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ABUNDANCE AND SEASONAL VARIATION OF HUMAN ENTERIC BACTERIA IN DHAMRA ESTUARY, EAST COAST OF INDIA

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ABSTRACT

Domestic sewage discharge and industrial influent are the sources of microbial population in riverine system. Dhamra River is a joint stream formed by the convergence of Brahmani and Baitarani River before meeting to the Bay of Bengal. It receives indiscriminate waste discharges from agricultural and domestic sources. The estuarine system of Dhamra River also carries influents from Dhamra port and nearby fishing harbors. The present study was aimed to estimate the current level of pollution in terms of monitoring human pathogenic bacteria and their seasonal variability of Dhamra estuary. Seasonal water and sediment samples (n=70) were collected from a particular estuarine point in every tidal cycle (LT, MT and HT). The sampling was carried out over a period of 36 hours from each season. Bacteriological analysis such as total viable count (TVC), *Escherichia coli* (EC) and *Streptococus faecalis* like organism (SFLO) both in water and sediment were analyzed to know the pollution indicator bacteria of the study site. The concentration of TVC, EC and SF were exceeding to its usual limit. The result reflected Dhamra River must carry the anthropogenic activities and domestic sewage from fishing harbor and shipyard movement. Higher concentration of EC and SF pathogenic bacteria in riverine system signify a threat to the aquatic ecosystem. Dhamra estuary states both water and sediment were holding very higher number of EC and SF by crossing World Health Organization's permissible limits.

KEYWORDS: Pathogenic bacteria, pollution, Dhamra Estuary.

SHORT COMMUNICATION

Estuarine water contains both pathogenic and non-pathogenic microbes derived from river runoff, industrial effluents, sewage, and agricultural activities. Faecal polluted water may cause a health risk for users due to the presence of several microbial pathogens. This pathogen can create a health hazard and lead to disease when it enters to the food chain (WHO, 2003). Human interference with industrialization, urbanization and anthropogenic activities along the estuarine system has brought a decline in the water quality and adds to microbial population (Vincy *et al.*, 2017). Chiefly, domestic sewage discharge and industrial influent are the sources of microbial population in riverine system. Hence it is mandatory to monitor microbial testing especially enumerating faecal indicator bacteria (Tallon *et al.*, 2005; APHA 1998; Vignesh *et al.*, 2013). Keeping view in mind, the present study was deal with accounting different human enteric bacterial load with their seasonal variation along the estuarine gradient of Dhamra river.

Odisha is one of the maritime states of India, bearing an extensive coastline of about 480km endowed with some ecologically and economically important sea beaches, estuaries, creeks, backwater, lake, lagoon and mangroves (Sharma *et al.*, 2016).The Dhamra estuary is a tropical estuary (86^0 57' 00″ E – 87^0 01' 00″ E and 20^0 45' 00″ N – 20^0 48' 00″ N) on the East coast of India, and its hydrological characteristics are governed by monsoon regime (Barik and Panda, 2014). The estuary is a joint stream formed by the convergence of the two rivers i.e. Brahmani and Baitarani combine together to form Dhamra River before meeting the Bay of Bengal. Dhamra Estuary is near proximity to the mineral belt of Orissa, Jharkhand and West Bengal and receives waste discharges from industrial, agricultural and domestic from riverine sources. Dhamra port, the newly constructed port located northern side of the river mouth which is a source of anthropogenic disturbance on the estuarine water quality as well as ecosystem habitat (Sangita *et al.*, 2014). Bhitarkanika mangrove forest and Gahirmatha marine sanctuary is present very closer to the estuary which are world's most ecological sensitive area (Dash and Kar, 1990) for the conservation and management of crocodile and Olive Ridley sea turtles.

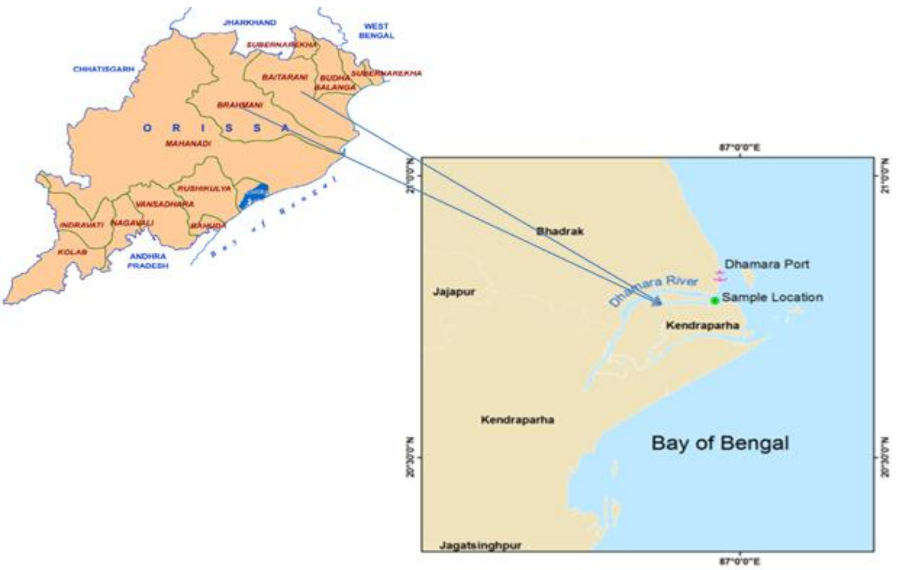

Fig. 1: Map showing the study site.

Table 1: Showing Seasonal pathogenic bacterial abundance in water and sediment.

		water (CFU/ml)	sediment (CFU/g)
Pre-monsoon	**TVC**	2 $x10^4$ to 62 $x10^4$	7 $x10^3$-11.3 $x10^5$
	EC	0.50 $x10^2$ to 11.50 $x10^2$	0 -6.3 x 10^3
	SFLO	0.75 $x10^2$ to 4 $x10^3$	0.50-18 $x10^3$
Post-monsoon	**TVC**	8.1 $x10^3$ to 20 $x10^4$	18 $x10^3$ -13.3 $x10^4$
	EC	0.2 $x10^2$ to 2.6 $x10^2$	0.5 $x10^2$-7 $x10^3$
	SFLO	0.5 $x10^2$ to 6.75 $x10^2$	1.5 $x10^2$- 7 $x10^3$
Summer	**TVC**	11.5 $x10^3$ to 20.4 $x10^4$	13 $x10^3$-72 $x10^3$
	EC	0.15 $x10^2$ to 10.6 $x10^2$	0.5 $x10^2$-33 $x10^2$
	SFLO	1.5 $x10^2$ to 6 $x10^3$	1.5 $x10^2$-7 $x10^3$

Seasonal water and sediment samples were collected from a particular estuarine point ($20^0$46'37.35''N latitude and $86^0$57'25.41''E longitude) of Dhamra estuary for a period of one year (2016-17). Biological samples were taken during pre-monsoon, post-monsoon and summer in every tidal cycle (LT, MT and HT) over a period of 36 hours with the help of fishing trawler. Water samples from sampling location were taken with Niskin's water sampler, while sediment samples were taken using Peterson grab (Area 20 cm x 20 cm). After collection it was kept with ice container send to microbiological laboratory of CSIR, IMMT. Bacteriological analysis such as total viable count (TVC), *Escherichia coli* (EC) and *Streptococus faecalis* like organism (SFLO) both in water and sediment were enumerated on HI chrome media. In water sample; during pre-monsoon, the pathogenic bacteria like TVC, EC and SFLO count in water were ranged between 2 $x10^4$ to 62 $x10^4$CFU/ml, 0.50 $x10^2$ to 11.50 $x10^2$ CFU/ml and 0.75 $x10^2$ to 4 $x10^3$ CFU/ml respectively. During post-monsoon; TVC counted to be 8.1 $x10^3$ to 20 $x10^4$ CFU/ml, EC 0.2 $x10^2$ to 2.6 $x10^2$ CFU/ml and SFLO 0.5 $x10^2$ to 6.75 $x10^2$ CFU/ml. During summer; TVC, EC and SFLO ranged from 11.5 $x10^3$ to 20.4 $x10^4$ CFU/ml, 0.15 $x10^2$ to 10.6 $x10^2$ CFU/ml and 1.5 $x10^2$ to 6 $x10^3$ CFU/ml. In water sample; higher TVC counts were observed in pre-monsoon season when compared with summer and post-monsoon. Similarly pathogenic bacteria *E. coli* and SF were minimum during post-monsoon compared to pre-monsoon and summer. Similar types of finding were also recorded by others (Borade *et al.*, 2015). Seasonal variation showed the pathogenic bacterial population in water samples counted much higher in pre-monsoon than summer and post-monsoon. Others also reported similar types of finding (Helen *et al.*, 2014; Mahapatro and Panda, 2016).

The occurrence and richness of bacteria in water sample is quite different from sediment. Here we have investigated and reported. During pre-monsoon, in sediment sample; TVC, EC and SFLO abundance ranged from 7 $x10^3$ to 11.3 $x10^5$, 0 to 6.3 x 10^3 and 0.50 to 18 $x10^3$. TVC, EC and SFLO count during post-monsoon were varied from 18 $x10^3$ to 13.3 $x10^4$, 0.5 $x10^2$ to 7 $x10^3$ and 1.5 $x10^2$ to 7 $x10^3$. In summer TVC, EC and SFLO counted to be 13 $x10^3$ to 72 $x10^3$, 0.5 $x10^2$ to 33 $x10^2$ and 1.5 $x10^2$ to 7 $x10^3$. Maximum TVC was recorded to be 11.3 $x10^5$ and minimum 72 $x10^3$ during pre-monsoon and summer season respectively. The higher amount of TVC in sediment could be attributable due to high microbial load in sediment. In addition to that, organic matter, fecal, macro nutrient like phosphorous and nitrogen compound also take an active part for the growth of heterotrophic bacteria (Langergrober, 2005;

Obi *et al.*, 2002; Jeeverandeman *et al.*, 2012) During the study period, pathogenic bacteria i.e. *E.coli* and SF found maximum during post-monsoon and pre-monsoon i.e. 7 $x10^3$ and 18 $x10^3$ CFU/g respectively and minimum *E.coli* and SF counted 33 $x10^2$ and 60 $x10^2$ CFU/g during post-monsoon. During the study period, all bacterial counts were high in sediment samples as compared to water sample. This type of hypothesis was also reported by other workers (Nagvenkar and Ramaiah, 2009 and Haller, 2009). Higher bacterial load in sediment may be due to growth supporting organic matter and micro nutrients (Helen, 2014).

The present investigation concludes that Dhamra estuarine ecosystem was heavily contaminated with human enteric bacteria especially EC and SF. Generally pollution indicator bacteria are transmitted which comes from different sources like influents from land, sewage channel, industries. As Dhamra estuary is surrounded by Dhamra port and fishing harbors, there may be a direct source of contamination. The result reflects, Dhamra river must carry the anthropogenic pollutants from riverine, fishing harbor and shipyard sources. The presence of higher concentration of EC and SF pathogenic bacteria in estuarine system might be a threat to aquatic ecosystem.

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CONFLICT OF INTEREST

None.

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