Short communication

Scientific Validation of Incorruptible Self-purificatory Characteristic of Ganga Water

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Perhaps the essential ingredient to any viable civilization is access to water. Nearly all the great civilizations of the world grew up around water, which provided the key not only to supplying freshwater, but also to agriculture, trade, transport, and defense. Such civilizations as the Indian civilization, Roman Empire, Egyptian Civilization, the Venetian Empire, and the Omayyad Dynasty were all founded on their access to water, which provided their population with the means to both survive and expand.

Water is considered a purifier in most religions; in Hinduism, the Ganga is personified as a goddess. The Ganga has an exalted position in the Hindu ethos. It is repeatedly invoked in the Vedas, the Puranas, and the two Indian epics, the Ramayana and the Mahabharata. Baptism in Christian churches is done with water. A ritual bath in pure water is done for the dead in many religions including Judaism and Islam. And in Islam, the daily Salah can only be done after Ablution (*Wodoo*); i.e., washing parts of the body in clean water.

The water of the river Ganga is frequently used for drinking, cooking, and bathing purposes due to ancient knowledge that Ganges water does not putrefy, even after long periods of storage. Water has been used from time immemorial for remedial purposes. Most religious beliefs involve some ceremonial use of 'holy' water and in India, the water of the river Ganga is treated with such reverence. Under the continuous Saraswati-Indus civilization going back to ~7500 BC the Ganga river is mentioned in Rigveda. Hippocrates (~500 BC) wrote about the healing of disease with water. Bathing held a prominent place in the law that was prepared by Moses under divine instruction for the government of the Hebrew nation. The relation of the bath in the treatment of leprosy also would lead one to believe that water was used for curative effects. Outbreaks of acute diarrheal disease have been identified as causes of fatal disease dating back as far as the

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Sanskrit literature and during Hippocratic times. Ernest Hankin, a British bacteriologist, reported in 1896 on the presence of marked antibacterial activity against *Vibrio cholerae*, which he observed in the water of the Ganga river in India, and he suggested that it might help to decrease the incidence of cholera in people using water from the Ganges. Though invisible it was possible to show that this principle was particulate and called by D'Herelle "bacteriophage". Thus in a way the world owes the discovery of bacteriophages to the Ganges water.

Scientists studied that the water of Ganga at its origin is in a pure state and even after being kept for several years, does not get contaminated. These medical properties of Ganga water are attributed to the medicinal secretions of herbs and mineral content which get mixed with the water. A study was conducted to validate our ancient knowledge about the antimicrobial effect of Ganga water and to evaluate the potential

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of Ganga water in our endeavor to explore the possibility of using Ganga water as a novel source of antimicrobial compounds. Enterohemorrhagic *Escherichia coli* is a worldwide cause of infection in humans and animals. *Escherichia coli* O157:H7 is a major enteropathogen responsible for causing outbreaks of hemorrhagic colitis and hemolytic uraemic syndrome. The human infectious dose is very low, and ingestion of as few as 10 cells is thought to be sufficient to cause illness. The objective of this study was to evaluate incorruptible self-purificatory characteristic and microbial community structure of Ganga water when spiked with *E. coli* O157:H7.

To facilitate a fair assessment of the potential of its self-purificatory and incorruptible abilities, Ganga water having resident bacterial population was spiked with even 5-fold log units higher pathogenic load of *E. coli* O157:H7. Incorruptible ability of the water was studied in fresh, 8 years, and 16 years old Ganga water samples spiked with *E. coli* O157:H7. In general, the number of culturable *E. coli* O157:H7 declined over time but tended to be greater in freshwater than in 8 and 16 years old waters. Age of water seems to influence survival of *E. coli*

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O157:H7; thus its fate was further studied in boiled water and after passing through 0.2 µm pore-size membrane filter. In order to elucidate the involvement of active principles if it is sensitive to high temperature, the water was boiled. Water samples thus prepared were spiked with *E. coli* O157:H7 to evaluate the antibacterial ability of the water. Boiling water at 100°C kills microbes, while filtration is becoming increasingly the method of choice for sterilization of biologicals, especially when the product is heat labile, because the filtration process is inherently nondestructive. Overall, survival was greater in boiled water than in water passed through 0.2 µm pore-size membrane filter indicating involvement of heat labile agents influencing survival of *E. coli* O157:H7 in Ganga water. An interesting observation was the ability of the 8 and 16 years old Ganga water to influence survival of *E. coli* O157:H7. Eight years old water had a better ability to kill *E. coli* O157:H7 compared with boiled water and water passed through 0.2 µm pore-size membrane filter. The antibacterial activity of 16 years old water was better than boiled water and almost comparable to water passed through 0.2 µm pore-size membrane filter indicating that combination of factors controlled the rate of decline and does not let it putrefy, even after long periods of storage. Or in other words, Ganga water killed highly pathogenic *E. coli* manyfold

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more efficiently as compared to normal water. Even the 16 years old Ganga water was extremely effective.

To investigate well-known self-purificatory characteristic of Ganga water, impact of adding *E. coli* O157:H7 on microbial community structure in Milli Q water and Ganga water after incubation of 0, 3, 5, and 7 days was assessed, using Biolog Eco plates. The Eco plates are intended for environmental samples; they have found application for the assessment of microbial metabolic diversity in water. This technique offers the potential to monitor changes in microbial diversity caused by environmental fluctuations, management practices, and pollution. There was distinct resolution of Milli Q water microbial communities from

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Ganga water microbial communities spiked with *E. coli* O157:H7. Results indicated no impact of adding *E. coli* O157:H7 on microbial community structure in Ganga water. Adding *E. coli* O157:H7 in Milli Q water resulted in significant differences in the microbial community structure. The results attain further importance when one considers the fact that even 5-fold log units higher pathogenic load of *E. coli* O157:H7 could not affect Ganga water's native microbial community structure in the studied environment. Or in other words residential bacteria in the Ganga water were immune to the presence of manyfold more highly pathogenic *E. coli*. The studies clearly demonstrate that Ganga water indeed has certain novel antimicrobial attributes, besides its remarkable fluidity and adaptability in the presence of heavy load of *E. coli* O157:H7 thereby validating the river's 'magical' remarkable self-cleansing properties.