Opinion

Open Access CrossMark

Is it possible to secure the safety of drinking water using only indicator bacteria?

Volume 2 Issue 2 - 2016

Heejung Kim,[1] Siwon Lee[2]

[1]School of Earth and Environmental Sciences, Seoul National University, Republic of Korea

[2]Water Supply & Sewerage Research Division, National Institute of Environmental Research, Republic of Korea

Correspondence: Siwon Lee, Water Supply & Sewerage Research Division, National Institute of Environmental Research, Incheon 22689, Republic of Korea, Tel: +82-32-560-8354; Fax: +82-32-563-7085; Email: siwonlee@korea.kr

Received: June 17, 2016 | **Published:** June 20, 2016

Opinion

Drinking water safety is a very important issue nationally in both developed and developing countries. The Republic of Korea has been devoting a lot of effort to ensure the stability and safety of drinking water. In the late 1990s, during the controversy about increased levels of enteric viruses in tap water, the debate about water safety made big waves in Korean society. Water quality standards for drinking water were established with new criteria for *fecal coliforms* (FCs) and *Escherichia coli* in order to strengthen prevention of fecal contamination in 2002. In addition, water treatment standards were established in terms of the presence of lead in the safety equipment that monitors tap water for human pathogenic viruses and protozoan microorganisms, such as *Cryptosporidium* and *Giardia*. The methods for analysis of protozoan microorganisms which is pathogenic microorganisms and preparations methods have been investigated to analyze the viruses. However, suspicions about drinking groundwater safety were raised because of the Noroviruses (NoVs) due to a food poisoning outbreak that was traced to groundwater in 2005. The safety issue was raised of potable groundwater. Furthermore, major infectious viruses of Human NoVs in groundwater became known as genotype GI and GII. These results were required continuous monitoring of the groundwater. Small water supply facilities and water treatment plants that are vulnerable to contaminate with Human NoVs, total coliforms (TCs) and *E.coli* have been managed via a nationwide monitoring network.

The failure of drinking water safety is directly linked to the human health problems associated with food poisoning. The national effort on microbial safety in drinking water is very important. Drinking water has water quality standards that are called total colony counts (at 35°C), TCs and FCs or *E. coli* in this country. Natural mineral bottled water has safety criteria such as total colony counts (at 21°C and 35°C), TCs, *fecal Streptococci*, *Pseudomonas aeruginosa*, *Clostridium perfringens*, *Salmonella spp.* and *Shigella spp.* in terms of water quality.

The drinking water facilities (i.e., groundwater wells, water springs and fountains) have been managed in accordance with water quality standards such as TCs, FCs, *E. coli* and *Yersinia enterocolitica*. On the other hand, pathogenic microorganisms that cause waterborne diseases vary widely. It is impossible to test water for all possible pathogenic microorganisms. Positive confirmation requires analysis of serotypes of the species within the specified limits. This approach has wasted a considerable amount of time and money. Despite all these efforts, detection of the pathogenic microorganisms in drinking water is a very rare event, except in special cases.

On the other hand, for microbes of the intestinal origin, such as pathogenic microorganisms, instead of direct monitoring of the presence of these pathogenic microorganisms and many other species that are sensitive to disinfection, it may be possible to monitor water for a strong indicator organism, e.g., TCs, FCs, *E. coli*. This kind of management of waterborne pathogenic microorganisms seems to be logical. Quality of drinking water is regulated by microbiological safety management in this country according to this scheme at present. Likewise, the management of drinking water by means of microorganisms as indicators is widely used worldwide. As noted earlier, the management of drinking water using a microbe as an indicator is popular because of its effectiveness. Using one of the most powerful indicators in drinking water management, researchers of such indicators have been able to release controversial studies that refute the above logic. As previously reported, soil that was not in contact with fecal pollutants for approximately 8.5years was used for isolation of *E. coli* from rain using a soil lysimeter. A variety of genetic and physiological properties was investigated. They found that there is a different genotype of *E.coli* that can survive and proliferate in soil environments. In addition, the physiological characterization was provided to support this finding under a variety of conditions such as temperature and nutrient composition of the soil medium, thus revealing better growth as compared to the standard strains of *E. coli*. These findings weakened the function and status of *E. coli* as a fecal pollution indicator, suggesting that there is a need to search for new fecal indicators. In addition to problems with the fecal indicator, this research reveals inadequacy of this species for other tests because pre-existing *E. coli* naturally multiplies in the soil in tropical, subtropical and temperate climates according to the various reports around the world. For these reasons, the United States Environmental Protection Agency also stated that it is necessary to employ *Enterococcus* as an alternative indicator of microorganisms related to fecal contamination. Moreover, there are reports that *Enterococcus species* such as *E. faecalis*, *E. faecium*, *E. casseliflavus*, *E. hirae*, *E. mundtii*, *E. gallinarum*, *E. durans*, *E. avium* and *E. sulfureus* originate in the general environment in soils and sediments.

On the other hand, due to recent changes in climate and in the environment, there is increasing probability of detection of novel patterns of waterborne pathogenic microorganisms that have never been seen in the past. The indicator microorganism as described above may lose its usefulness and status by indicating fecal contamination falsely, due to the new presence in the natural environment. This can threaten the safety of drinking water. Therefore, the discovery and adoption of new microbial indicators are urgently needed.

Nevertheless, it is not easy to find a new fecal microbe as an indicator that can replace *E. coli* and *Enterococcus*. Continuous efforts on the management will be needed for each waterborne pathogenic microorganism. In particular, viruses contaminating some sources of drinking water (e.g., groundwater and spring water) are reported in this country. There is a debate on whether the indicators currently in use can secure the safety of drinking water. Moreover, viruses have an entirely different mechanism of proliferation and activation and different size in comparison with bacteria. In Korea, viruses that are actively managed in water sources include only NoVs in terms of water quality standards. This situation is due to the difficulties with sampling, costs and time.

Korean own high-efficiency standard diagnostic methods and positive controls are currently being developed to protect the water supply from major waterborne viruses. In addition, bacteria such as Legionella are much more difficult to manage than other microorganisms by means of an indicator. In such cases, there is a need to manage a couple of distinct criteria. Thus, the relatively high incidence (high detection rate) of some pathogenic microorganisms in water will necessitate creation of a standard test method to manage these microbes independently of an indicator organism. There is a need to review the set of water quality standards through continuous monitoring of drinking water. Microbiological management of drinking water safety by means of an indicator organism is most preferable in terms of efficiency.

Nonetheless, the use of one microorganism as a representative of all pathogenic microorganisms is not a perfect solution at present. Therefore, we should find alternative indicator organisms and select waterborne pathogenic microorganisms with a high detection rate and incidence in the environment of another country. It is also necessary to evaluate analytical methods of other country and to investigate continuous monitoring of drinking water to ensure its safety. As a result, drinking water safety can be ensured in the era of climate change.

Acknowledgements

None.

Conflict of interest

The author declares no conflict of interest.