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CURRENT TRENDS OF ESCHERICHIA COLI AS INDICATOR ORGANISM OF DOMESTIC WATER QUALITY

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Abstract- Better public health depends on regular monitoring of water quality as faecal contamination is a serious problem due to the potential for contracting disease. Bacterial contamination in water is measured using indicator organisms, notably Escherichia coli which is used as primary indicators of contamination in fresh and marine water quality, respectively, rather than the total coliforms present. Monitoring the microbiological quality of drinking water relies largely on examination of indicator bacteria such as coliforms, *Escherichia coli*. *E. coli* is a member of the faecal coliform group and is a more specific indicator of faecal pollution than other faecal coliforms. Two key factors have led to the trend toward the use of E. coli as the preferred indicator for the detection of faecal contamination, not only in drinking water. The faecal coliform definition has also been revised to coincide better with the genetic make-up of its members and now includes newly identified environmental species. Public health protection requires an indicator of fecal pollution. It is not necessary to analyze drinking water for all pathogens.

Index Terms: **fecal indicator, bacteria, *Escherichia coli*, water quality, trends**

I. INTRODUCTION

Water is a natural resource and is essential to sustain life. Accessibility and availability of fresh clean water does not only play a crucial role in economic development and social welfare, but also it is an essential element in health, food production and poverty reduction. (Edwards, P.R. and W.H. Ewing, 1986) However, safe drinking water remains inaccessible for about 1.1 billion people in the world and the hourly toll from biological contamination of drinking water is 400 deaths of children below the age five. (Neill, M.A., P.I. Tarr, D.N. Taylor and A.F. Trofa, 1994.) The microbiological quality of drinking water is a concern to consumers, water suppliers, regulators and public health authority alike.

Drinking water is one of the basic needs of life and essential for survival. Still more than one billion people all over the world do not have ready access to an adequate and safe water supply and more than 800 million of those unsaved live in rural areas. In India, ground water is being used as raw water for 85% public water supply. (According to world health report 1998). Water supply varies widely in terms of region and country. In 1970s, of the approximately 2.5 billion people in developing world, only 38% has safe drinking water. At the beginning of the 1980s, water supply coverage was 75% in urban areas and 46% in rural areas. In developing countries, 75% of the population had access to water supply.

Escherichia coli is the type species of the genus Escherichia, which contains mostly motile, Gram- negative, non-spore forming and facultative anaerobic bacilli within the family Enterobacteriaceae (Edwards and Ewing, 1986). It was first described by a German paediatrician, (Theodor Escherich in 1885). (Neill et al., 1994). The bacilli measure approximately 2-3m in length and 0.6m in width and live as a normal flora in the lower intestine of most warm blooded animals including human being. They can be grown and maintained on ordinary laboratory media. The optimum temperature for its growth is 370C, but can withstand a wide range of temperature (20 to 40°C). The morphology and form of E. coli colonies is different on different culture media, e.g. typical E. coli colonies in Mac Conkey's Lactose Agar (MLA) medium are pink to red with a pale periphery, whereas in Eosin Methylene Blue (EMB) agar medium, they are bluish black with a greenish metallic sheen (Cruickshank et al., 1975). In 1892, Shardinger proposed the use of E. coli as an indicator of faecal contamination. Accordingly, E.coli was reinserted in the drinking water regulations. E.coli survives in drinking water for between 4 and 12 weeks, depending on environ-mental conditions (temperature, micro flora, etc.).

The importance of quality changes in distribution is based upon evidence concerning the frequency and extends of known quality changes and their impact upon human health, a significant proportion of recognized piped drinking water-related disease outbreaks are related to quality deterioration in distribution. (Cheryl D, Mark W, Le-Chavallier MW.) Piped distribution systems for drinking water are as important to the quality and safety of drinking water as the treatment itself. Water entering the distribution system must be microbiologically safe and ideally should be biologically stable. The distribution system itself must provide a secure barrier to post-treatment contamination as the water is transported to the user. (Geldreich EE, Le-Chavellier MW.)

E. coli are present in the intestine of men and animals and are released into the environment in faecal material. As faecal matter is the main source for disease-causing agents in water, faecal bacteria are widely used as indicators of contamination which can affect rivers, sea beaches, lakes, ground water, surface water, recreational water and the many and diverse activities associated with these (Ishi S, Sadowsky MJ). Contamination can result from leakage of sewage, sewer overflow caused by storm events and accidental or deliberate release into receiving water bodies, as well as water draining from agricultural land or directly from livestock and birds human faecal waste gives rise to the highest risk of waterborne disease. Waterborne disease might account for one-third of the intestinal infections world visually clear and colorless drinking water is acceptable. However, it should also be safe and free from chemical toxin and pathogenic microorganism (Maheshwari, 2008). Escherichia coli are widely distributed in the gastro-intestine tract of humans, pests, ruminants, non-ruminants and wild animal, where they are known to live as commensals (Feng and Weagant, 2009; Frederick, 2011).

Water is regarded as an essential and abundant source to the living organisms on the earth for their survival and growth but in India, 70% of the available water has been polluted by industries or domestic wastes. Drinking water contaminated with different chemical or physical sources has the greatest impact on health of human being, especially in developing countries contaminants of water has been classified into physical, chemical and biological sources. Physical sources are turbidity, colour, odour and other floating matter. Chemical sources comprises of Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), chlorides, alkalinity, pH, hardness etc. biological source of contaminants are the coliform bacteria and pathogens causing gastrointestinal disorders.

II. BRIEF HISTORY

Theodore von Escherich, a German bacteriologist, discovered the bacterium Escherichia coli in 1885. The bacterium, commonly known as E. coli, can be found in the human intestinal tract and comes in multiple forms, only one of which is deadly. E. coli is only two microns in length and one micron wide. It is rod-shaped and covered with small pili for mobility.

Widely known for its lethal capability, E. coli 0157:H7 is the most common and dangerous strain of E.coli and is found in feces and meat. When milk, cider, water, sawdust, and even the air come in contact with cow feces they may become contaminated with E. coli. Meat is the primary source of infection in humans.

Contamination is caused by direct exposure to the fecal matter of cattle. In order to kill E. coli 0157:H7, the contaminated material must be cooked at 160 degrees Fahrenheit or higher. In the United States alone, each year approximately 73,000 people are afflicted with symptoms of E. coli 0157:H7 toxicity and 61 people die. Globally, the E. colocator Glove will reduce the number of people who suffer from E. coli 0157:H7.

III. HISTORICAL REVIEW

In the year the 1880s the term ‘Coliform’ was first used to describe rod-shaped bacteria. Later in the year 1914, it was determined by the U.S. Public Health Service as aerobic and facultative anaerobic Gram-negative, non-spore-forming bacilli at 35 to 370C, fermenting lactose to produce acid and gas (CO2) within 48 hours (APHA, 2005).

E. coli was proposed as an indicator of fecal contamination of water by Schardinger in 1892 and was first introduced as an indicator of fecal contamination (Tallon et al., 2005). According to the WHO, the water should be tested for the presence of any pathogenic bacteria before the consumption to protect the health of the public. The presence of even single E. coli makes water non-potable. The definition of coliform changes regionally. The definition in Canada for coliform is same as in the US. European legislation, representative model of French Standardization Association (NFT90-413 and NFT90-414; AFNOR, 1990), defines total coliforms (TC) as: Gram-negative, rod-shaped, non-spore-forming, oxidase negative, aerobic or facultative anaerobic bacteria, able to grow in the presence of bile and ferment lactose with gas and acid (or aldehyde) production within 48 h at 37 ± 10C. However, the water from the source is treated, and safe drinking water is supplied through the distribution system.

Water leaving water treatment plants should meet standard criteria to provide assurance of reduction of pathogens to acceptable levels. The aim is not to provide sterile water to the consumer but safe water. Water transported through distribution systems is subject to both chemical and microbial quality changes, where it provides a habitat for microbial growth, which is sustained by organic and inorganic nutrients present on the pipe and in the conveyed water. Hence, water should regularly be examined to ensure that a drinking-water supply satisfies standard guidelines. The distribution system of drinking-water provides a habitat for microorganisms, providing organic and inorganic nutrients present in the pipe and in the water. Some of the viable organisms remaining in the water entering the Review of Literature 14 distribution pipeline may multiply if nutrients are available above 150C lead to the formation of biofilms on internal surfaces. Internal corrosion the older

pipe system also causes the deposition of sediments harboring number of microorganisms including pathogens. There are several reports on the deterioration of water quality in distribution system leading to water-borne illness (Craun and Calderon, 2001); (Blackburn et al. 2004).

Traditionally, indicator micro-organisms have been used to suggest the presence of pathogens. (Berg G, In: Berg G,ed..) Today, however, we understand a myriad of possible reasons for indicator presence and pathogen absence or vice versa. In short, there is no direct correlation between numbers of any indicator and entire pathogens. (Grabow WOK, Neubrech TE, Holtzhausen CS, Jofre J). Nonetheless, the ideal is to validate appropriate index organisms by way of epidemiological studies. A good example is the emerging use of an enterococci guideline for recreational water quality. (WHO World Health Organization; 1998). Often epidemiologic studies fail to show any relationship to microbial indicators, due to poor design and/or due to the widely fluctuating ratio of pathogen(s) to faecal indicators and the varying virulence of the pathogens. (Fleisher JM Int J Epidemiol 1990, Fleisher JM Res J Wat Pollut Contr Fed 1991).

Current standards tend to be more specifically based, focusing on *Escherichia* coli. This is a thermos tolerant coliform and is consistently present in very large numbers in the faeces of warm-blooded animals, including man, where it is a natural inhabitant of the intestine. Many coliform bacteria, including *E. coli*, can survive for a considerable time in water, making them a good indicator for the presence of other pathogenic bacteria. If coliform bacteria are detected, but no *E. coli*, it is likely that the contamination may be from soil or vegetation, or it may provide a warning that more serious contamination could follow, especially after heavy rain. However, the presence of any coliform bacteria in treated water indicates either deficiencies in the treatment process or some form of post-treatment contamination and the circumstances should always be investigated immediately.

IV. USE OF *Escherichia Coli* AS INDICATOR ORGANISM

Escherichia coli are the predominant member of the facultative anaerobic portion of the human colonic normal flora. (Krieg NR, Holt JG, eds).The bacterium's only natural habitat is the large intestine of warm-blooded animals and since E. coli, with some exceptions, generally does not survive well outside of the intestinal tract, its presence in environmental samples, food, or water usually indicates recent faecal contamination or poor sanitation practices in food-processing facilities. (Feng P, Weagant S, Grant M). The population of E. coli in these samples is influenced by the extent of faecal pollution, lack of hygienic practices, and storage conditions. (Krieg NR, Holt JG, eds).The mere presence of E. coli in food or water does not indicate directly that pathogenic microorganisms are in the sample, but it does indicate that there is a heightened risk of the presence of other faecal-borne bacteria and viruses, many of which, such as Salmonella spp. or hepatitis A virus, are pathogenic. (Brüssow H, Canchaya C, Hardt WD) For this reason, E. coli is widely used as an indicator organism to identify food and water samples that may contain unacceptable levels of fecal contamination. (Atlas J, Ronald M, Richard B).

E. coli is considered a more specific indicator of fecal contamination than fecal coliforms since the more general test for fecal coliforms also detects thermo tolerant non-fecal coliform bacteria. (Francy DS, Donna N, Myers T, et al). The E. coli test recommended by the United States Environmental Protection Agency (EPA) confirms presumptive fecal coliforms by testing for the lack of an enzyme which is selective for the E. coli organism. This test separates E. coli from non-fecal thermos tolerant coliforms.

V. CONCLUSION

Sensitive and frequent monitoring of environmental waters is essential to minimize adverse effect on human health. His World Health Organization states, Water must be examined regularly and frequently because pollution is often intermittent and may not be detected if examination is limited to one or only a small number of samples. For this reason, it is better to examine drinking water frequently by means of a simple test rather than less often by several tests or a more complicated test. Furthermore, the WHO states, Examination for faecal indicator bacteria in drinking water provides a very sensitive method of quality assessment. *E. coli* best fulfills these conditions. Itis pre-sent in extremely high numbers in the faeces of all mammals, it does not appreciably multiply in the environment.

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