

# Evaluating the Environmental Impact of Ganesh Idol Immersion on Water Quality at Hira Ghat and Kalatalav, Mumbai

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## ABSTRACT

The religious activities involving idol immersion, have been raising concerns about increasing water pollution caused by rituals that are salient features of the festival involving Ganesh idol immersion. Idols are made up of plaster of Paris, clay, acrylic colours, varnish, iron rods, cloth, and various other decorative items. These biodegradable and non-biodegradable materials when immersed in water lead to pollution affecting the potability of water and a potential risk to the aquatic biodiversity. The current project aims to assess water quality in pre and post idol immersion conditions in the local water reservoirs namely, Hira Ghat and Kalatalav. The analysis was carried out on the basis of various physicochemical and microbiological parameters. The trend observed in the change of physicochemical characters of the water bodies implies the detrimental effect of the immersion activities during festivities.

**Keywords:** idol, Ganesh, degradable, physicochemical, immersion

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## INTRODUCTION

Water bodies, particularly lakes and ponds, play a vital role in sustaining aquatic ecosystems and providing essential resources for surrounding communities. In urban areas, however, these water bodies often face a multitude of anthropogenic pressures, leading to their degradation (Chaudhary and Gupta, 2015). One such activity that significantly impacts water quality is the immersion of Ganesh idols, a widely practiced tradition in India, particularly in Mumbai, during the festival of Ganesh Chaturthi.

Ganesh festival, a social gathering initiated by Lokmanya Tilak during the freedom struggle, is a major religious event amongst the people of Maharashtra. Ganesh Chaturthi celebrated in the Bhadrapada month of the Hindu calendar that aligns between August to September of Gregorian calendar (Reddy and Kumar, 2001). Every year during the 11day Ganesh festival different sized Ganesh idols are worshipped and immersed in water bodies throughout Maharashtra and its neighbouring states. Approximately 1,60,000 idols of varying sizes and makes are immersed in Mumbai and Surat respectively (Anon, 2018). This cultural and religious event results in the introduction of various pollutants, including paints, chemicals, oils, and organic matter, into the aquatic environment.

The process of idol immersion, though symbolic, has raised concerns regarding its environmental impact. The materials used in the construction of idols, such as plaster of Paris, synthetic paints, and decorations, often contain harmful substances like heavy metals, oils, and chemicals that are not biodegradable (Kadam, 2014; Chaudhary et al, 2015; Bhist & Rani, 2017; Gupta et al, 2018; Patel et al, 2020 Sarkar et al, 2021). Additionally, the effluents from nearby settlements, improper waste management practices, and the large number of participants in the immersion process further exacerbate the pollution load on water bodies. These activities not only affect the physical appearance and aesthetic quality of the water but also have profound implications for its physicochemical and microbiological properties (Sarkar et al, 2021).

Hira Ghat Pond and Kalatalav Lake, two prominent water bodies in Mumbai, serve as important sites for Ganesh idol immersion. Both are integral to the local community's cultural and environmental landscape, but they are increasingly threatened by the negative consequences of idol immersion (Kumar et al. 2019). The impact of such activities on water quality, particularly in terms of physicochemical parameters like pH, dissolved oxygen (DO), turbidity, and biochemical oxygen demand (BOD), as well as the microbiological quality (including bacterial contamination), remains poorly understood (Bashir et al, 2022; Sharma et al, 2016).

This research aims to assess the impact of Ganesh idol immersion on the water quality of Hira Ghat Pond and Kalatalav Lake by analysing key physicochemical and bacteriological parameters before and after the immersion season. The findings of this study help in understanding the extent of water quality deterioration due to anthropogenic activities and provides a valuable insight for formulating strategies to mitigate the environmental impact of the Ganesh Chaturthi festivities. The aim of this research is to contribute to the growing body of knowledge on the intersection of cultural practices and environmental sustainability, with the goal of promoting eco-friendlier and sustainable religious practices in the future.

### METHODOLOGY

Water samples were collected from suitable sampling sites in Kalatalav and Hira Ghat, respectively, in Kalyan and Ulhasnagar. An adequate amount of pre and post-idol immersion samples was collected in one litre of clean and dry plastic bottles and preserved at  $4 \pm 0.1^\circ\text{C}$  in a refrigerator (Kumar et al, 2019). The objective of this research was to analyse water samples with respect to physicochemical and microbiological parameters as mentioned in Tables 1 and 2 respectively. The methodology employed was in accordance with Trivedy and Goel (1984 & 1987) and APHA (2005) standards. Additionally, this study involves the screening of different groups of microbes like phosphate solubilizers, cellulose degraders, nitrosifiers and nitrifiers, sulfate reducers, and sulfur oxidizers, in addition to measuring coliforms and enteric pathogens utilizing numerous fermentations and MPN approaches (Table 3)

**Table 1: Physical and chemical parameters and their respective methods utilized to analyse water samples.**

Sr. no.	Parameters	Method/Instrument	Chemical	
	<b>Physical</b>		<b>Chemical</b>	
1.	Colour	Visual Method	pH	pH meter
2.	Temperature	Hg Thermometer	Alkalinity	Titrimetrically (N/50 H <sub>2</sub> SO <sub>4</sub> )
3.	Specific Conductivity	Conductometer	Total Hardness	Titrimetrically (EDTA)
4.	Turbidity	Photoelectric Turbidimeter	Biochemical Oxygen Demand (BOD)	Winklers Method
			Chemical Oxygen Demand (COD)	Closed Reflux Method
			Total Dissolved Solids (TDS)	TDS meter
			Chlorine	Mohr's Method

**Table 2: Microbiological parameters and respective media utilized to analyse microbiological load in water samples**

Sr. No.	Microbiological Parameters	Media
1.	Viable Count / SPC	Nutrient agar
2.	Most Probable Number (MPN)	
	• Presumptive	Mac Conkey's agar*
	• Confirmation	BGLB broth*
	• Completed	EMB* agar, Gram Staining, IMViC

**Table 3: Screening of different activity-based microbes in water samples**

Sr. No.	Activity based microbes	Enrichment Media	Isolation Media
1.	Nitrosifiers and Nitrifiers	Winogradsky's medium I & II	Nitrosifiers and Nitrifiers
2.	Phosphate Solubilizers	Pikovasky's broth	Pikovasky's agar
		<b>Screening - Pikovasky's agar + Bromophenol blue</b>	
3.	Cellulose degraders	Mac Beth Broth	Cellulose agar

		Screening - Congo red agar	
4.	Sulphate reducers	Postgate's broth	Starkey's agar
5.	Sulphate oxidizers	Thiosulfate broth	Thiosulfate agar
		Screening - BaCl <sub>2</sub>	

## RESULTS

The pre-immersion and post-immersion water samples collected from Hira Ghat and Kalatalav were analysed with respect to various physicochemical and microbiological parameters. The methodology section outlines the standard methods employed for the analysis. The physical parameters like colour, temperature, turbidity, and conductivity; chemical parameters like pH, alkalinity, hardness, BOD, COD, TDS, and chlorine; and microbiological parameters like viable count, MPN, and isolation and identification of the bacteria of pre-immersion and post-immersion water samples were analysed for comparative study.

Post-immersion samples showed a considerable rise in turbidity while their conductivity decreased. A significant increase and decrease were observed in the turbidity and conductivity of post-immersion water samples, respectively (Table 4). The graphical representation in Figure 1,2, and 3 shows distinct increase of BOD and COD values observed in the post-immersion samples of Kalatalav. The increased values of BOD and TDS in the samples were indications of possible contaminations due to idol immersion activity (Table 5). Similarly, viable count was found to be higher in post-immersion than pre-immersion samples (Figure 4 & 5), and the presumptive test of MPN was on the border of permissible lists and below the range of the given standard (Fig 6). Of the various activity-based organisms, nitrogen-utilizing and cellulose-degrading bacteria that were found in the Hiraghat and Kalatalav samples, respectively, survived in the post-immersion conditions. There was a notable absence of phosphate solubilizers in Hiraghat 2 samples (post-immersion), possibly due to the increased level of contaminants. The isolates found in the water sample were analysed and identified using biochemical characterization (Tables 9,10&11). The isolates of the genus *Pseudomonas*, *Klebsiella*, *Enterobacter*, *Bacillus* were commonly found in the water samples. Though appearance of *Enterobacter sp.* in post-immersion samples shows evidences of possible faecal contamination.

**Table 4: Results of the physical parameters of the water samples.**

Sr. No.	Sample	Colour	Temperature (°C)	Turbidity (NTU)	Conductivity (µS)
1	HG-1a	Yellowish brown	28	7	125
2	HG-1b	Yellowish brown	29	10	113
3	HG-2a	Reddish brown	30	20	173
4	HG-2b	Reddish brown	30	38	119
5	KT-1a	Green	26	3	2336
6	KT-1b	Green	27	5	205
7	KT-2a	Yellowish green	27	15	398
8	KT-2b	Yellowish green	30	26	344
<b>Standard</b>			*	<b>10</b>	<b>400</b>

\* Not to exceed 5 °C higher than the intake water temperature (MPCB, Prevention and Pollution Control Act, 1974)

**Keys:** HG-1a, HG-2a – Pre-immersion and HG-1b, HG-2b – Post-immersion Hiraghat samples from different sites.  
KT-1a, KT-2a – Pre-immersion and KT-1b, KT-2b – Post-immersion Kalatalav samples from different sites.

**Table 5: Analysis results of the chemical parameters of the water samples**

Sr. no.	Sample	pH	Alkalinity	Hardness	BOD (mg/L)	COD (mg/L)	TDS	Chlorine
1	HG-1a	7.1	252	120	6	29	240	15.7
2	HG-1b	7.9	250	130	6.6	47	245	16.1
3	HG-2a	8.3	267	170	3.7	29	590	16.9
4	HG-2b	8.4	263.3	190	6.4	43	591	18.5
5	KT-1a	6.9	96	115.5	6.9	16	130	14.2

6	KT-1b	6.4	102	131	7.2	71	120	19.0
7	KT-2a	7.8	114	150	3.6	24	190	22.0
8	KT-2b	7.7	130	142	5.4	22	165	30.0
<b>Standard</b>		<b>6.5-8.5</b>		<b>300</b>	<b>3</b>	<b>250</b>		

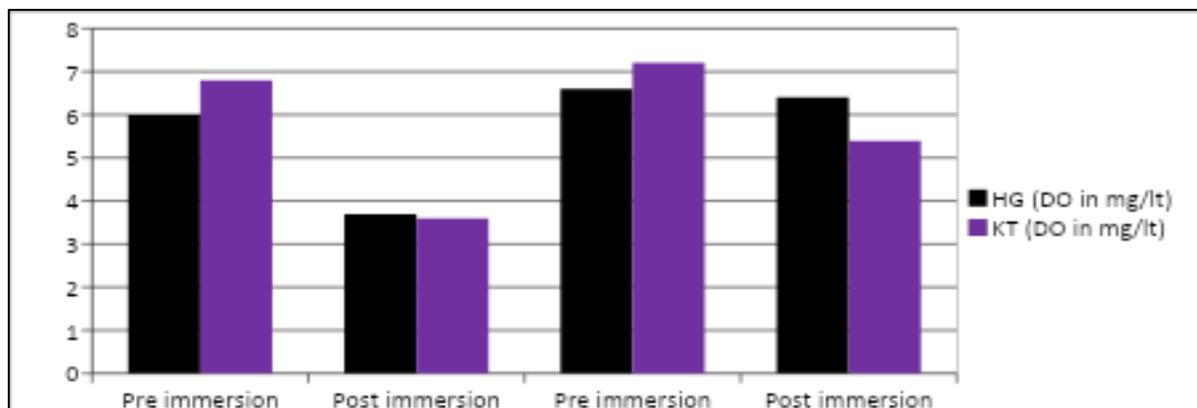


Fig 1: Graphical representation of Chemical parameter –Dissolved Oxygen

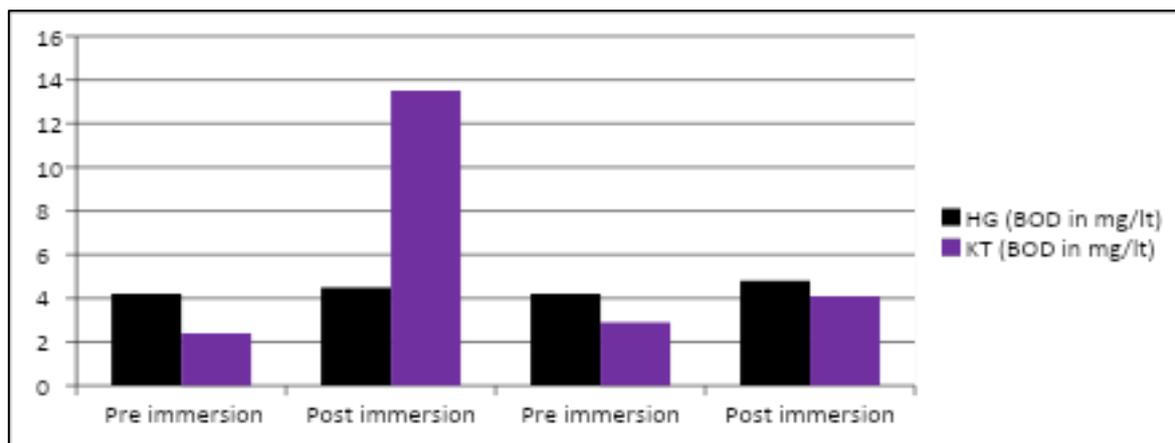


Fig 2: Graphical representation of parameter –Biological Oxygen Demand (BOD)

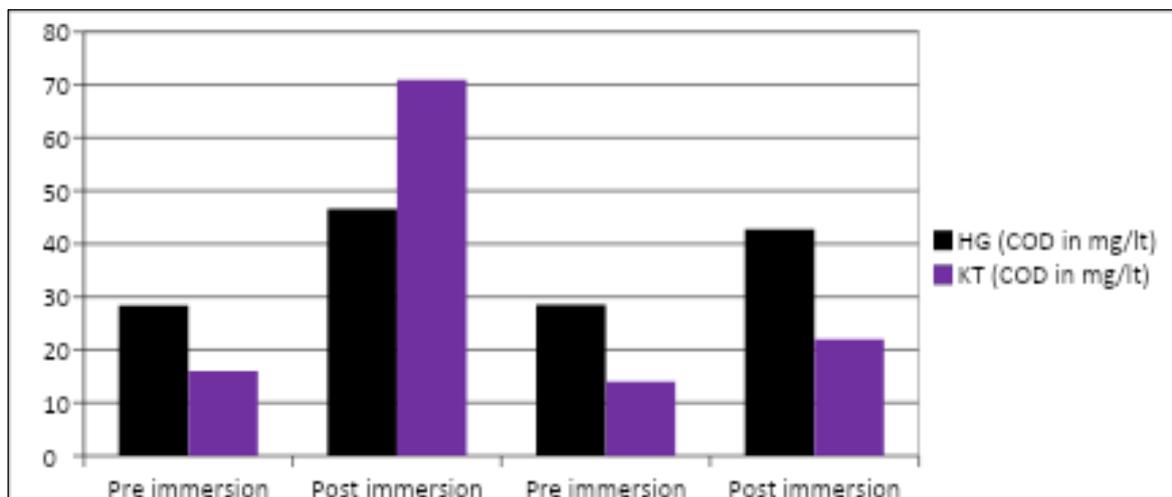


Fig 3: Chart 3 Graphical representation of Chemical parameter – (COD)



Fig 4: Plates showing Viable Count of dilutions  $10^{-5}$ ,  $10^{-6}$  &  $10^{-7}$

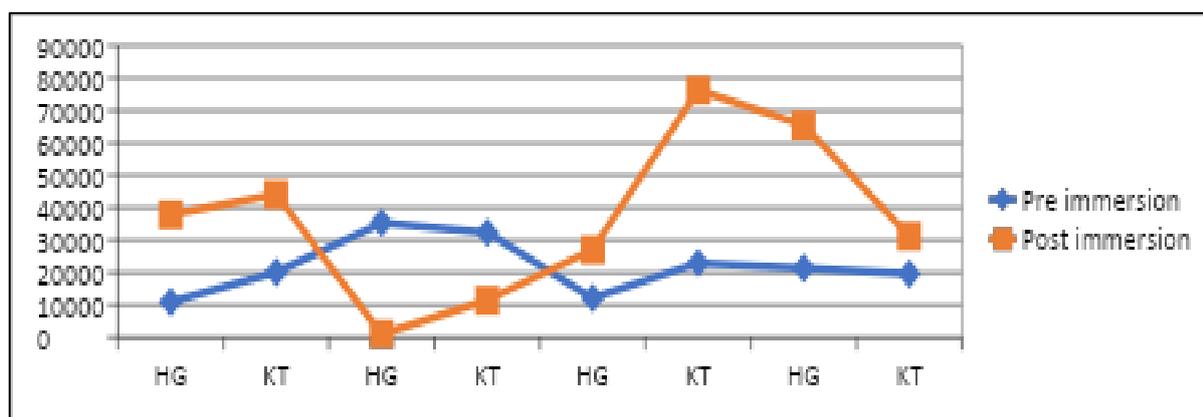


Fig 5: Graphical representation of Viable count (CFU/ml) x  $10^5$

Table 6: Analysis results of the activity-based microorganisms in the water samples. Key: (+) – Growth observed, (-) – No growth observed

Sr. no.	Sample	Nitrosifiers	Nitrifiers	Phosphate solubilizers	Cellulose degraders	Sulfate reducers	Sulfate oxidizers
1	HG-1a	+	+	-	-	-	-
2	HG-1b	+	+	-	-	-	-
3	HG-2a	-	-	+	-	-	-
4	HG-2b	-	-	-	-	-	-
5	KT-1a	-	-	-	-	-	-
6	KT-1b	-	-	-	-	-	-
7	KT-2a	-	-	-	+	-	-
8	KT-2b	-	-	-	+	-	-



Fig 6: The MPN result for a batch of samples

Table 7 - Biochemical characterization of the isolates found in Hiraghat. (Pre immersion)

Isolates	Sugar fermentation							TSI							9	10	11	12	13	14	15	16	17	18	19	20	21	22
	1	2	3	4	5	6	7	8	B	S	G	H <sub>2</sub> S																
HG1	A	A	A	-	A	A	A	-	Y	Y	-	-	-	+	-	-	+	-	+	-	-	+	-	+	+	-		
HG2	-	-	-	-	-	A	-	-	Y	P	-	-	-	+	+	+	+	-	+	-	+	+	-	+	+	-		
HG3	A	A	A	A	A	A	A	-	Y	P	-	-	-	-	+	-	+	-	+	-	-	+	-	+	+	-		
HG4	A	A	A	A	-	A	A	-	Y	P	-	-	-	-	+	-	+	-	+	-	-	+	-	+	+	-		
HG5	A G	A G	A	A	A	A G	A G	-	Y	Y	-	-	-	-	-	-	+	-	+	-	-	+	-	+	-	-		
HG6	A	A	A	A	-	-	-	-	Y	Y	-	-	-	-	+	+	+	-	+	-	-	+	-	+	-	-		
HG7	-	A	A	A	-	A	A	-	Y	P	-	-	-	-	+	+	+	-	+	-	-	+	-	+	+	-		
HG8	A	A	A	A	A	A	A	+	Y	Y	-	-	-	-	-	+	+	-	+	-	-	+	-	-	+	-		
HG9	-	A	A	A	A	A	A	-	Y	Y	-	-	-	+	-	+	+	-	-	-	-	+	-	-	+	-		
HG10	-	-	-	-	-	-	-	+	Y	P	-	-	-	+	+	-	+	-	+	-	-	+	-	+	+	-		

Table 8 - Biochemical characterization of the isolates found in Hiraghat. (Post -immersion)

Isolates	Sugar fermentation							TSI							9	10	11	12	13	14	15	16	17	18	19	20	21	22
	1	2	3	4	5	6	7	8	B	S	G	H <sub>2</sub> S																
HG1	A	A	A	A	A	A	A	-	Y	P	-	-	-	-	+	-	+	-	+	-	-	-	-	-	-	+	-	
HG2	A	A	A	A	A G	A	A	-	Y	P	-	-	-	+	+	-	+	-	+	-	-	-	-	-	+	+	-	
HG3	A	A	A	A	A	A	A	-	Y	Y	-	-	-	+	+	-	+	-	+	-	-	-	-	-	+	+	-	
HG4	A	A	A	A	A	A G	A	+	Y	P	-	-	-	-	+	-	+	-	+	-	-	-	-	-	+	+	-	
HG5	A	A	A	A	A	A	A	-	Y	P	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	+	-	
HG6	A G	A G	A G	A	A	A	A	-	Y	P	-	+	-	+	+	+	+	-	+	-	-	-	-	-	+	+	-	
HG7	A	A	A	A	A	A	A	+	Y	P	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	+	-	
HG8	-	A	-	A	-	A	A	+	Y	P	-	-	-	-	+	+	+	-	+	-	+	-	-	-	-	+	-	
HG9	A	-	A	A	A	A	A	+	Y	P	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	+	-	
HG10	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	+	-	-	-	-	-	+	+	-	
HG11	A	A	A	A	A	A	A	+	Y	P	-	+	-	+	+	-	+	-	+	-	-	+	-	-	-	-	+	
HG12	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	+	-	-	+	-	-	+	+	+	
HG13	A	A	A	A	A	A	A	+	Y	P	-	-	-	-	+	-	+	-	+	-	-	-	-	-	-	+	-	
HG14	-	-	-	A	-	-	-	+	Y	P	-	-	-	-	+	+	+	-	+	-	-	-	-	-	+	+	-	
HG15	A G	A	A	A	A	A	A	+	Y	P	-	+	-	+	+	-	+	-	+	-	-	+	-	+	+	+	-	

Table 9 - Biochemical characterization of the isolates found in Kalatalav. (Pre-immersion and post immersion)

Isolates	Sugar fermentation							TSI							9	10	11	12	13	14	15	16	17	18	19	20	21	22
	1	2	3	4	5	6	7	8	B	S	G	H <sub>2</sub> S																
KT1	A	A G	-	A G	A	A	A	+	Y	P	+	-	-	+	+	-	+	+	+	-	-	-	-	+	+	-		
KT2	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	+	-	-	+	-	-	+	-		
KT3	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	-	-	+	-	-	-	-	+	-	+	+	-		
KT4	A	A	A	A G	A	A	A G	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	+	-	-	+	-		
KT5	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	+	-	+	+	-		
KT6	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	+	-	+	+	-		
KT1	A	A	A G	A	A	-	A	+	Y	P	-	-	-	+	-	-	+	-	+	-	-	+	-	-	+	-		
KT2	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	+	+	-	-	+		
KT3	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	+	-	-	+	-		

KT4	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	+	-	+	+	-
KT5	A G	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	+	-	-	+	-	-	-	+
KT6	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	-	-	+	+	+
KT7	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	+	-	+	+	-
KT8	A	A	A	A	A	A	A	-	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	+	-	+	-
KT9	A	A	A	A	A	A	A	+	Y	P	-	-	-	+	+	-	+	-	-	-	-	-	-	+	+	-

**Abbreviations used:** 1-Glucose, 2-Sucrose, 3-Xylose, 4- Maltose, 5-Mannitol, 6- Lactose, 7- Arabinose, 8- Urea, 9- PPA, 10- NaCl, 11- Citrate, 12- Lysine complete, 13- Lysine incomplete, 14- Indole, 15- Gelatinase, 16- Motility, 17- Nitrataase, 18- MR, 19- VP, 20- Oxidase, 21- Hugh liefson’s (aerobic), 22- Hugh liefson’s (anaerobic) A- acid, G- gas, Y- yellow , P- pink, + positive, -negative, HG- Hiraghat, KT- Kalatalav

**Table 10 - Identification of the Hiraghat and Kalatalav isolates**

Isolates	Identified organism	Isolates	Identified organism
HG1	<i>Pseudomonas fluorescens</i>	HG11	<i>Enterobacter asburiae</i>
HG2	<i>Pseudomonas borbori</i>	HG12	<i>Pseudomonas fluorescens</i>
HG3	<i>Pseudomonas salmonii</i>	HG13	<i>Bacillus licheniformis</i>
HG4	<i>Serratia plymuthica</i>	HG14	<i>Paenibacillus macerans</i>
HG5	<i>Yersinia mollaretti</i>	HG15	<i>Bacillus trypoxylicola</i>
HG6	<i>Xenorhabdus beddingii</i>	KT1	<i>Bacillus licheniformis</i>
HG7	<i>Brenneria alni</i>	KT2	<i>Bacillus megaterium</i>
HG8	<i>Yersinia bercovieri</i>	KT3	<i>Paenibacillus castanae</i>
HG9	<i>Klebsiella pneumonia</i>	KT4	<i>Enterobacter asburiae</i>
HG10	<i>Serratia plymuthica</i>	KT5	<i>Enterobacter asburiae</i>
HG1	<i>Pseudomonas fluorescens</i>	KT6	<i>Pseudomonas cichorii</i>
HG2	<i>Pseudomonas cichorii</i>	KT1	<i>Yersinia bercovieri</i>
HG3	<i>Enterobacter asburiae</i>	KT2	<i>Enterobacter asburiae</i>
HG4	<i>Serratia rubidaea</i>	KT3	<i>Staphylococcus xylosus</i>
HG5	<i>Enterobacter cloacae</i>	KT4	<i>Bacillus trypoxylicola</i>
HG6	<i>Enterobacter aerogenes</i>	KT5	<i>Enterobacter asburiae</i>
HG7	<i>Raoultella terrigena</i>	KT6	<i>Bacillus trypoxylicola</i>
HG8	<i>Citrobacter freundii</i>	KT7	<i>Pseudomonas cichorii</i>
HG9	<i>Enterobacter cloacae</i>	KT8	<i>Pseudomonas cichorii</i>
HG10	<i>Klebsiella pneumonia</i>	KT9	<i>Klebsiella pneumoniae</i>

Key: HG - Hiraghat, KT - Kalatalav

 Indicates pre-immersion samples

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