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Survey on E.Coli and Residual Chlorine in Drinking Water

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***Abstract* – E.coli is a type of fecal coli form bacteria commonly found in the intestines of animals and humans. E.coli is short form for Escherichia coli. The presence of E.coli in water is a strong indication of recent sewage or animal waste contamination. That sewage may contain many types of disease causing organisms. There are many different strains of E.coli and the most severe is E.coli O157:H7 which produce strong toxin and can cause a variety of diseases such as diarrhea, urinary tract infections, respiratory disease, meningitis and more. In the present scenario, E.coli is one of the major pathogenic bacteria and hence it is attracting considerable attention in the research field, and in the analytical laboratories. The safety of drinking water has to be ensured by the concentration of E.coli, and it cannot be higher than 1CFU/mL. Several tests are available for determining the presence of E.coli in drinking water, but they are more expensive than the standard E.Coli tests and many labs may not have the expertise or supplies to perform these tests. Also none of the traditional detecting approaches such as Polymerase chain reaction (PCR), Surface Plasmon resonance (SPR) biosensor and Latex Agglutination has performed perfectly, that we can see from the literature. On the other side, electrical, electrochemical (e.g. impedance, DEP) and immunochemical biosensors have detection limits between 10^3 and 10^5 CFU/mL with an assay time at least 2h under ideal conditions. Other optical methods such as SPR, IR, and Optical fibers etc have even lower detection limit between 10^1 and 10^6 CFU/mL, and they also require incubation of several hours to days, stable laboratory environment with expensive equipment.**

***Keywords* – Escherichia Coli, Morphology, Metabolism.**

I. Introduction

E.coli is a type of fecal coli form bacteria commonly found in the intestines of animals and humans. E. coli is short for Escherichia coli. The presence of E. coli in**.** Water is a strong indication of recent sewage or animal waste contamination. Sewage may contain many types of disease-causing organisms. The presence of E.Coli in drinking water indicates that water may be contaminated with human or animal wastes. Disease causing microbes in these wastes can cause severe illness or health risk for infants, young children and people. Many authors have worked on detection of E.Coli in drinking water.

The enzymatic methods have been developed for detection of E.Coli based on the hydrolysis of chromogenic or flurogenic substrates by β-galactosidase and β-glucuronidase activity (***Brenner et al***,. 1993, ***George et al*** 2000, ***Bitton*** 2005). Recent reviews shown that E coli to be the best indicator for the assessment of fecal contamination (***Clark et al*** 1991). Commercially available kits based on these substrates and standard methods (MTF and Membrane filtration MF) techniques have also been performed to enumerate E.Coli in various types water (***Edberge et al*** 1990, ***Eckner*** 1998).

Sungkyun Kim et al (2011) developed an immunofluorescence method for the detection of food borne pathogens in food system and E.coli cells internalized in baby spinach leaves using microwire sensor coupled with high frequency alternating current. In this method, the targeted bacterial cells in the sample solution were captured on microwires of 25µm diameter and bound to fluorescein isothiocyanates labeled polyclonal E.Coli antibodies. ***Wibleboer D et al*** (2010) developed a hand held fluorescence detector for rapid detection of E.Coli in water. ***Nassim Nikkhoo et al*** (2013) developed an integrated system for the detection of live bacteria like E.Coli using potassium sensitive FETs in CMOS. The assay time for the detection of live bacteria was reported in this work is 10 min. ***Yixian wang et al*** (2011) reported subtractive inhibition assay for the detection of E.coli O157:H7 using surface plasma Resonance immunosensor. In this method, E.Coli O157:H7 cells and antibodies were incubated for a short of time and antibodies were removed by a stepwise centrifugation process. ***Paul E Johnson*** reported and developed a low cost, portable, highly sensitive self contained single cell detection prototype for E.Coli enumeration for rapid monitoring of surface water. The method adopted was based on LED-induced fluorescence of antibody-DNA labeled cells. ***Melanie M. Hoehl et al*** (2012) developed "Rapid and Robust detection methods for poison and Microbial contamination" and introduced a chemical method for quantification of wide range of chemical and microbial contaminations using a simple instrument, and testing was done with multichannel, multisampling UV-vis spectrophotometer/ fluoremeter that employ two frequencies of light to interrogate the sample. ***Liju Yand, Rashid Bashir*** (2003) has reported an impedance technique to detect and/or quantify food borne pathogenic bacteria and dealt with a significant development of impedance biosensors with other techniques such as dielectrophoresis electropermeabilization. After going through the literature, it is found that controller based E.Coli monitoring or detection systems are not found. Further, the standard methods require incubation, filtration, expensive instrument and laboratory environment which cannot be

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afforded for all people. To detect such low level micro bacteria in drinking water in an easy and efficient way, useful to all kinds of people in the society, it is aimed to design and develop a low cost, reliable and simple embedded device with more precision. A cost effective instrument will be designed using microcontroller, sensors useful to all people in the society. Further it can be monitored in simple and easy way. It will be more reliable, sensitive and more accurate.

II. Type and Morphology

E. coli is a Gram-negative, facultative anaerobic (that makes ATP by aerobic respiration if oxygen is present, but is capable of switching to fermentation or anaerobic respiration if oxygen is absent) and nonsporulating bacterium.[1] Cells are typically rod-shaped, and are about 2.0 µm long and 0.25–1.0 µm in diameter, with a cell volume of 0.6–0.7 μm^3 *E. coli* stains Gram-negative because its cell wall is composed of a thin peptidoglycan layer and an outer membrane. During the staining process, *E. coli* picks up the colour of the counterstain safranin and stains pink. The outer membrane surrounding the cell wall provides a barrier to certain antibiotics such that *E. coli* is not damaged by penicillin.[1] Strains that possess flagella are motile. The flagella have a peritrichous arrangement.

a. Metabolism:

E. coli can live on a wide variety of substrates and uses mixed-acid fermentation in anaerobic conditions, producing lactate, succinate ethanol, acetate, and carbon dioxide. Since many pathways in mixed-acid fermentation produce hydrogen gas, these pathways require the levels of hydrogen to be low, as is the case when *E. coli* lives together with hydrogen-consuming organisms, such as methanogens or sulphate-reducing bacteria[1].

*b. **Genetic adaptation:***

E. coli and related bacteria possess the ability to transfer DNA via bacterial conjugation or transduction, which allows genetic material to spread horizontally through an existing population. [2]The process of transduction, which uses the bacterial virus called a bacteriophage,[29] is where the spread of the gene encoding for the Shiga toxin from the *Shigella* bacteria to *E. coli* helped produce *E. coli* O157:H7, the Shiga toxin-producing strain of *E. coli*.

c. Infectuous Behaviour of E.Coli :

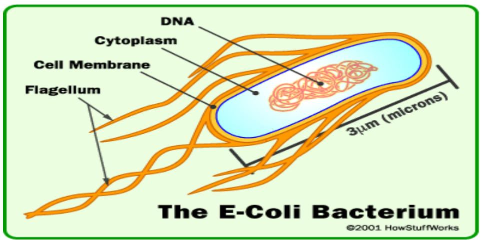
E. coli (*Escherichia coli*) is the name of a germ, or bacterium, that lives in the digestive tracts of humans and animals. There are many types of *E. coli*, and most of them are harmless. But some can cause bloody diarrhea. Some strains of *E. coli* bacteria may also cause severe anemia or kidney failure, which can lead to death. Other strains of *E. coli* can cause urinary tract infections or other infection we get an *E. coli* infection by coming into contact with the feces, or stool, of humans or animals[3]. This can happen when you drink water or eat food that has been contaminated by faces

d. E coli in food:

E. coli can get into meat during processing. If the infected meat is not cooked to 71°C (160°F), the bacteria can survive and infect you when you eat the meat. This is the most common way people in Canada become infected with *E. coli*. Any food that has been in contact with raw meat can also become infected [4]. Other foods that can be infected with *E. coli* include: Raw milk or dairy products. Bacteria can spread from a cow's udders to its milk. Check the labels on dairy products to make sure they contain the word "pasteurized." This means the food has been heated to destroy bacteria [10].Raw fruits and vegetables, such as lettuce, alfalfa sprouts, or unpasteurized apple cider or other unpasteurized juices that have come in contact with infected animal feces

***E. coli* in water:**

Human or animal feces infected with *E. coli* sometimes get into lakes, pools, and water supplies. People can become infected when a contaminated city or town water supply has not been properly treated with chlorine or when people accidentally swallow contaminated water while swimming in a lake, pool, or irrigation canal. E-coli can often be found in water tanks and in addition it is found in bore water. Town water supplies should be free of e coli. E-coli lives in the intestines of warm blooded animals[8]. Most homes in New Zealand have birds and occasionally possums getting on your house roof[4]. These animals poo all over your roof, it then rains and washes the poo into your tank. There are millions of bacteria in a single poo from 1 bird or possum. If the conditions are right in your tank then you will have a huge growth of potentially harmful bacteria coming from every tap in your home



E coli from person to person contact

The bacteria can also spread from one person to another, usually when an infected person does not wash his or her hands well after a bowel movement. *E. coli* can spread from an infected person's hands to other people or to objects. Moreover, person-to-person contact easily spreads the organisms. Also, indirect spread of *E. coli* can also occur since the organisms can survive outside the body on utensils and many other surfaces [5]. The organisms can cause wound infections or even spread to the brain (meningitis). If the intestinal tract is injured by trauma ulceration, or other diseases, it may allow *E. coli* to cause infection of the abdomen (peritonitis) and/or sepsis.

Symptoms of E Coli:

Symptoms of intestinal infection generally begin between one and five days after you have been infected with E. coli. Symptoms can include abdominal cramping, sudden, severe watery diarrhea that change bloody stools, loss appetite / nausea, vomitin, fatigue, fever bloody, urine, decreased, urineoutput, paleskin, bruising, dehydration. Multiple tube fermentation has been used for the assessment of microbial quality of drinking water[6]. But this method has some limitations and time consuming process (***Edberge et al.,*** 1988, ***George et al*** 2000).

III. Conclusion

This review examines studies from various disciplines to understand pathogen contamination in ambient water bodies the worldwide prevalence of pathogen contamination is a serious concern, and enhancing the understanding of major pathogen sources and their significant impacts on water resources is crucial. A considerable number of studies on pathogen contamination have been conducted on a laboratory-scale; more emphasis should be given to field-scale studies for enhancing the understanding of pathogen interactions in the environment [7]. Developing new models, and improving existing modeling approaches commonly used for predicting water-borne pathogen levels will likely to help in assessing pathogen contamination at watershed-scale. Considering the limited ability of existing models to predict pathogen contamination, improvement and development of new models are needed so that pathogen levels can be predicted more accurately. Integrating knowledge from multiple fields (e.g., hydrology, microbiology, and ecology) would increase the understanding of pollution levels and potential causes of pollution, and can also help devise long-term strategies to improve water quality.

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