an aquatic environment may occur at all depths ranging from surface region to very bottom of ocean. The surface layer and bottom sediments have the highest concentration of microorganisms.

- **Plankton**

The aggregation of floating microbial life in surface region of aquatic ecosystem is called plankton.

Plankton may be composed primarily of algae called phytoplankton or it may me predominantly protozoan's and another minute animal life called zooplankton.

- **Benthic microorganism**

Microbial inhabitants of bottom region of body of water are referred as benthic microorganisms. It is the richest of an aquatic ecosystem in terms of number and kind of microorganisms.

Problems of unsafe drinking water

Drinking water of most communities is obtained from the surface source such as rivers streams and lakes. Such natural water suppliers particularly streams, lakes and rivers are likely to be polluted with industrial and domestic water. Polluted water contains vast amount of organic matter that serves as excellent nutritional source for growth and multiplication of microorganisms. These pathogens are responsible for intestinal infections such as dysentery, cholera, typhoid, fever and parathyroid fever.

WHO (World health organization) estimates that 1.7 million deaths per year results from unsaved water supply. Most diarrheal diseases and 90% of these deaths occur in children living in under developing countries where potable water at minimum .In addition to bacterial infection unsaved water suppliers are responsible for numerous parasitological infections. These parasitic protozoa are *Entamoeba histolytica*, *Blantidium coli.*

Some bacterial pathogens are *Salmonella typhi, Vibrio cholerae*.

These are enteric pathogens. They cause infection in intestine and they live in water or aquatic ecosystem.