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**Water contamination detection by E.Coli**

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# Abstract

Water is essential to life, but many people do not have access to clean and safe drinking water and many die of waterborne bacterial infections water are mandated to be monitored for levels of fecal indicator bacteria. These bacteria are used to indicate the potential presence of pathogens in the environment *Escherichia coli* is normally present within the intestinal tracts of warm-blooded animals. Monitoring the microbiological quality of drinking water relies largely one examination of indicator bacteria such as coliforms, *Escherichia coli, and* *Pseudomonas aeruginosa*. *E.coli* is a member of the fecal coliform group and is a more specific indicator of fecal pollution than other fecal coliforms. facts have led to the trend toward the use of *E. coli* as the preferred indicator for the detection of fecal contamination, not only in drinking water, but also in other matrices as well: first, the finding that some *fecal coliforms* were non fecal in origin, and second, the development of improved testing methods for *E.coli .* The fecal coliform definition has also been revised to coincide better with the genetic frame of its members and now includes identified environmental species. As a result, fecal coliforms are increasingly being referred to as *thermotolerant* coliforms. This, combined with improved detection methods for E.coli, has started a trend toward the use of *E.coli in* place of thermotolerant coliforms as a more reliable indicator of fecal pollution in drinking water. At present, *E.coli* appears to provide the best bacterial indication of fecal contamination in drinking water. This is based on the prevalence of thermotolerant (fecal) coliforms in temperate environments as compared to there are incidence of *E.coli*, the prevalence of *E.coli* in human and animal faces as compared to other thermotolerant coliforms, and the availability of affordable, fast, sensitive, specific and easier toper form detection methods for *E.coli*.

# Key words: Indicators of fecal contamination; Escherichia coli; Pathogenic E. coli.

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# Introduction

Contamination of water and food with fecal bacteria is, and remains, a common and diligent issue, affecting public health and local and national economies (Stewart, J.W. et al..2007). Water- related infection is the major cause of horribleness and mortality worldwide. Among these, diarrheal illnesses are evaluated to cause 1.8 million deaths each year, for the most in developing countries (WHO, 2004). Progressed water supplies and proper sanitation can decrease the occurrence of gastrointestinal diseases. However, outbreaks of water- and food-borne diseases still frequently happen even in developed countries. Water is a natural resource and inessential 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. (Bartram, J., Fewtrell, et al.. 2001) Water helps maintain the moisture of internal organs of the body;( Gerald.P, 2011) maintains normal consistency off fluids such as blood and lymph;( Dooge, J.C., 2001 ) regulates body temperature; removes *poisons* or *toxins* from the body through urine, sweat and breathing (International Water Management Institute, 2007) and is essential for regulating the normal structure and functions of the skin (Burton, G.A., Gunnison, et al,1987) The body loses about four liters of water every day The microbiological quality of drinking water is a concern to consumers, water suppliers, regulators and public health authority alike. The potential of drinking water to transport microbial pathogens to great number of people, causing subsequent illness is well documented in countries at all levels of economic development. (Payment, P., 1997)It is stated that, most sporadic cases of water born intestinal illnesses will not be detected or if detected ,may not be recognized as water related. (Medema, G.J, et al,2003)Several researchers have attempted to estimate the total burden of waterborne diseases world-wide.

There is a manifest need for additional transdisciplinary studies that assimilate knowledge gained from multi-research endeavors studying pathogen contamination, and provide a comprehensive synopsis in order to comprehend the entirety of the problem. Therefore, the goal of this review is to present a broad research scope assessment of E coli contamination of water resources. It has been synthesized the potential health risks imposed by pathogens in water. Further, the impact of water resources development on E coli contamination, future challenges, and recommendations are summarized. In addition, we provide a brief discussion with the use of indicator organisms for assessing water quality.( Pandey, P.K., et al, 2014)

# Indicators of fecal contamination

The presence of indicator organisms indicates that water is contaminated by potentially dangerous fecal matter and hence their absence denotes in general the water safety. Although coliform organisms may not always be directly related to the presence of fecal contamination or pathogens in drinking water, the coliform test is still useful for monitoring the microbial quality of drinking water. (Niemie, R.M, et al,2001.) confirmed that only

*E. coli* is considered as a specific and reliable indicator of fecal pollution of water, since the more general test for Fecal Coliforms (FC) also detects thermotolerant non-fecal coliform bacteria

Water is ordered to be monitored for levels of fecal marker bacteria. These bacteria are utilized to demonstrate the potential presence of pathogens in the environment, since detection and identification of numerous types of pathogenic organisms is frequently difficult due to their low numbers and specific growth requirements.(Stewart, J.W. Santo Domingo,et al, 2007). Whereas few bacteria are right now utilized as indicator organisms for fecal contamination, the perfect indicator bacterium ought to be:

1) Show in intestinal tracts of warm-blooded animals.

2) Display when pathogens are there, and missing in uncontaminated samples.

 3) show in greater numbers than the pathogen,

4) Able to outlive essentially to pathogens in the environment;

5) Be unable to multiply in the environment;

6) Recognized and measured by easy, rapid, and inexpensive methods;

Coliforms are characterized as the lactose-fermenting, gram-negative, *Enterobactericeae*, counting *E. coli*, *Enterobacter*, *Klebsiella*, and *Citrobactor*(Leclerc, D.A.A. Mossel.et al, 2001). Thermotrophic coliforms (also called “fecal coliforms”), which can develop at a hoisted temperature (44.5°C), were at first suggested as a more “fecal-specific” indicator. (USEPA, 1976). Nevertheless, a few individuals of thermotrophic coliforms, such as *Klebsiella*, be able to start from non-fecal sources as well (USEPA. 1986).

# Escherichia coli

Use of Escherichia coli as indicator organism Escherichia coli are the predominant member of the facultative anaerobic portion of the human colonic normal flora.( Emch, M.Ali,et al,2008) 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.The population of E. coli in these samples is influenced by the extent of faecal pollution, lack of hygienic practices, and storage conditions. (Emch, M., Ali, 2008)The more 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. (Hale, T.L., 1991) 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. (Todar, K., 2009.) E. coli is considered a more specific indicator of fecal contamination than fecal coliforms since the more general test for fecal coliforms also detects thermotolerant non-fecal coliform bacteria. (Tetteh, G.L. and Beuchat, L.R., 2003.)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 thermotolerant coliforms.

 *E. coli* is a natural and essential part of the bacterial flora in the gut of humans and animals. Most *E. coli* strains are nonpathogenic and reside harmlessly in the colon. However, certain serotypes do play a role in intestinal and extra-intestinal diseases, such as urinary tract infections ( Scheutz, F.; Strockbine, 2005). In a study of the enteric bacteria it says that *E. coli* was the commonest species, being isolated from nearly half of the species studied.

*E.coli* is a rod-shape, gram-negative, gamma proteobacterium within the family *Enterobactericeae*. The necessary habitat of *E. coli* is thought to be the minor intestine of warm-blooded animals, as well as humans (Savageau, M.A. 1983). More than one million (106) *E. coli* cells are generally show in 1 g of colon material, and are frequently released into the environment (their secondary habitat) through fecal deposition (Savichtcheva, O., N. et al,2007). Until moderately as of late, however, E*. coli* was believed to survive ineffectively in the environment and not to grow in secondary habitats, such as water, sediment, and soil (Winfield, M.D., et al,2003). *E. coli* faces numerous stresses in the environment, counting low and high temperature.(Williams, L.M. Avery, et al,2005),restricted moisture(Solo-Gabriele,M.A. Wolfert,et al, 2000), variation in soil texture(Ogden, I.D,et al,2001)low organic matter content, high salinity (Stewart, J.W,et al,2007), solar radiation, and predation(Solo-Gabriele, M.A. Wolfert,et al, 2000)

latest studies, however, have appeared that *E. coli* can survive for long periods of time within the environment, and possibly replicate, in water, on algae, and in soils in tropical( Fujioka, R.S,et al. 2003),subtropicaland temperate environments (Ishii, S., W.B. Ksoll, et al. 2006).Relatively high concentrations of nutrients and warm temperatures in tropical and subtropical environments are likely factors enabling *E. coli* to stay alive and grow outside of the host,( Carrillo,E. Estrada,et al,1985) The accumulation of nutrients, such as manure, significantly increased the concentration of *E.coli*, suggesting that *E.coli* can develop and maintain their population in temperate environments if favorable conditions exist (Fig.1).

 (By appanahalli, M.N., et al. 2006) reported that *E. coli* strains were habitually isolated from sure protected temperatures soils in Indiana, and their genetic structure was different from these bacteria isolated from animals (Fig. 2A).additionally ,( Ishii, S., W.B. Ksoll,et al. 2006)reported that geno ordinarily indistinguishable *E. coli* strains were always isolated from a temperate soil. The soil-borne *E. coli* strains had DNA fingerprint impression designs from animal-borne separates, proposing that they were not recently deposited by animals

It Has also been reported. (Na, S.H., et al,2006) appeared that *E. coli* can enter viable But non culturable (VBNC) state in natural water held at 4°C. Taken together, these consequences propose that *E.coli* can stay alive, grow, and become “naturalized” members of soil and algal communities.The capability of *E. coli* to survive and grow in the environment is expected due to its flexibility in energy acquisition. *E. coli* is a heterotrophic bacterium, requiring only simple carbon and nitrogen sources, additionally phosphorus, sulfur, and other trace elements for their growth. This bacterium can moreover degrade different types of aromatic compounds such as phenyl acetic acid and benzoic acid, to produce energy.( Díaz, E., A. Ferrandez,et al,2001) In addition, *E. coli* can grow both beneath aerobic and anaerobic conditions, which they may face in a diversity of fluctuating environments. Besides, *E. coli* can grow above a wide range of temperatures (7.5–49°C), with has a growth optimum of 37°C.(Jones, T., C.O. Gill, et al,2004). The long-term survival of *E. coli* beneath freezing temperature has moreover been reported,( Gagliardi, J.V., et al,2002). The capability of *E.coli* to grow and survive over various conditions likely allows them to turn into an integrated member of microbial communities in a variety of environments.





Fig. 1. Schematic graph of the lifecycle of *E. coli*.

Once *E. coli* is released from their primary host (warm-blooded animals) through fecal droppings, the mainstream of the released bacteria die due to low nutrients and other environmental factors. A few of them, however, turn out to be attached to soil, sand, sediment, or algae surfaces, and survive longer. In some circumstances, these *E. coli* strains be able to grow and maintain their populations long enough to become adapted or “naturalized” to the environment. The adapted or naturalized *E. coli* stay alive and replicated in the environment, and can be reintroduced to animal hosts through get in touch with water and food.



# Pathogenic E. coli

even though most *E. coli* are harmless commensally bacteria, some strains can be cause human diseases. Shiga toxin-producing *E. coli* (STEC), as well as enterohemorrhagic *E. coli* (EHEC), can be reason for bloody diarrhea as well as potentially fatal human diseases, such as hemolytic uremic syndrome (HUS) and hemorrhagic colitis (HC)( Nataro, J.P., and J.et al, 1998.). *E. coli* O157:H7 is one of the most recognized serotypes of EHEC, and has caused many large outbreaks of food- and water-borne illness. In addition to STEC and EHEC, at least five additional pathogroups of *E. coli* have been recognized. Entero pathogenic *E. coli* (EPEC) are one of the major reassign of watery diarrhea in infants, particularly in developing countries. Entero toxigenic *E. coli* (ETEC) are the major cause of traveler’s diarrhea and enteroaggregative *E. coli* (EAEC) can effect persistent diarrhea, enduring for further than two weeks. Entero invasive *E.coli*(EIEC)are genetically, biochemically, and pathogenically directly related to *Shigella* (Nataro, J.P., et al.1998). Several, researchers believe that *Shigella* as being a subgroup of *E. coli*( Pupo, G.M., et al.2000). While extra intestinal pathogenic *E. coli* (ExPEC), as well as uropathogenic and avian pathogenic strains, are considered to be harmless while they are in the intestinal tracts, they be capable of cause neonatal meningitis/sepsis and urinary tract illness if acquired by others( Welch, R.A.,et al.2002)broad surveys are available on the pathogens is, diagnosis, and sources of pathogenic *E. coli*(Paton, J.C., et al.1998).In any case, the distribution of pathogenic *E. coli* in the environment has not been inspected in detail. A few ponders have exposed that EPEC strains can be more frequently detected in the environment than the STEC(Lauber, C.L.,2003) reported the occurrence of possible EPEC strains, but no STEC, at Great Lake beaches. likewise, (Higgins, J.A., et al.2005)reported that the Intiman receptor gene *tir*, an EPEC virulence reason, was more frequently detected than *stx* genes (STEC virulence factor) in water samples from urban streams. Whereas cattle and other ruminant animals (sheep, goats, and deer) might serve as major reservoirs of STEC(Ishii, S., K.P. ,et al.2007), EPEC strains might be equally distributed among diverse human and animal hosts. The broad distribution of potential EPECinalarge number of animal hosts may, in part, explain the frequent detection of this pathogen in the environment.

## Pathogenic Escherichia coli Strains

*E. coli* strains isolated from intestinal diseases have been grouped into at least six different main groups, based on epidemiological evidence, phenotypic traits, clinical features of the disease and specific virulence factors. From these, enterotoxigenic (ETEC, namely O148), enterohemorrhagic (EHEC, namely O157) and enteroinvasive serotypes (EIEC, namely O124) are of outstanding importance and can be transmitted through contaminated water.( Huys, G., Cnockaert,et al 2003)

## *Enterotoxigenic E. coli (ETEC) Strains*

Enterotoxigenic *E. coli* (ETEC) serotypes can cause infantile gastroenteritis. The number of reports of their occurrence in developed countries is comparatively small, but it is an extremely important cause of diarrhea in the developing world, where there is no adequate clean water and poor sanitation. In developing countries, these strains are the most commonly isolated bacterial enteropathogen in children below 5 years of age, and account for several hundred million cases of diarrhea and several ten of thousand deaths each year (Cabral, J.P., 2010)

Disease caused by ETEC follows ingestion of contaminated food or water and is characterized by profuse watery diarrhea lasting for several days that often leads to dehydration and malnutrition in young children (Bettelheim, K.A., 1991).ETEC also are the most common cause of travelers‘diarrhea‖ that affects individuals from industrialized countries travelling to developing regions of the World (Cabral, J.P., 2010)

## Enterohemorrhagic E. coli (EHEC) Strains

Reported outbreaks had been associated mainly with the consumption of contaminated foods, such as raw or undercooked ground meat products and raw milk. The primary reservoir of this bacterium has been found to be healthy cattle (Ottawa, O., 2006)

*E. coli* serotype O157:H7 causes abdominal pain, bloody diarrhea, and hemolytic uremic syndrome. This bacterium produces Shiga-like toxins. The incubation period is 3–4 days, and the symptoms occur for 7–10 days. It is estimated that 2–7% of *E. coli* O157:H7 infections result in acute renal failure (Cabral, J.P., 2010)

Although *E. coli* O157:H7 is not usually a concern in treated drinking water, outbreaks involving consumption of drinking water contaminated with human sewage or cattle feces have been documented. An increasing number of outbreaks are associated with the consumption of fruits and vegetables (sprouts, lettuce, coleslaw, salad) contaminated with feces from domestic or wild animals at some stage during cultivation or handling. EHEC has also been isolated from bodies of water (ponds, streams), wells and water troughs, and has been found to survive for months in manure and water-trough sediments(Cabral, J.P., 2010)

Person-to-person contact is an important mode of transmission through the oral-fecal route. An asymptomatic carrier state has been reported, where individuals show no clinical signs of disease but are capable of infecting others (Ottawa, O., 2006)

## Enteroinvasive E. coli (EIEC) Strains

Enteroinvasive *E. coli* (EIEC) behave in many respects like shigellae. They are capable of invading and multiplying in the intestinal epithelial cells of the distal large bowel in humans. The illness is characterized by abdominal cramps, diarrhea, vomiting, fever, chills, a generalized malaise, and the appearance of blood and mucus in the stools of infected individuals.(Parker, F.R., 2005)

EIEC strains were isolated, for instance, from 28 subjects in the Jesreel district of Israel during a peak period for dysentery. An investigation in Croatia showed that *E. coli* O124 could frequently be isolated from cases of gastroenteritis, enterocolitis, and dysentery. The dysentery was more common among the older age groups, while the two other types of disease occurred equally in all age groups. A 1985 survey was carried out in Bankok, Thailand in which 410 children with diarrhea and an equal number of control children without diarrhea were examined for the presence of strains of *Shigella*, EIEC, and other pathogens. It was found that 17 of the children with diarrhea and six without yielded EIEC (Garrity, G.M., 2005)

Any food contaminated with human feces from an ill individual, either directly or via contaminated water, could cause disease in others. Outbreaks have been associated with hamburger meat and unpasteurized milk (Parker, F.R., 2005)

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# Conclusion

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. Safe drinking water for all is one of the major challenges of the 21st century. Microbiological control of drinking water should be the norm everywhere. It is obvious that results of numerous studies that exchange fecal indicators need to be residential in order to improve predict public health risks. (Savichtcheva, et al.2007) reported that a genetic marker for Bacteroides had a higher predictive value for the incident of bacterial enteric pathogens than those based on whole and fecal coliforms. It’s obvious that E.coli appears to be the most excellent in principal of bacteriological quality of water, primarily because of the, availability of foldable, fast, sensitive, specific and easier to achieve detection methods for E.coli. Though the fact remains that the lifespan of E.coli in water is short, thus it best determines, recent contaminations. It is consequently significant that there is continuous monitoring for E. coli to determine the bacteriological eminence of water.

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