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CONTAMINANT IDENTIFICATION IN WATER BY MICROBIAL BIOSENSORS: A REVIEW

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| Abstract

The various microorganisms are used to identify contaminated water. With the help of biosensors, drinking water pollution can be estimated. Rising environmental pollution is badly affecting water. Drinking contaminated water causes serious diseases in human beings as well as in animals. Microorganisms in contaminated water can spread serious diseases. Biosensors are genetically modified to identify the occurrence of heavy metals, chemicals, and toxins in contaminated water. Different microbes are used as biosensors, such as Escherichia coli, algae, fungi, Clostridium, etc. All these biosensors help to detect water pollution in different ways. For example, algae can detect water contamination by fluorescence during photosynthesis. Most rural areas are affected by contaminated water. Most people living in rural areas are affected by the polluted water, as clean water is not available in these areas. People living in rural areas use water that looks clear but contains micro-pathogens that can cause dangerous diseases. Biosensors are important for identifying contamination. Biosensors can easily detect pollution. Water is very important for survival. Drinking contaminated water can cause serious illness. Therefore, clean water is very important.

| Keywords

Microbial Biosensors; Water Pollution.

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Introduction

The biggest reason for water pollution and its scarcity is the growing human population and industrial pollution in the world (Khatri, Vairavamoorthy et al., 2008). Contaminated water kills millions worldwide (WHO, 2003). According to the report, youngsters under the age of five are most affected by contaminated water (UNICEF, 2006). About a decade ago, according to WHO research, most of the world's communities lived in water-scarce countries, mostly in rural areas and less developed areas. The current situation is so bad that, according to UNICEF, 1.7 billion individuals, including those in rural areas, will not have access to clean water. Some people live in rural areas that are still backward. There are no plants to treat polluted water in these areas. Such polluted water causes dangerous diseases. These include diseases that can be fatal. Due to water scarcity, people living in such areas turn to rivers, open ponds, springs, and open wells for drinking water, according to WHO and UNICEF. Unfortunately, all the principles of cleanliness are ignored, and these wells are often dug near toilets. Some of them are located near animal bathing areas (Maas, Perold, et al. 2017). Due to poverty and a lack of basic necessities, some people move to less developed areas where clean water is not available. Human health is not at all safe due to the use of

contaminated water. Diseases caused by contaminated water are caused not only by viruses, pathogenic protozoa, and bacteria (Organization 1996) but also by some biopesticides, hormones, phenolic acid, surface-active agents, toxins, metals, and nitrates (Young, Wolfheim et al. 2012). The pathogenic microorganisms present in contaminated water have a very bad effect on human health, which is very harmful to humans. Many pathogenic microorganisms present in contaminated water cause serious diseases, such as diarrhea, cholera, typhoid, paratyphoid, hepatitis A, dermatitis, intestinal fever, etc. (Butt and Ghaffar 2012). Biosensors are used to check water pollution for the best measurement of pollution. Water is considered an intermediate risk, according to the WHO guideline for water pollution detection. Some bacteria, like Escherichia coli, Enterococci, Clostridium perfringens, Streptococcus facials, fungi, and algae, are used as biosensors for contaminated water. Among the living pollutants, E. coli is the most prominent, and its number varies between 10 and 100 colony-forming units (CFU) (Lindemann, Constantinidou et al., 1982). Contaminated water is also estimated from the presence of Clostridium per fringes spores, sometimes due to the flow of contaminated rainwater and drainage, which increases the number of coliforms in the aquatic environment, making water more polluted. Water tests are done to assess water contamination, and various tests are done for this. If Streptococcus is not present in the water, then the water is not contaminated. Such water can be drunk (Warburton, McCormick et al., 1994). Sometimes the drinking water is clean in appearance, but it smells bad. And when it is drunk, it has a bad taste. The water is contaminated with fungi that are very harmful for health (Hageskal, Lima et al. 2009). Water quality is degraded by algae, which is a major cause of water contamination and can be estimated easily.

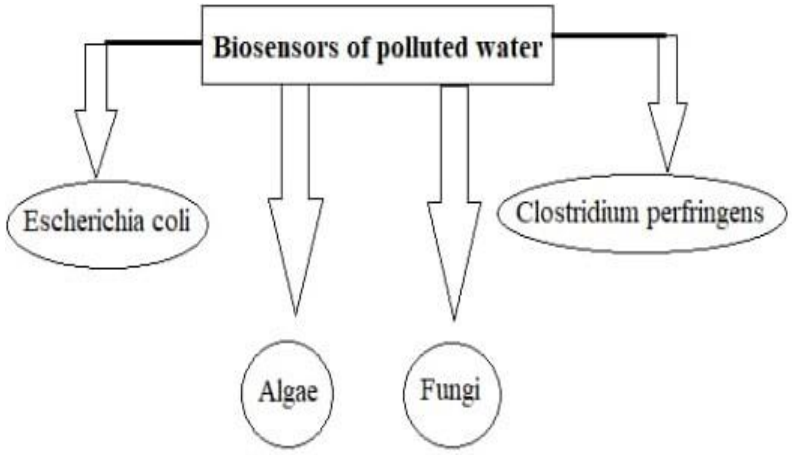

Figure 1: There are many types of biosensors that are used for the contaminated water such as Escherichia coli, Algae, Fungi and Clostridium perfringens.

Escherichia coli is used as a biosensor for contaminated water. Escherichia coli is an indicator organism that plays a very important role in identifying water contamination (Krieg and Holt 1984). Escherichia coli indicates not only water pollution but also
environmental and soil pollution, etc. Escherichia coli is an organism that is an anaerobic Gram-negative bacteria and also a negative rod-shaped germ. E. coli is a stick-shaped microorganism. It can rely on any substrate with a large number of Its length is about 2 micrometers, and the E. coli diameter is 0.5 m. The diameter of E. coli with cell volume is about 0.6 to 0.7 µm3 (Odonkor and Ampofo 2013). The major reason for affecting the fecal range is the increase in the E. coli population, which is mostly due to poor storage and a lack of hygiene principles and storage conditions (Taj, Samreen et al. 2014). Fecal coliform is used less as an indicator of intestinal contamination than E. coli because intestinal contamination from E. coli is

easily assessed. The same test that is commonly used for fecal coliforms is also used for E. coli from non-fecal thermotolerant coliform bacteria. Confirms gastrointestinal coliform; this test is designed to test for E. coli biology. We use this test to isolate E. coli from non-fecal thermotolerant coliforms (Hussein, Abdullah, et al. 2019). It normally resides in the lower intestines of humans and animals (Garrity, 2007).

Most E. coli strains are harmless, producing vitamin 43 and K2, as well as expelling pathogenic bacteria from the intestine and preventing them from harming their hosts. But also certain E. coli cause dangerous diseases, such as serotype O157:H7, etc. (Fotadar, Zaveloff et al., 2005). In fact, different schemes by McConnell bring out almost 128 types of coliform. Bergey and Deehan, in 1920, identified about 256.46 species of calf form (MacConkey, 1909). For fecal contamination, Indole formed the gelatin liquidation and production of sucrose yeast for differentiation coliform. These were the reactions of Pros core, one of the most important tests to identify allergies (Hendricks 1978). All of these tests ended in IMViC (in dole, methyl). Water sanitary engines are used to identify contaminated water. But identifying contaminated water through the use of fecal bacteria is the fastest process. Despite their high numbers, these bacteria were considered less fecal and more common, including Escherichia coli, Citrobacter, Enterobacter, and Klebsiella. E. coli was produced by stress, and the natural biological processes of E. coli develop some stressors that can be harmful, may cause an unpleasant change in its host animal, and usually cause diarrhea, which is dangerous for healthy children and adults (Nataro and Kaper 1998). There are also some viruses that cause serious illnesses, such as O157:H7, and early deaths in young people and the elderly (Blankenhorn, Phillips et al., 1999). For the preparation of ethanol, carbon dioxide, lactate, and acetate, E. coli uses mixed-acid fermentation during an anaerobic process. Mixed oxide fermentation is a process in which hydrogen GAS is produced by many pathways. These pathways are necessary to maintain the level of hydrogen. There are some bacteria that use these pathways, such as sulfate-reducing bacteria; this is what happens when E. coli live together. E. coli can grow easily at 37 °C, and this is the best temperature for the growth pattern of E. coli (Campanella, Cubadda et al., 1997). In some laboratories, at a temperature of 49 °C, different strains can multiply. Its growth may be occurring in an aerobic environment. But sometimes it contains anaerobic breathing, including redox pairs, oxidation of pyruvate acids, formic acids, hydrogen, and amino acids (Ingledew and Poole 1984). Stress is used to isolate E. coli. In the sample, different types of stresses are given to the different non-pathogenic E. coli. Due to stress on the pathogenic sample, it delays. The small populations of E. coli grow at 44 and 45.5 °C initially (Fotadar, Zaveloff et al., 2005). Sometimes acid and gas will not be produced by pathogenic strains in 48th broths because there is no production from lactose in E, LST, or BGLB. If the media contains sodium lauryl sulfate, then it will show growth at 44.5 °C, and this is only possible when the plasmid is removed. Pathogenic E. coli strains also contain some known to scramble that also contain many factors of virulence. According to the research, during selective enrichment cultures, 95% of E. coli cells lost their plasmid (March and Ratnam, 1986). E. coli should not be used for the detection of food or water isolation from the rocking strain. Other methods of isolation of E. coli strains used for the hemorrhage EE, namely the insertion of 0157:H7, will be differently approached. H7 should be used in different ways instead of isolating hemorrhage EE through other E. coli methods (Kubitschek 1990). And many other E. coli that are present in K0157:H7 create strains that lead to biochemical differences that can be identified by isolation methods. 0157:H7 Escherichia coli yeast either does not occur or is very slow; it does not produce practical β-glucuronidase, but other tests are performed that give accurate results that include other E. coli. In addition, E. coli 0157:H7 produces a stress that prevents rimonous agar plates from boiling. On the other hand, the non-sarbatol structure is associated with 60% of other E. coli, and most agar plates are evaluated by the group's Monoclonal antibodies, polymerase chain reaction, DNA testing, and monoclonal antibodies such as Universe Pro Cider are used to differentiate organs from agar. (4E8C12) method that is specific to the outer membrane protein of E. coli 0157: H7 and, therefore, both media on β-glu curonidase activity such as sorbitol MUG, which contains

McKinsey, during sorbitol fermentation (Spano, Goffredo et al. 2003). The importance of cleanliness is due to the fact that the number and identification of Escherichia coli depend on different estimates. Coliform and neural call is the definition of the ICOR group due to the unique identification of E. coli, the specimens of IMVC (Leclercq, Wanegue et al. 2002). Red pH contains moderate methyl, acting as an indicator that indicates the ability of pigments to monitor glucose levels in high acids. Natural products such as butanadiol and glucose metabolism 2.3 acetane are both produced by IV, also called the Vogues Proskauer reaction, if used as a single carbon source if C represents Is, which refers to the ability of the bacterium. With the help of IMViC's profile, which shows the exact ING due to recent data, It gives the same answer for E. coli IMVIC as for biotypes I and II. And also gives the same result to samples II E. coli as a comparison of some samples even in other events. And it takes 48 hours to partly explain the fact that detect and insole's large amounts. For this speculation, additional tests are very important (Paton and Paton 1998).

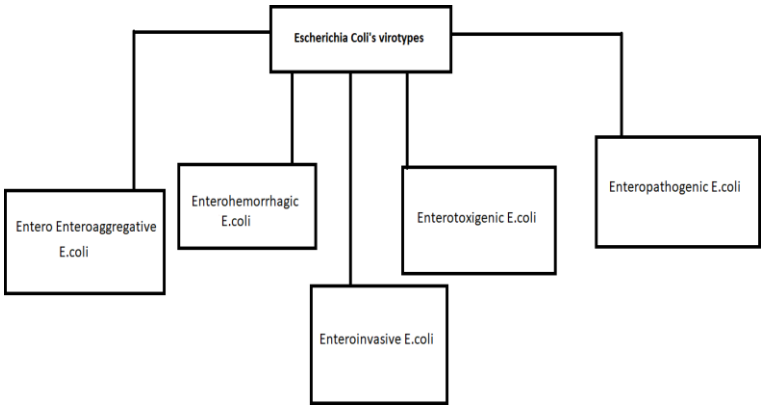

Figure 2: There are five virotypes of E.coli that relays on the different hosts such as enter toxigenic and enteropathogenic relays on rabbits, humans dogs etc. On the other hand enter invasive and Entro-entrenteraggregative only relay on human.

Algae is used as a biosensor for contaminated water. The measurements being taken to curb the spread of pollution in the world require the use of biosensors that can detect pollution. such as herbicides due to pollution or micro-algae that cause contamination of fresh water and seawater. But some biosensors, such as microalgae, help detect contamination. Types of microalgae such as chlorophyta, cyanobacteria, and diatoms help detect water contamination (Moreno-Garrido 2008). An important component of phytoplankton is also called green microalgae, such as chlorophyta. This is the type of algae that can easily survive in the system conditions that can be harmful for other microorganisms. Hats are used in the development of many biosensors that help respond to important changes in the water system (Scognamiglio, Pezzotti et al. 2010). Due to its good stability for the production of biological signals, the green alga, also known as Chlorella vulgaris, is used for the creation of biosensors that help analyze contaminated water (Védrine, Leclerc et al. 2003). With the help of chlorophyll fluorescence emitted by the activity of photosynthesis, it can help in the detection of water that contains pesticides as well as heavy metals in polluted water (Durrieu, Tran-Minh et al. 2006). Algal biosensors were first used to estimate contaminated water based on photosynthesis. Such biosensors are used to detect contamination due to the photosynthesis of living cells in water (Van der Heever and Grobbelaar 1998). Due to the change in electrical as well as optical signals, these sensors are based on the fluorescence of chlorophyll, which is incorporated into chloroplasts (Naessens, Leclerc et al. 2000), while amygdala photosynthesis with sensors follows the evolution of synthetic oxygen with the help of a Clark electrode (Dubinsky, Falkowski et al.

1987). Like chlorophyta, cyanophyta, also known as blue-green algae, are photosynthetic prokaryotic microorganisms that are also used as biosensors for contaminated water. Some inactivated cyanobacteria, like Synechococcus and Synechocystis, also work as biosensors to identify the toxicity of water. These types of blue-green algae detect water pollution through their respiration, nitrogen fixation, and photosynthesis systems. Diatomophyceae, or Bacillariophyce, are the type of diatoms that also help to indicate polluted water. They belong to the eukaryotic microorganisms, and Diatomophyceae or Bacillariophyceae are the most noticeable microalgae in fresh water and oceans. All marine environments contain diatoms (Reid, Tibby, et al., 1995).

Figure 3: The chlorophyta (type of green algae) present on the filters that is indicated polluted water.

Fungi are used as biosensors for contaminated water. Contamination with pathogenic microorganisms is a major concern for water consumers, who are refocusing on drinking water quality. Like other organisms, fungi play an important role in identifying water contamination (Hageskal, Lima et al. 2009). The fungus has never been so common in the past. The fungus was not considered as such, but later tests revealed that the fungus, like other micro-organisms, played a major role in testing water contamination. Different types of microbes in contaminated water cause serious diseases in humans. The fungus has never been so common in the past. The fungus was not considered as such, but later tests have shown that fungi, like other microorganisms, have played a key role in testing water pollution. Different types of germs in contaminated water cause serious diseases in humans. Water fungi were largely ignored, but modern research on contaminated water has led to a lot of work on the fungus over the past decade (SCHÜßLER, Schwarzott et al. 2001). When cases of fungus in drinking water came to light, water problems were examined in the 1960s and 1970s (Anglin, Hser et al., 1997), and it was estimated that the antinomy and cyanobacteria caused tasteless and smelly water. The amount of microfungi was also found in the water. According to a study from 1980, fungal infections in the water caused a variety of diseases (Rose, Martyny, et al., 1998). Some microorganisms, such as fungi and microbacteria, work as detecting elements that help convert biological responses into electric signals. Biosensors that are fungal-based are more beneficial as compared to bacteria because fungal-based biosensors have a high binding capacity and are more specific. Due to their suitable properties, fungi make them a more suitable applicant for preparing fungal-based biosensors (K. Hussain, Malavia et al. 2020). Normally, fungal-based biosensors are specific to electrical techniques such as luminescence, growth rate fluorescence, colorimetry, etc. In the field of molecular biology, recently, fungal-based biosensors have been used for new coding insertion arrangements and also in the modification of the fungal genome, offering more precise, accurate, and cost-effective procedures.

And many other yeasts based on biosensors are used for the identification of water pollution (Nugaeva, Gfeller et al., 2005). Some fungi are also causing infectious diseases that are harmful to humans.

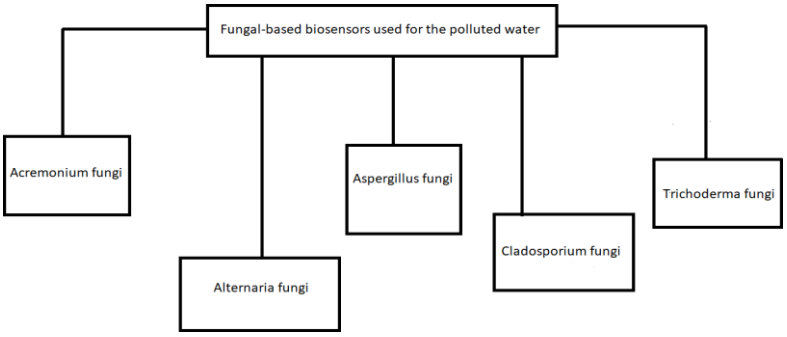

Figure 4: Acrenomium, Alternaria, Aspergillus,Cladosporium and Tichoderm all are the types of fungi that are found in the drinking water and are also used as biosensors of contaminated water.

Clostridium per fringes is used as a biosensor for contaminated water. Clostridium perfringens is the type of biosensor that helps detect water pollution. It is a rod-shaped gram-positive bacteria. Its size is about 0.3–0.2 micrometers, and its length is about 1.5–20.0 micromettes. Clostridium perfenies are the pathogenic bacteria that cause harmful diseases (Myers,

Rasko et al. (2006) Clostridium perfringensis is associated with human waste. However, it is not used in the U.S. and only in a peripheral area of Europe as a fecal indicator system. Another reason was the conflicting information that was developed according to preliminary research with this organism. An American activist who reviewed the 1945 searches and European workers examined it in 1960 with bonds According to most studies, the S.E. decided to compare the density of the pharynx with that of Escherichia coli (Bisson and Cabelli 1980). In the second absence, the results depend on the investigator and the sample examination, noting the presence of one of these indicators. even at the place where the samples were taken. However, a U.S. investigator

generally concluded that the presence of a Clostridium perfringens signaling system was of no value in indicating organ contamination. Perfringe was found to be irregular in well and river water samples (Cabelli 1977).

The conclusions and findings are dependent on the investigator and the sample being examined. Even the locations where the samples were taken were varied. American investigators concluded in general that the C. Perfringens indicator system did not have any value in indexing the presence of fecal contamination. Muhammad ET Morrison reported recently that Clostridium perfringens in water samples from wells and rivers was found to be irregular (Fujioka and Shizumura 1985). The results were compared with those of fecal coliforms, and it was concluded that these indicators were more accurate. Given our knowledge of ecology and physiology, it is not surprising that contradictory findings and conclusions have been drawn. I would expect E. coli, in the absence of Clostridium perfringens, to be recovered from water subject to small-scale, immediate sources (Mueller-Spitz, Stewart et al. 2010). The E. coli concentrations in feces, wastewater, and urine are approximately two orders of magnitude higher than Clostridium perfringens (Vierheilig, Frick et al. 2013). On the other hand, one might expect to isolate. It is not surprising to find contradictory results and conclusions, given the current knowledge regarding the ecology of the indicator systems. On the one hand, E. coli would be expected to recover in its absence (Bisson and Cabelli 1980). The conclusion and findings are dependent on the investigator and sample being examined. Even the

location where the samples were taken varied. However, American investigators concluded, in general, that Clostridium perifringes in the water samples from wells and rivers were found to be irregular (Cabelli 1977). The results compared with those of fecal coliforms concluded that these indicators were more accurate (Chukwu, Nwaokorie et al. 2016). Given the knowledge about ecology and physiology, it is not surprising that contradictory findings and conclusions have been
drawn. One would expect E. coli, in the absence of Clostridium perfringens, to be recovered from water subject to small-scale, immediate sources. Escherichia coli concentrations in feces, wastewater, and urine are approximately two orders of magnitude higher than Clostridium perfringen (Labbe and Juneja 2002). On the other hand, one might expect to isolate. It is not surprising to find contradictory results and conclusions, given the current knowledge regarding the ecology of the indicator systems (Vierheilig, Frick et al. 2013). On the one hand, E. coli would be expected to be recovered in the absence of Clostridium perfringens when water is subject to small scale (Vierheilig, Frick et al. 2013). Escherichia coli densities in wastewater and feces about two instructions to size higher Clostridium can also be isolated without E. coli in cases of environmental stress, such as prolonged transit in the water environment (Bisson and Cabelli, 1980).

Conclusion

Many microorganisms in the environment cause pollution. They harm the environment as well as humans. Several techniques are used to determine pollution in the environment, but modern research shows that some microorganisms are used for the detection of pollution in the environment, and this is a big achievement. Algae and fungi, some bacteria like cyanobacteria, clostridium, and some species of Escherichia coli are used as biosensors. All these species are used for the detection of water contamination, food contamination, and environmental contamination. Algae (blue-green algae) and other strains show their functions by florescence and by many advanced techniques. It is mainly used for water purification. Fungus-based biosensors work in luminous techniques, electrical techniques, and colorimetry. It is used for water decontamination. Clostridium perfringes is a biosensor that is used for water contamination detection as an immediate source. Different advancements for the progress of biosensors should be built up for a healthy environment. It may save the lives of animals, humans, and other worldwide organisms.

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