Exploring prevalence of potential pathogens and fecal indicators in geographically distinct river systems through comparative metagenomics

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ABSTRACT

Microbial communities are considered as vital members to reflect the health of a riverine system. Among them, pathogenic and fecal indicators imply health risks involved with potability of river water. The present study explores the diverse microbial communities, distribution pattern of potential pathogens, and fecal indicators between the geographically distinct Himalayan and Peninsular river systems of India. It also inquires into the environmental factors associated with community variance and distribution pattern of microbial indicators. The application of high-throughput amplicon sequencing approach unveiled significant demarcation ($p < 0.004$, Anosim R = 0.62) of samples suggesting unique microbial diversities in these two river sediments. Random forest analysis revealed *Desulfobulbulus*, PSB_M_3, and *Opitutus* in Himalayan, while DA101, *Bacillus,* and *Streptomyces* in the Peninsular as significant contributors to develop overall dissimilarity between the river systems. Permutational multivariate analysis of variance and co-occurrence network analysis were used to study the relationships between microbial taxa and environmental factors. Amongst the various studied environmental parameters, pH, K, Ca, Mg, Ba, and Al in the Himalayan and salinity, Na, temperature, and Th in the Peninsular significantly influenced shaping of distinct microbial communities. Furthermore, the potential pathogenic genera, including *Flavobacterium, Clostridium, Arcobacter, Pseudomonas,* and *Bacillus* were highly prevalent in both the river systems. *Arcobacter*, *Clostridium*, *Acinetobacter, Bacteroides,* and *Caloramator* were the prominent fecal indicators in these river systems. Our findings provide salient information about the crucial role and interplay between various environmental factors and anthropogenic influences in framing the microbiome of the distinct river systems in India. Moreover, assessing potential pathogenic and fecal indicators suggest the public health risk associated with untreated sewage discharge into these water sources. The detection of various F/S indicators and potentially pathogenic bacteria in Himalayan and Peninsular river systems emphasize the urgent need for future monitoring and management of major riverine systems in India.

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The study reveals distinct microbial diversity, the prevalence of pathogenic microbes, presence of fecal/sewage indicators and the role of edaphic factors in their distribution patterns in the two major river systems of India.

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1. Introduction

Microbes play a critical part in the functioning and balancing of an ecosystem. The sediments near riverbanks harbour unique microbial assemblages for performing the metabolic functions like biogeochemical and nutrient cycling, biophysical processes, and energy flow in the river ecosystems (Liu et al., 2011; Shade et al., 2012; Zhang et al., 2016). Microbial load in the sediments, and their sensitivity towards environmental cues and anthropogenic disturbances are often considered as indicators of river ecosystem