Eco. Env. & Cons. 30 (January Suppl. Issue) : 2024; pp. (S128-S131)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2024.v30i01s.023

Abundance of Heterotrophic Bacterial Population in Coastal Waters of Palghar Taluka, Maharashtra, India

Shailaja P. Palan[1] and Shilpa M. Gharat[2]

[1,2]Department of Biotechnology, Sonopant Dandekar College, Palghar 401 404, M.S., India

(Received 3 June, 2023; Accepted 7 August, 2023)

ABSTRACT

The population density of total heterotrophic bacteria in coastal water at 4 different sites along Palghar taluka namely; Kelwa coast, Navapur coast, Dandi creek and Satpati coast were studied. Total heterotrophic bacterial count was found to range from 0.34×10^2 – 423.1×10^2 CFUml^{-1} in coastal waters. Average heterotrophic bacterial abundance was noted higher during monsoon at all 4 sites in the study with $47.2\times 10^2 \pm 34.79$ CFU ml^{-1}at Satpati coast, $281.55\times 10^2 \pm 148.45$ CFU ml^{-1} at Dandi creek, $265.26\times 10^2 \pm 149.74$ CFU $^{ml-1}$ at Navapur coast, and $1.12 \times 10^2 \pm 0.54$ CFU $^{ml-1}$ at Kelwa coast. Dandi creek recorded highest bacterial count throughout study period irrespective of season.

Key words*: Heterotrophic bacteria, seasonal variation, coastal water, Palghar.*

Introduction

Bacteria's are a crucial heterotrophic link between suspended matters and dissolved organic matter that affects biogeochemical cycling of nutrients in marine ecosystem. Though the dissolved organic matter in the oceans are of marine origin (Koch *et al.*, 2005) the contribution through various external sources has been noted to result in an increase of organic load in the marine waters (Amin *et al*., 2017; Shynu *et al*., 2015). Several factors like, temperature, monsoon, protozoan grazing, riverine input, phytoplankton abundance are known to affect both abundance and diversity of the heterotrophic bacterial population from tropics to polar (Pomeroy and Wiebe, 2001; Sinha *et al*., 2017; Blanchet *et al*., 2016). The bacterial community composition is significantly altered in response to external inputs (Nogales *et al*., 2011) and further noted to be different in polluted and non-polluted coastal realms (Sachithanandam *et al*., 2020). Pathogens in marine environment prevail by associating with various marine life forms and are routes for transmission to humans via contaminated food resources, aerosols and zoonosis. Thompson *et al*. (2005) cited increased pathogenicity in the subgroup of pathogens distributed in the environment in response to various environmental interactions and furthermore some pathogens can exist in VBNC state (Viable but non culturable state) in response to extreme conditions. The existing chemical physical condition in response to both natural and human interferences can alter the microbial composition of the habitat and bacteria are prompt responders to these changes in marine environment (Fernandes *et al*., 2012). Thus can help reflect primary scenario on prevailing health status of coastal environment. Coastal ecosystems owing to its economical importance and resources have been constantly under threat for overuse, around the world. From acting as a source of livelihood, food, aesthetics, recreational purposes, tourism and imbibing ability, the coastal ecosystems

([1,2]Assistant Professor)

have become a hub for commercial, residential and industrial set ups. Palghar district lies along the Arabian Sea coast. The coastal region enclosing Palghar taluka harbors many small ports, recreational beaches, and industrial zones. Some studies in past decade along Palghar coast have indicated the anthropogenic influences on the physico- chemical attributes of the coastal environment (Mehta *et al*., 2008; Singare *et al*., 2011; Volavoilkar and Nayak 2014) and the underlying life forms (Patil-Bhonde and Athalye, 2017; Dhonde and Patil, 2018). Still, there is paucity in knowledge of the microbiological characteristics along the coastal environments of Palghar taluka with reference to abundance and diversity of heterotrophic bacteria. This preliminary investigation is to determine the seasonal variation in abundance of heterotrophic bacteria in water column in different appalling environments along the coast of Palghar taluka can help in understanding the underlying ecological processes and its sanitary quality.

Materials and Methods

Study site

Palghar taluka is in northwest region of Maharashtra. In the study the coastal water at 4 different location along the coastal region of Palghar taluka were studied, namely at Kelwa beach (19°36'39.6"N 72°43'46.8"E) are creational beach, at Navapur coast (19°47'14.1"N 72°40'54.2"E) harbouring CETP outfall, at Dandi creek (19°47'59.8"N 72°41'19.0"E) small poorly flushed creek receiving both industrial and domestic and used for fishing by locals and at Satpati coast (19°43'47.0"N 72°41'47.6"E) major fishing village and port largely used for sorting of fish catch for storage, local market and export.

Fig. 1. Study area showing four study sites at Dandi creek, Navapur coast, Satpati coast and Kelwa coast

Sampling

Sampling was carried out on monthly basis from November 2019 to October 2020. For microbiological study, 1l of near shore surface water samples were collected at a depth of 0-30 cm from sites 200m apart in triplicates from 4 sites viz. at Kelwa coast, Navapur coast, Dandi creek and Satpati coast in sterile polyethylene bottles. Collected samples were appropriately labeled and kept at 4°C and brought within 6 hrs of sampling. For enumeration of total heterotrophic bacteria (THB) in water sample by spread plate technique, 10 ml of the water sample was added to 90 ml of sterile saline and was serially diluted and spread on Sterile Zobell's marine agar M384 (Hi media Mumbai) and incubated at 27 °C ± 2 °C for 24-48 hrs. The average bacterial count from triplicate sample was calculated as $CFUml^{-1}$.

Results and Discussion

Abundance of total heterotrophic bacteria (THB)

Bacteria though resilient are known to be rapid indicators of underlying perturbation. With this pursuit seasonal variation in total heterotrophic bacteria was studied in terms of their abundance in the water column.

The total heterotrophic count was found to vary from 0.34×10^2 – 423.1×10^2 $CFUml^{-1}$ in the coastal waters along the Palghar taluka (Fig. 2). At Kelwa coast the highest total heterotrophic count recorded was 1.55×10^2 $CFUml^{-1}$ in the month of August 2020 and lowest recorded was 0.34×10^2 $CFUml^{-1}$ in the

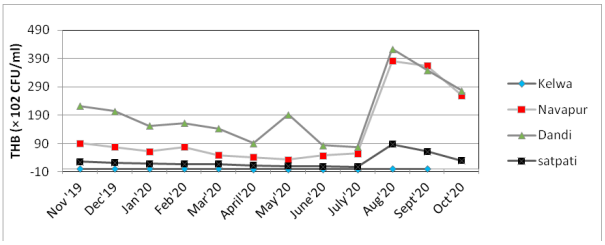

Fig. 2. Monthly variation in Total heterotrophic Bacterial count (THB)

month of July 2020. At Navapur coast the highest heterotrophic count recorded was 381.21× 10^2 $CFUml^{-1}$ in August 2020 and lowest was 33.25× 10^2 $CFUml^{-1}$ in May 2020. At Dandi creek highest heterotrophic count recorded was 423.1 × 10^2 $CFUml^{-1}$ in August 2020 and lowest was 77.8 × $10^2$$CFUml^{-1}$ in June 2020. At Satpati coast, highest heterotrophic count recorded was 87.35× 10^2 $CFUml^{-1}$ in August 2020 and lowest was 8.45× 10^2 $CFUml^{-1}$ in July 2020. Counts recorded were noted to be similar to the load noted in Cochin estuary (Robin *et al*., 2012) and even higher than the population density noted at Uran coastal water which is impacted by severe fecal contamination (Pawar, 2017). Further seasonally, the count was found to be highest during monsoon and least during premonsoon at all sites (Fig. 3). Monsoon associated abundance of THB in water is in response to both wet and warmer weather that provides the optimal temperature for growth of bacteria (Dong *et al*., 2010). Monsoon derived run off from terrestrial and riverine carrying organic load and resuspension of particulate matter from may add to the bacterial load (Bharati *et al*., 2018; Fernandes *et al*., 2012). Kademane *et al*., (2018) cited lower THB counts during pre-monsoon due to inactivation of bacteria in response to increased temperature and salinity. Similar trend was also recorded by Borade *et al*., 2018 at Tapi estuary. Between the sites, highest heterotrophic bacterial count in water column was recorded at Dandi Creek throughout the year, and being highest during monsoon. This may be as a resultant combined effect of lower salinity at Dandi creek receiving riverine dilution and continuous input of effluents and discharges prevalent in the creek. At Dandi a sudden spike in count in May 2020 was recorded. Counts noted in the study are higher than the noted at the sites impacted by industrial effluent, domestic sewage (Borade *et al*., 2014; Bharathi *et al*., 2018). Higher living bacterial counts in marine environment serve as reliable index of industrially polluted coastal environments (Ramaiah *et al*., 2002)

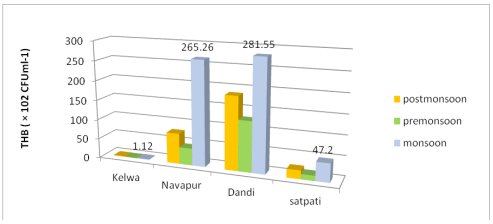

Fig. 3. Seasonal variations in Total heterotrophic bacterial count (THB) in surface water

Conclusion

The study provides the preliminary insight on annual microbiological status of the coastal waters of Palghar taluka and noted ubiquitous occurrence of heterotrophic bacteria in the coastal waters. Abundance points towards the perpetual presence of heterotrophic bacteria in the coastal waters and suggests the eutrophic condition to prevail at most of the sites but prominently at Dandi creek. Monsoon runoffs, port related activities, unhygienic practices, sewage disposal were found to be detrimental in plenteous bacterial number in the coastal environs of Palghar taluka. A detailed study to ascertain the generic and species composition can further ascertain occurrence of virulent species would help in identifying the source of bacterial population and the microbial population dynamics and the help in assessing the sanitary quality of the coast in different eco niches of coastal habitats.

Acknowledgement

The first author is thankful to Dr. Kiran Save, Principal and management of S.D.S.M. College, Palghar-401404 (M.S.) India, for providing the facilities and encouragement for conducting this study.

References

Amin, M. N., Kroeze, C. and Strokal, M. 2017. Human waste: An underestimated source of nutrient pollution in coastal seas of Bangladesh, India and Pakistan. *Marine Pollution Bulletin.* 118(1-2): 131-140.

Bharathi, M. D., Sundaramoorthy, S., Patra, S., Madeswaran, P. and Sundaramanickam, A. 2018. Seasonal and spatial distribution of heterotrophic bacteria in relation to physico-chemical properties along Ennore coastal waters. *Indian Journal of Marine Sciences.* 47(03) : 587-597.

Blanchet, M., Pringault, O., Panagiotopoulos, C., Lefèvre, D., Charrière, B., Ghiglione, J. F. and Joux, F. 2017. When riverine dissolved organic matter (DOM) meets labile DOM in coastal waters: changes in bacterial community activity and composition. *Aquatic Sciences.* 79(1): 27-43.

Borade, S., Dhawde, R., Maloo, A., Gajbhiye, S. N. and Dastager, S. G. 2014. Occurrence and seasonal variation in distribution of fecal indicator bacteria in Tapi estuary along the West coast of India. *Indian Journal of Marine Sciences.* 43(3): 340-347.

Donde, S. S. and Patil, A. L. 2018. Study of fish diversity in vaitarna river of wada taluka of Palghar district

in Maharashtra, India. *Int. J. Curr. Microbiol. App. Sci*, *7*(5): 201-206.

Dong, H., Jiang, H., Yu, B., Liu, X. and Zhang, C. 2010. Impacts of environmental change and human activity on microbial ecosystems on the Tibetan Plateau, NW China. *Gsa Today*. 20(6): 4-10.

Fernandes, C. E., Das, A., Nath, B. N., Faria, D. G. and Bharathi, P. L. 2012. Mixed response in bacterial and biochemical variables to simulated sand mining in placer-rich beach sediments, Ratnagiri, West coast of India. *Environmental Monitoring and Assessment*. 184(5): 2677-2689.

Kademane, C., Rajesh, M., Rajesh, K. M. and Vandana, K. 2018. Studies on heterotrophic bacteria and total coliforms in relation with environmental parameters of water in Gurupur Estuary, off Mangaluru, Karnataka, India. *Pollution Research.* 37(4): 989-995

Koch, B. P., Witt, M. R., Engbrodt, R., Dittmar, T. and Kattner, G. 2005. Molecular formulae of marine and terrigenous dissolved organic matter detected by electrospray ionization Fourier transform ion cyclotron resonance mass spectrometry. *Geochim. Cosmochim. Acta* 69: 3299–3308.

Mehta, B. H. and Amin, C. S. 2008. A study on sea water pollution levels in Vasai region, Mumbai, India. Journal. *Industrial Pollution Control.* 24: 1-8.

Nogales, B., Lanfranconi, M. P., Piña-Villalonga, J. M. and Bosch, R. 2011. Anthropogenic perturbations in marine microbial communities. *FEMS Microbiology Reviews.* 35(2): 275-298.

Patil-Bhonde, S. K. and Athalye, R. 2017. Study of Phytobenthos in Vaitarna river near Ghodmal, Tal-Vada, Thane, Maharashtra. *Life Sciences Leaflets*. 91: 8-16.

Pawar, P. R. 2017. Assessment of microbial diversity in marine waters along the Uran coastal area of Navi Mumbai, Maharashtra, India. *Advances in Environmental Biology*. 11(8): 11-24.

Pomeroy, L. R. and Wiebe, W. J. 2001. Temperature and substrates as interactive limiting factors for marine heterotrophic bacteria. *Aquatic Microbial Ecology*. 23(2): 187-204.

Robin, R. S., Vardhan, K. V., Muduli, P. R., Srinivasan, M. and Balasubramanian, T. 2012. Preponderance of enteric pathogens along the coastal waters of Southern Kerala, Southwest coast of India. *Marine Science.* 2(1): 6-11.

Ramaiah, N., Kenkre, V. D. and Verlecar, X. N. 2002. Marine environmental pollution stress detection through direct viable counts of bacteria. *Water Research.* 36(9): 2383-2393.

Sachithanandam, V., Saravanane, N., Chandrasekar, K., Karthick, P., Lalitha, P., Elangovan, S. S. and Sudhakar, M. 2020. Microbial diversity from the continental shelf regions of the Eastern Arabian Sea: A metagenomic approach. *Saudi Journal of Biological Sciences.* 27(8): 2065-2075.

Shynu, R., Rao, V. P., Sarma, V. V. S. S., Kessarkar, P. M., and ManiMurali, R. 2015. Sources and fate of organic matter in suspended and bottom sediments of the Mandovi and Zuari estuaries, western India.*Current Science*. 108(2): 226 -238

Singare, P. U., Trivedi, M. P., Mishra, R. M. and Dagli, D. V. 2011. Assessing the physico-chemical parameters of sediment ecosystem of Vasai Creek at Mumbai, India. *Marine Science.* 1(1): 22-29.

Sinha, R. K., Krishnan, K. P., Hatha, A. A. M., Rahiman, M., Thresyamma, D. D. and Kerkar, S. 2017. Diversity of retrievable heterotrophic bacteria in Kongsfjorden, an Arctic fjord. *Brazilian Journal of Microbiology*. 48(1): 51-61.

Thompson, J. R., Marcelino, L. A. and Polz, M. F. 2005. Diversity, sources, and detection of human bacterial pathogens in the marine environment. In: *Oceans and Health: Pathogens in the Marine Environment* (pp. 29-68). Springer, Boston, MA.

Volvoikar, S. P. and Nayak, G. N. 2014. Reading source and processes with time from mangrove sedimentary environment of Vaitarna estuary, west coast of India. *Indian Journal of Geo Marine Sciences.* 43(6): 1069-1081.