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Study of Bacterial Assessment of Varhala Devi Lake in Bhiwandi, Maharashtra, India.

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Abstract

The Bacteriological Quality of water is determined by the presence or absence of indicator organisms. There are 5 common types of bacteria i.e. (Bacillus, Cocci, Vibrio, Spirochete and Spirilla). In this study Bacterial assessment is determined. The sample were collected from 3 different sides (Visarjan ghat, Fenegaon, Peace Park) & Centre of the Varhala Devi Lake during the mid-summer in the month of April 2023. The MPN of the Centre water sample is more (i.e. 540/ 100ml) than other (Peace park – 170/100ml, Fenegaon – 350/100 ml, Visarjan ghat – 240/100 ml) sites of water sample. In Varhala Devi lake Bacterial species like Escherichia coli, Pseudomonas Spp., Klebsiella Spp., Bacilli spp., Salmonella Spp., Proteus Spp., Staphylococci., Streptococci. are identified. Some Fungal sp. like Candida Spp., Aspergillus Spp. and Trichophyton Spp. are also identified. The Varhaladevi Lake is used for many things, like drinking water, bathing, washing domestic animals, cleaning vehicles, washing clothes, immersion activities and even for religious activities. However, the lake doesn't have the natural ability to clean itself, so it easily collects pollutants such as sewage spills, water runoff, and waste from nearby residents. It can cause various bacterial and fungal diseases. When the lake water gets contaminated. It can cause various bacterial and fungal diseases. So, it becomes a risk to people's health if they drink it. It's really important to make sure the water in the lake stays clean and safe for humans to use. Keeping the water quality good is not only important for people, but also for the plants and animals that live in the lake. The lake has a delicate and complicated ecosystem, so it's crucial to take care of it to protect all the living things that depend on it.

Keywords:
Varhaladevi, Lake, Bacterial Assessment, Escherichia coli, Pseudomonas spp., Bacilli spp., Salmonella spp., Candida spp. Diseases.

I. Introduction

Water is essential for human nutrition. We use it directly for drinking and indirectly in our food and daily activities. But only a tiny portion (0.3%) of Earth's water is suitable for human use. This includes freshwater sources like lakes, rivers, and groundwater. The rest (97.7%) is made up of oceans, glaciers, and other forms that we can't use. Unfortunately, water is easily contaminated by various harmful microorganisms like bacteria, fungi, viruses, and protozoa. These tiny creatures can cause diseases that seriously affect our health. So, it's crucial to ensure our water is safe and free from these harmful agents (Taiwo Adekanmi Adesakin, et.Al, 2020).

Water is a complicated system made up of living and non-living things, along with organic and inorganic substances. Some things dissolve in it, while others don't. That's why it's crucial to check the quality of water, as it can be different from one place to another. When it's natural quality changes, it upsets the balance and makes it unsuitable for our needs. Also, getting water from places like rivers and underground sources has become more uncertain as time goes on (Shaziya Mohammed Irfan Momin, 2016).

Leeuwenhoek is known as the father of microbiology because he was the first to discover tiny living organisms like protists and bacteria. His remarkable achievements opened our eyes to the unseen world of microscopic creatures. He had a unique ability to observe these tiny organisms, and his curiosity led him to explore this previously unknown realm (Nick Lane, 2015).

The bacteriological quality of water is determined by the presence or absence of indicator organisms. If drinking water is devoid of indicator organisms, it poses no risk of transmitting infectious diseases (Gebrewahd, et.Al, 2020). There are 5 common types of bacteria (i.e. Bacillus, cocci, spirilla, vibrio & spirochete). Bacillus species are bacteria that have a rod-shaped morphology and can form endospores. They are typically aerobic or can survive in environments with low oxygen levels as facultatively anaerobic organisms. Gram staining of Bacillus species usually results in a positive Gram reaction, although in certain species, the cultures may exhibit a Gram-negative appearance as they age (Peter C. B. Turnbull, 1996). Cocci bacteria are characterized by their spherical shape. Among the cocci bacteria is Staphylococcus, which derives its name from the Greek word "staphyl," meaning grapes, as these bacteria resemble clusters of grapes when viewed under a microscope. Staphylococcus is responsible for causing various skin infections (Jane Buckle PhD, et.Al, 2015). Spirilla (sing. spirillum) shapes are curved-shaped bacteria which can range from a gently curved shape to a corkscrew spiral. Many spirilla are rigid and able to move. Vibrio are slightly curved or comma-shaped bacterial cells with less than one complete turn or twist in the cell, generally single and 2–3 μm long. Spirochete - It has a helical structure and flexible body (not rigid), a thin structure, long, spiral helical-shaped cells, or corkscrew-shaped spiral bacilli. Spirochete moves by axial filaments (Prof. Dr. Osman Erkmen, 2021).

Tiny living organisms, known as microorganisms, are crucial in freshwater ecosystems, and they have a big impact on the water quality. Some bacteria act as decomposers, breaking down organic materials and releasing important nutrients like nitrate and phosphate. The variety and amount of microorganisms in lakes greatly affect the overall water quality. Another important group is cyanobacteria, which get their energy from sunlight through photosynthesis. They play a vital role in the food chain by producing oxygen and providing nourishment to the freshwater systems (James Benson, et.Al, 2019).

Bacteria have different preferences when it comes to temperature, oxygen levels, pH, and energy sources. They can be categorized into groups like psychrophiles (cold-loving), mesophiles (moderate temperature-loving), thermophiles (heat-loving), and hyperthermophiles (extremely heat-loving) based on their favorite temperature conditions. Depending on their oxygen needs, bacteria fall into groups such as obligate aerobes (require oxygen), microaerophiles (need a little oxygen), obligate anaerobes (cannot tolerate oxygen), aerotolerant anaerobes (can survive in the presence of oxygen but don't use it), and facultative anaerobes (can live with or without oxygen). Microorganisms can also be classified based on their preferred pH, like neutrophiles (preferring neutral pH), acidophiles (thriving in acidic conditions), or alkaliphiles (liking alkaline environments). Bacterial growth can be influenced by osmotic conditions, which affect how water and nutrients move in and out of the cells. Bacteria get their energy from different sources, leading to the categories of phototrophs (using light as an energy source) and chemotrophs (using chemicals as an energy source). They can also be classified based on their carbon source, as autotrophs (self-sustaining) or heterotrophs (needing organic compounds). By combining these nutritional patterns, we can group organisms into photoautotrophs, photoheterotrophs, chemoautotrophs, or chemoheterotrophs. For their growth, bacteria require nitrogen, minerals, and water. Some bacteria have complex nutritional needs and depend on many growth factors; these are called fastidious organisms (Gary Kaiser, 2023).

The aim of this research is to analyse the water of Varhala Devi Lake in Bhiwandi, specifically focusing on bacterial pollutants. The lake, located near Dhamankarnaka in Bhiwandi city, is used for various purposes including drinking, bathing domestic animals, washing vehicles, bathing, washing clothes, and religious activities. However, the lake lacks self-cleaning ability and readily accumulates pollutants such as sewage spills, water runoff, and domestic waste from nearby residents. This contamination poses health risks to those who consume the water. It is crucial to maintain the quality of the lake water for human consumption, the well-being of aquatic life, and other subsequent uses due to the lake's complex and fragile ecosystem (Shaziya Mohammed Irfan Momin, 2016). The biggest threat to human health is fecal contamination, especially from human waste. Human feces are riskier because they often contain harmful pathogens. It's extremely important to make sure water stays clean and free from fecal contamination. We must understand that water quality is vital for public health because many diseases spread through water when we ingest contaminated water or food contaminated with fecal matter. This is known as the fecal-oral route of transmission (Leticia Arregui, et.Al, 2017).

II. Materials & Method

Samples were taken from different spots of the lake are:

1. Peace Park.
2. Fenegaon.
3. Center of the lake.
4. Visarjan ghat.

I was accompanied by my helper for taking pictures during sampling. The water sample were collected in 3bottles of 1000ml and 1bottle of 750ml. Then the collected samples were taken to the {(MICRO BITE DIAGNOSTICS laboratory) (ISO 9001:2015 Reg.No.23EQJJ29)} for further identification of bacterial research. The samples were collected during the mid-summer in the month of April 2023. The samples were collected under the surface of water level in between 10 cm – 20 cm.

Materials which were used are as follows:-

Glass wares are Test tubes, Petri dish, Bumper tubes, Suspension tubes, Nichrome wire loop, Slides, Compound microscope, Beaker, Flasks, Glass spreader, Pipettes of (0.1ml, 5ml and 10ml), Butter paper, Spatula and Durham tubes. Stains/chemicals are Crystal violet, Grams iodine, Saffranine, Decolourizer, H_2O_2, Methylene Red (MR) and Vogas Proskauer (VP). Types of agars/ media used are Nutrient agar, Mac-Conkey agar and Sabouraud's agar.

Technique:-

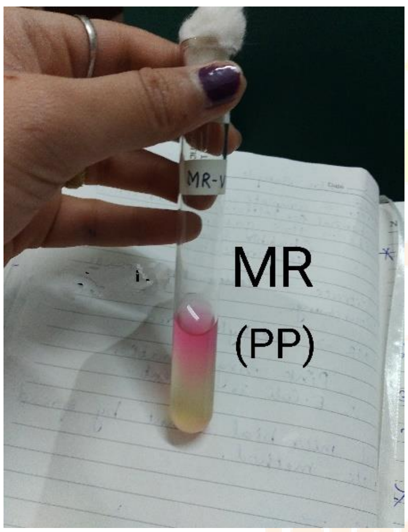
1) Most Probable Number (MPN):- Nutrient Broth: single standard, double standard.
2) Total Microbial Count (TMC) :- Aerobic Bacteria (Nutrient agar & Mac-Conkeyagar),
   Fungal (Sabouraud's agar).
3) Bio chemicals: - MR – VP, Urease, Triple sugar iron (TSI), Mac-Conkey.
4) Rapid test: - Oxidase, Catalase.
5) Spread plate method.
6) Gram staining.

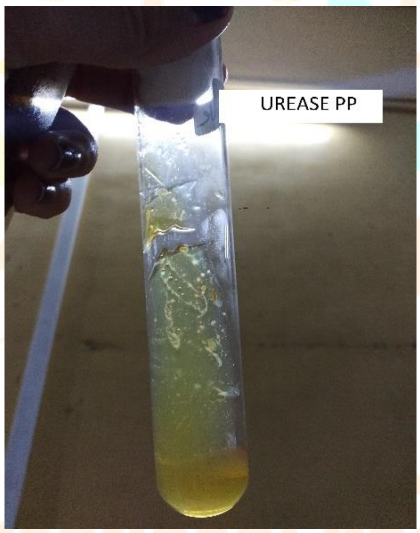
Methodology: - Before using any glass wares, all the glass wares are sterilized in autoclave machine. The MPN method is used for counting the bacteria and pathogen which is present in water sample. For single standard (0.1ml of water sample in 5ml of nutrient broth is taken in 5 different test tubes & 1ml of water sample in 5ml of nutrient broth is taken in 5 different test tubes). For double standard (5ml of water sample in 5ml of nutrient broth is taken in 5 different test tubes).

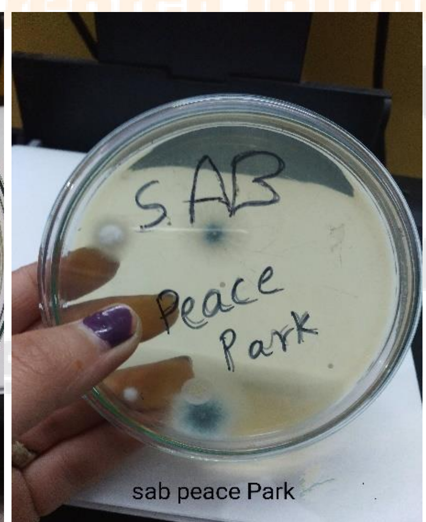
The total microbial count of aerobic bacteria was determined by spread plate method on nutrient agar and macconkey agar. Sabouraud's agar (as it is used for fungal growth and yeast) it was also determined by spread plate method.

III. Observation & Result

Peace Park Water Sample:





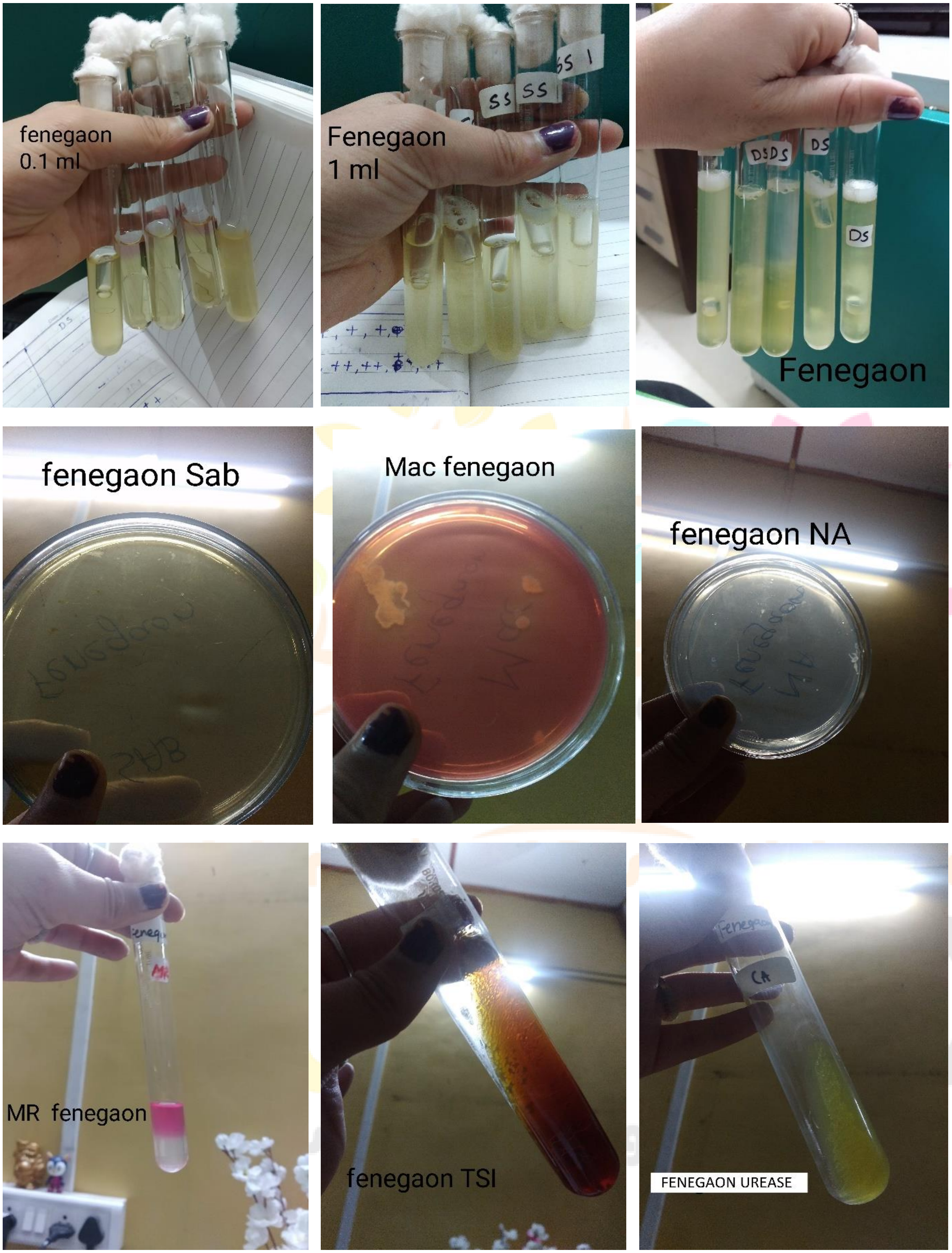


Isolation			
MPN	Single Stranded	0.1ml Sample + 5ml NB = 1 1ml Sample + 5ml NB = 4	Most Probable Number for positi tubes of 1, 4, 5 is **170/ 100 ml**
	Double Stranded	5ml Sample + 5ml NB = 5	
Total Microbial Count	Nutrient Agar	Big Colonies are 570/ml Small Colonies are $2*10^4$/ml	

	Sabouraud's Agar	60 Colonies /ml
Identification		
Biochemicals	Mac-Conkey Agar	Colourless colonies = 2790/ml Pink colonies = 750/ml
	Triple sugar iron (TSI)	Gas Producing Coliform present.
	Urease slant	Urease negative, absence of *H. Pyrollea, Proteus, Brucella spp.* etc.
	MR- VP	MR +ve, VP -ve
Rapid Tests	Catalase	Positive
	Oxidase	Positive
Gram Staining	Mac (Colourless colony) Mac (Pink Colony)	Gram negative Pathogens are present Gram negative Pathogen Concluded as *Escherichia coli*
	NA (Big Colony)	Gram negative Pathogen and streptococci present
	Sab	Fungal mycelia seen Green Colony: *Aspargillus spp.* White Colony: *Trichophyton spp.*

Remark: Suggested of presence of Coliform like ***Escherichia coli, Pseudomonas spp., Klebsiella spp., Streptococci***, Fungal ***Aspergillus spp.*** and ***Trichophyton spp***. also present in given water sample of Peace Park.

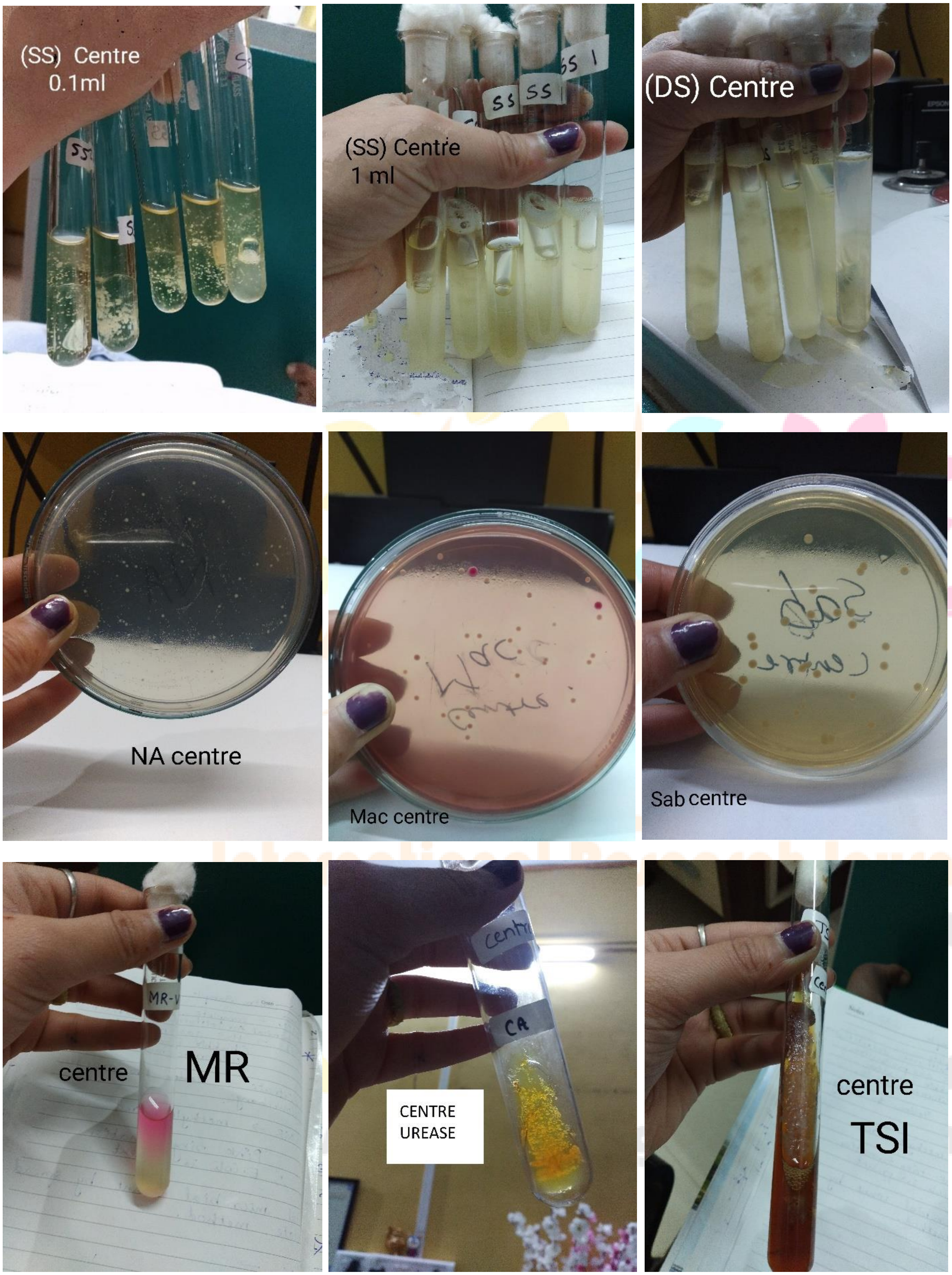
a) Fenegaon Water Sample:



Isolation			
MPN	Single Stranded	0.1ml Sample + 5ml NB = 1 1ml Sample + 5ml NB = 5	Most Probable Number for positive tubes of 1, 5, 5 is **350/ 100 ml**
	Double Stranded	5ml Sample + 5ml NB = 5	
Total Microbial Count	Nutrient Agar	Big Colonies are 400/ml Small Colonies are 11900/ml	
	Sabouraud's Agar	400 Colonies /ml	
Identification			
Biochemicals	Mac-Conkey Agar	Colourless colonies = 1600/ml Pink colonies = 200/ml	
	Triple sugar iron (TSI)	Gas Producing Coliform present	
	Urease slant	Urease negative, absence of *H. Pyrollea, Proteus, Brucella spp.* etc	
	MR- VP	MR +ve, VP -ve	
Rapid Tests	Catalase	Positive	
	Oxidase	Positive	
Gram Staining	Mac (Colourless colony Mac (Pink Colony)	Gram negative Pathogens are present Gram negative Pathogen Concluded as *Escherichia coli*	
	NA (Big Colony) NA (Small Colony)	Gram Positive Pathogen *Bacilli spp.* Gram positive *Staphylococci* present	
	Sab	Fungal spores seen suggested of *Candida spp.*	

Remark: Suggested of presence of Coliform like ***Escherichia coli, Pseudomonas spp., Klebsiella spp.*** also Presence of ***Bacilli spp. and Staphylococci***. Fungal ***Candida spp.*** present in given water sample of Fenegaon.

b) Centre Water Sample:

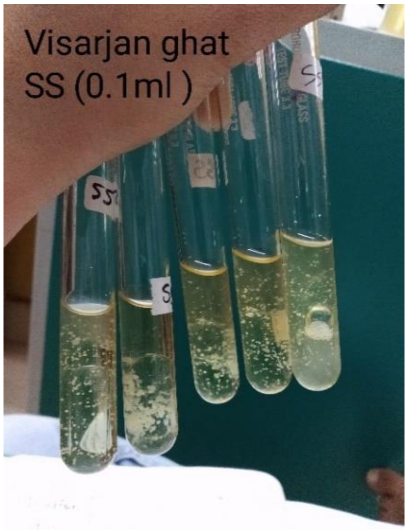


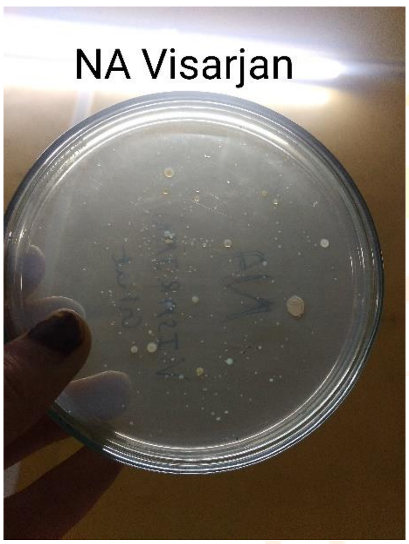
Isolation			
MPN	Single Stranded	0.1ml Sample + 5ml NB = 2 1ml Sample + 5ml NB = 5	Most Probable Number for positive tubes of 2, 5, 5 is **540/ 100 ml**
	Double Stranded	5ml Sample + 5ml NB = 5	
Total Microbial Count	Nutrient Agar	Big Colonies are 3800/ml Small Colonies are 10^5/ml	

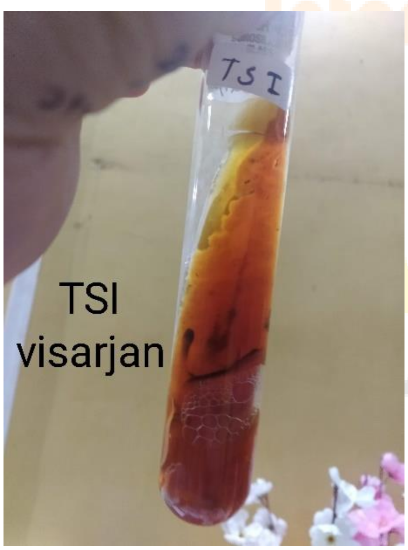
	Sabouraud's Agar	2800 Colonies /ml
Identification		
Biochemicals	Mac-Conkey Agar	Colourless colonies = 3000/ml Pink colonies = 200/ml
	Triple sugar iron (TSI)	Gas Producing Coliform present
	Urease slant	Urease negative, absence of *H. Pyrollea, Proteus, Brucella spp.* etc
	MR- VP	MR +ve, VP -ve
Rapid Tests	Catalase	Positive
	Oxidase	Negative
Gram Staining	Mac (Colourless colony Mac (Pink Colony)	Gram negative Pathogens are present Gram negative Pathogen Concluded as *Escherichia coli*
	NA (Big Colony) NA (Small Colony)	Gram Positive Diplococci present Gram positive cocci in chain present
	Sab	Fungal spores seen suggested of *Candida spp.*

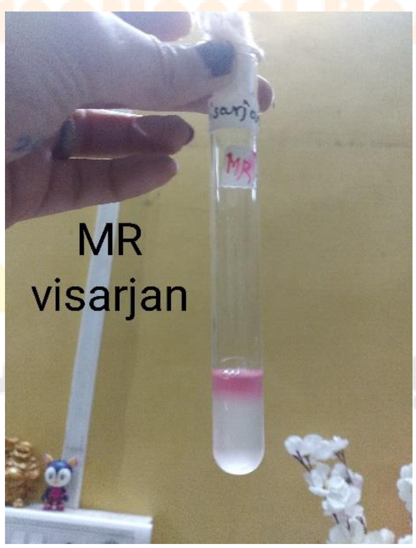
Remark: Suggested of presence of Coliform like ***Escherichia coli, Proteus spp., Klebsiella spp.*** also Presence of ***Bacilli spp. and Streptococci***. Fungal ***Candida spp.*** in given water sample of Central Varhaladevi Lake.

c) Visarjan Ghat Water Sample:









Isolation			
MPN	Single Stranded	0.1ml Sample + 5ml NB = 0 1ml Sample + 5ml NB = 5	Most Probable Number for positive tubes of 0, 5, 5 is **240/ 100 ml**
	Double Stranded	5ml Sample + 5ml NB = 5	
Total Microbial Count	Nutrient Agar	Big Colonies are 1600/ml Small Colonies are 2600/ml	
	Sabouraud's Agar	Big green colonies are 100/ml and colourless Colonies are 300/ml	
Identification			
Biochemicals	Mac-Conkey Agar	Colourless colonies = 700/ml Pink colonies = 41700/ml	
	Triple sugar iron (TSI)	H2S Gas Producing Coliform like *Salmonella spp*. Present	
	Urease slant	Urease positive *H. Pyrollea, Proteus, Brucella spp.* etc. may present in wat sample	
	MR- VP	MR +ve, VP -Ve	
Rapid Tests	Catalase	Positive	
	Oxidase	Positive	
Gram Staining	Mac (Colourless colony Mac (Pink Colony)	Gram negative Pathogens like Pseudomonas may present Gram negative Pathogen Concluded as presence of *Escherichia coli*	
	NA (Big Colony) NA (Small Colony)	Gram Positive cocci in cluster observed suggested of *Staphylococcus spp.* Gram positive *bacilli spp*. present	
	Sab	Fungal spores seen suggested of *Candida spp.*	

Remark: Suggested of presence of Coliform like ***Escherichia coli, Pseudomonas spp., Klebsiella spp.*** also Presence of ***Bacilli spp. and Staphylococci***. Fungal ***Candida spp.*** present in given water sample of Visarjan Ghat.

IV. Discussion

The specified Bacteria's like ***Escherichia coli, Pseudomonas spp., Klebsiella spp., Bacillus spp., Salmonella spp. Streptococci, Staphylococci,*** and ***Proteus spp.*** are found in THE VARHALA DEVI LAKE water samples.

Escherichia coli, commonly known as E. coli, is a significant pathogen linked to waterborne illnesses. It is a facultative anaerobic bacterium that naturally resides in the large gastrointestinal tracts of warm-blooded animals and is a prevalent part of the normal flora in the human colon. The presence of E. coli in food or water typically indicates recent fecal contamination or inadequate hygiene practices in food processing facilities. As a result, fecal contamination, inadequate sanitation measures, and substandard storage conditions greatly impact the population of E. coli (tephen T. Odonkor, et.Al, 2020). When ammonium sulfate and certain amino acids were added to the unfiltered lake water, it resulted in extended survival times for E. coli. Interestingly, the duration of survival was directly proportional to the concentration of the nitrogen source that was added (C H Lim, et.Al. 1989). Although E. coli is the most prevalent gram-negative bacterium found in the gastrointestinal tract of humans, it typically does not possess significant harmful properties in that environment. However, when it is present in locations beyond the intestinal tract, it can cause infections such as urinary tract infections (UTIs), pneumonia, bloodstream infections (bacteremia), infections in the abdomen and pelvis, meningitis and inflammation of the peritoneum (peritonitis), among other conditions. E. coli is a significant cause of infections acquired in healthcare settings, including UTIs associated with catheter use and pneumonia associated with ventilator use (ventilator-associated pneumonia or VAP). Additionally, E. coli can be present in soil, on vegetables, and in water sources, as well as in undercooked meats. Certain strains of E. coli, when ingested, can cause gastrointestinal illness in humans. (Matthew Mueller, et.Al. 2023).

The *Pseudomonas* genus consists of over 140 species, with most of them being harmless bacteria that live off decaying matter. However, there are more than 25 species associated with human-related issues. These bacteria typically cause opportunistic infections, meaning they take advantage of weakened immune systems. Some examples include Pseudomonas aeruginosa, Pseudomonas fluorescens, Pseudomonas putida, Pseudomonas cepacia, Pseudomonas stutzeri, Pseudomonas maltophilia, and Pseudomonas putrefaciens. Only two species, Pseudomonas mallei and Pseudomonas pseudomallei, cause specific diseases in humans, known as glanders and melioidosis, respectively. Among the pseudomonads, Pseudomonas aeruginosa and Pseudomonas maltophilia are responsible for about 80% of infections diagnosed in clinical samples. Pseudomonas aeruginosa is particularly concerning because it is widespread in various moist environments, but it usually doesn't harm healthy individuals. However, it poses a significant risk to hospitalized patients, especially those with serious underlying conditions like cancer or burns. The infections caused by Pseudomonas aeruginosa can be life-threatening due to a combination of weakened immune defenses, bacterial resistance to antibiotics, and the production of harmful enzymes and toxins by the bacteria (Barbara H. Iglewski, 1996). Pseudomonads are a diverse group of bacteria that thrive in various environments, including soil, seawater, freshwater, and even on plants and animals. They are commonly found in both domestic and clinical settings. Pseudomonads possess remarkable adaptability, enabling them to survive in a wide range of habitats, including distilled water. This adaptability contributes to their widespread distribution in the environment. Their presence has significant implications for ecology, agriculture, and commercial sectors. Pseudomonads are known for their role in causing food spoilage and participating in the degradation of petroleum products and other materials. In the realm of agriculture, they rank among the most significant plant pathogens. In healthy individuals, pseudomonads can lead to eye and skin diseases (Kristina D. Mena, et.Al, 2009).

Klebsiella bacteria are commonly found in healthcare settings and can cause infections acquired during hospital stays. They are also widespread in nature, inhabiting various environments such as the gastrointestinal tract of mammals, soil, surface waters, and plants. Interestingly, Klebsiella isolates obtained from the environment can closely resemble those found in human clinical cases in terms of their biochemical characteristics and virulence. Although the exact medical significance of Klebsiella in natural environments is not fully understood, these habitats are believed to serve as potential reservoirs for the growth and spread of these bacteria, which can potentially colonize animals and humans. The Klebsiella genus is divided into five different species. The two most significant species in terms of clinical relevance are Klebsiella pneumoniae and Klebsiella oxytoca. On the other hand, Klebsiella ornithinolytica, Klebsiella terrigena, and Klebsiella planticola are rarely found in human clinical samples. K. planticola and K. terrigena are considered to be primarily found in the environment, as indicated by their species names. Unlike K. pneumonia, neither K. planticola nor K. terrigena can grow at higher temperatures, such as 44.5°C. (R. PODSCHUN, et.Al, 2000) When assessing the cleanliness of an environment, it is important to consider how well indicator bacteria can survive compared to harmful pathogens. Wastewater typically contains different types of indicator bacteria in unknown quantities. Since there is no single counting method that can exclusively identify one specific species, sanitation coliform analysis often involves enumerating a mixture of bacteria with unknown composition. Even the thermo tolerant coliform component, often referred to as "fecal coliforms," consists of at least two genera: Escherichia and Klebsiella (SEPPO I. NIEMELA, et.Al, 1982)

Streptococci: - Fecal streptococci are considered traditional indicators of fecal contamination. They are Gram-positive bacteria that do not produce spores and are unable to break down hydrogen peroxide (catalase-negative). These bacteria grow at a temperature of 35 °C in a medium that contains bile salts and sodium azide. They also have the ability to break down a substance called esculin. Sodium azide acts as a strong inhibitor of the respiratory chain, which is crucial for energy production in most bacteria. Since streptococci are among the few bacteria that lack a respiratory chain, this test becomes highly specific for identifying them, making false positive results uncommon **(**João P. S. Cabral**,** 2010**).** Streptococci are a type of gram-positive bacteria that require oxygen to survive. They can cause various health problems such as sore throat (pharyngitis), lung infections (pneumonia), skin infections, infections in wounds, blood infections (sepsis), and inflammation of the inner lining of the heart (endocarditis). The symptoms experienced by an individual depend on which organ is affected by the infection. Infections caused by a specific type of streptococci called group A beta-hemolytic streptococci may lead to additional complications like rheumatic fever and glomerulonephritis, which affect the heart and kidneys, respectively (Larry M. Bush, MD, FACP, et.Al. 2023).

Staphylococci are a type of gram-positive bacteria that need oxygen to survive. Among them, Staphylococcus aureus is the most harmful. It often causes infections on the skin and, in some cases, can lead to pneumonia, endocarditis (inflammation of the heart lining), and osteomyelitis (bone infection). Staphylococcus aureus infections commonly result in the formation of abscesses, which are pus-filled pockets. Certain strains of Staphylococcus aureus produce toxins that can cause conditions like gastroenteritis (stomach and intestine inflammation), scalded skin syndrome, and toxic shock syndrome. To diagnose an infection, a Gram stain and culture are usually performed. Treatment typically involves using antibiotics that are effective against penicillin-resistant bacteria, known as penicillinase-resistant beta-lactams. However, due to the prevalence of antibiotic resistance, more powerful antibiotics like vancomycin or newer alternatives may be necessary (Larry M. Bush, MD, FACP, et.Al. 2023).

Bacillus species are rod-shaped bacteria that thrive in oxygen-rich environments and form spores. Gram-positive bacteria are a type of bacteria that, in some species, can appear Gram-negative as they age. They are found widely in nature. Among them, Bacillus anthracis is the only Bacillus species that specifically infects vertebrates and causes anthrax. Other Bacillus species, such as Bacillus larvae, B. lentimorbus, B. popilliae, B. sphaericus, and B. thuringiensis, infect certain groups of insects. Although some Bacillus species like B. cereus can occasionally cause diseases in humans and livestock, most Bacillus species are harmless and serve as decomposers. Bacillus species have diverse physiological characteristics and are utilized in various medical, pharmaceutical, agricultural, and industrial processes. They can produce enzymes, antibiotics, and other useful substances. Notably, antibiotics like bacitracin and polymyxin are derived from Bacillus species. Certain Bacillus species are used as standards for testing in medical and pharmaceutical assays. The spores of Bacillus stearothermophilus, an obligate thermophile, are employed to assess heat sterilization methods. B. subtilis subsp. globigii, which is resistant to heat, chemicals, and radiation, is commonly used to validate alternative sterilization and fumigation procedures. Some Bacillus species play important roles in natural or artificial waste degradation. Insecticides often utilize Bacillus species that are effective against specific insects. However, Bacillus spores can be challenging to eliminate as they possess resilience against heat, radiation, disinfectants, and drying. This resilience often leads to contamination of medical and pharmaceutical materials. Bacillus species are well-known in the food industry for their ability to cause spoilage in various products (Peter C. B. Turnbull. 1996).

Salmonella bacteria are a type of Gram-negative bacilli that have flagella and can survive with or without oxygen. They are characterized by their O, H, and Vi antigens. There are more than 1800 known types of Salmonella, which are considered separate species in the current classification. Salmonellosis, caused by Salmonella infection, can range from common gastroenteritis (resulting in diarrhea, abdominal cramps, and fever) to serious systemic illnesses known as enteric fevers, including typhoid fever, which require immediate antibiotic treatment to prevent life-threatening conditions. Salmonella can also cause focal infections and can persist in the body without causing symptoms. The most common form of salmonellosis is a self-limiting gastrointestinal illness. When pathogenic strains of Salmonella are ingested through contaminated food, they can survive the acidic environment of the stomach and invade the lining of the small and large intestines, producing toxins. This invasion triggers the release of pro inflammatory cytokines, leading to an inflammatory response. This acute inflammation causes diarrhea and can result in ulceration and damage to the intestinal lining. In some cases, Salmonella can spread from the intestines to other parts of the body, causing systemic disease. Non-typhoidal salmonellosis is a worldwide disease that affects both humans and animals. Animals are the main carriers of the bacteria, and the disease is usually transmitted through contaminated food, although person-to-person transmission can also occur. Typhoid fever and other enteric fevers, on the other hand, primarily spread from person to person through the fecal-oral route and do not have significant animal reservoirs. Asymptomatic carriers, also known as "typhoid Marys," can unknowingly spread the disease. Vaccines are available for typhoid fever but not for non-typhoidal salmonellosis. Controlling these diseases involves practicing hygienic slaughtering methods, ensuring thorough cooking of food, and refrigeration to prevent bacterial growth (Ralph A. Giannella, 1996).

Proteus bacteria are a type of Gram-negative bacteria that belong to the Enterobacteriaceae family and are commonly found in the gastrointestinal micro biota as harmless organisms. They are short, straight rods that can exist in two forms: "swimming" and "swarming." The swimming form, which has multiple flagella, is prevalent in liquid environments. The genus Proteus includes various species such as Proteus mirabilis, P. vulgaris, P. penneri, P. hauseri, P. terrae, P. cibarius, and unnamed genomospecies. In humans, except for P. cibarius and P. terrae, all these species have been found in clinical samples. Normally, the human gut contains a small amount (less than 0.05%) of Proteus species, including P. vulgaris, P. mirabilis, and P. penneri. While Proteus bacteria can be harmful and cause infections, research has mainly focused on their role in urinary tract infections rather than intestinal issues. Proteus species, especially P. mirabilis and P. vulgaris, are often responsible for opportunistic infections in healthcare settings. Patients with existing gastrointestinal conditions are at higher risk of secondary Proteus infections, often in combination with other bacteria. Proteus species can also lead to peritonitis, an infection of the abdominal cavity, following gastrointestinal tract perforations. In one study of 383 patients with peritonitis, Proteus species were identified in 23% of cases (Amy L. Hamilton, et.Al, 2018).

The fungal species like *Candida Spp.*, *Aspergillus Spp.* and *Trichophyton Spp*. are also present in the water sample of the Varhala Devi Lake.

V. Conclusion

During present study by microbial diversity of following bacteria were recorded which confirm the degradation of water quality of Varhala lake. Recently, it is observed that the lake water quality has been degraded due to heavy domestic disposal and surrounding natural polluted water effluents and though lake is protected by all 3 sampling sites by constructing 3 artificial water bodies then also leaching and improper disposal of religious water and non-maintenance of equipment installed by lake conservation project during 2008. The number of bacteria has been recorded which is not a good sign of healthy water as this water is used for portable drinking purpose by Bhiwandi Nizampura City Municipal Corporation (BNCMC), along with bacteria like ***Escherichia coli, Pseudomonas Spp., Klebsiella Spp., Bacilli Spp., Salmonella Spp., Proteus Spp., Staphylococci, Streptococc***i. 3 species of fungus ***Candida Spp., Aspergillus Spp., & Trichophyton Spp.***, are also recorded which is again the deteriorating sign of the Varhala Devi Lake. Proper sanitation, disinfectant, anti-bacterial material, bioremediation, stopping of industrial & domestic sewage effluents entering into the water May enhance the good quality of water and ecological status of Varhala Devi lake and will stop further growth or flourishment of the bacteria and fungi.

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