Restoration and rejuvenation of water bodies with bio enzymes produced from Citrus Fruit peels

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Abstract - In this present article, we attempt to demonstrate how to restore and rejuvenate water bodies using bio-enzymes. We have prepared bio-enzyme from Citrus Fruit peels and tried to explore how it affects water quality parameter indices, such as, hardness, alkalinity, chloride ion concentration etc. Water quality parameters are measured for water samples with and without the bio-enzyme at different time intervals. Our study shows a marked improvement in the water quality parameters that not only reveals the potential use of the bio-enzyme on water treatments but also enables the whole treatment to be cost effective and eco-friendly. Moreover, the organic residue derived during the preparation of bio-enzymes can be further used as good quality manure which can improve the soil quality instead of using harmful chemical fertilizer and thus demonstrates an efficient and effective way towards the management of organic solid wastes across the ecosystem.

Keywords–Bio-enzyme; Water-body; Restoration; Rejuvenation; Bio-remediation

1.0 Introduction

Water plays an important role in the regulation of oxygen, minerals and essential nutrients required for the existence of life on the earth. As per the reports of NITI Aayog, 70% of the water bodies in India are found to be contaminated with water pollutants generated from different anthropogenic activities that pose severe threat to the sustainable issues across the country[1]. Moreover, the depletion of groundwater resources day by day has added extra risk on the biosphere which is also an important concern across the present global scenario. Thus restoration and rejuvenation of water bodies has become an important sustainability issue that requires initiatives to analyze and improve water quality parameters by effective emerging waste water treatment methodologies. Beside chemical treatments, use of eco-friendly processes such as, treating the water samples with bio enzymes have also been found to be a promising technique to solve the present crisis. Bio enzymes are simple cost effective eco friendly organic compounds that are conventionally prepared from domestic organic wastes, such as citrus fruit and vegetable peels through fermentation in presence of jaggery and selective microorganisms. The concept of Bio enzymes was introduced by Dr. RosukonPoompanvong who was the founder of the organic agricultural association of Thailand[2]. Bio enzymes are very much effective in breaking down the organic wastes and have been found to have potential multipurpose cleaning activity. Beside this,

bio enzymes are also expected to improve water quality parameters and thus can be treated as cost effective bio-remediator.

We use citrus fruit peels that were fermented in presence of jaggery and requisite amount of water to prepare bio-enzyme[3] that has been found to improve the quality parameters of water samples collected from water bodies adjacent to our college premises. The study of the effectiveness of the enzyme over the quality parameters of the collected water samples has been measured by standard measurement techniques and the trends in the values of Hardness, alkalinity, Chloride ion concentration, pH etc are reported to support our claim. Additionally we use the organic residue collected after the successful filtration of the enzyme from the incubated mixture as effective manure and thus attempt to demonstrate an effective way towards solid waste management issues[4].

2.0 PROCEDURE:

1. Preparation of bio-enzyme
2. Determination of water quality parameters

2.1 Preparation of Bio enzyme

During the winter season plenty of orange peels were available in the college premises as the food waste which were collected to prepare the bio-enzyme as well as to manage the biodegradable waste. Orange peel mainly contains cellulose, lignin and hemicelluloses. Cellulose, the simplest natural polymer, helps in the fermentation process. Orange peels, jaggery and water were taken in a particular ratio in a closed tightly sealed container and kept in dark for a span of 3 months (Fig. 1). The gases produced in the mean time were released after a particular interval of days which is generally one week. When the clear liquid layer was obtained on the top of the mixture (alcohol present ~3%), fruit peels were taken out of the mixture by using Buchner funnel and the supernatant liquid was obtained with bio-enzyme (Fig. 2). The extracted fruit peels could be used as manure in the future.

Fig. 1 Incubation of Bio-enzyme

Fig. 2 Separation of Bio-enzyme

2.2 Determination of water quality parameters:

Hardness

Hardness is the characteristics of water which prevents formation of lather with soap. It is caused by the presence of Carbonate, Bicarbonate, Sulphate and Chloride salts of Magnesium and Calcium ions. Hardness in water is estimated by complexometric titration using di-sodium salt of EDTA and EBT as an indicator at pH =8-10. EBT forms an unstable wine red coloured complex with calcium or magnesium ions which on titrating against EDTA, the ions form complex with EDTA leaving EBT ion free whose color is blue therefore the end point of the titration is characterized due to a change from wine red to blue.

Chloride content

Chlorine is most often found in natural water bodies as a component of sodium or potassium salt (sodium chloride) or in some times as calcium salt. Water contain chloride ion (Cl^-) in form of soluble salts. Estimation of Chloride ion can be done by Mohr's method. Various anthropogenic as well as natural sources, such as, the soil weathering, deposition of salt, salt spray used for road de-icing, waste water, contamination of fresh ground water by salty ocean water in the coastal areas are found to be common reasons for the presence of chloride ion in the natural bodies. The sample water containing chloride is titrated against silver nitrate solution using potassium chromate as an indicator. The end point of the titration is characterized by the change from yellow to brick red.

Alkalinity

Water becomes alkaline due to the presence of some soluble bases like NaOH, KOH and salts like Na_2CO_3, K_2CO_3, $NaHCO_3$ etc. Alkalinity of water can easily be measured by using standardized (N/50) H_2SO_4 solution.

Total Dissolved Solid (TDS)

Total Dissolved Solid is determined with the help of TDS meter.

pH

pH is the negative logarithm of hydrogen ion concentration. The scale of pH is from 0 to 14. pH 7 is neutral. Solution pH below 7 is considered as acidic and above 7 is basic in nature. pH of a solution is determined by pH meter.

3.0 Results and discussions

Our aim is restoration and rejuvenation of water bodies adjacent to our college campus with bio-enzymes produced from citrus fruit peels. The water bodies from where the sample was collected (Fig. 2) were largely covered by garbage, weeds, household waste, such as single use plastics, plastic bottles and many other anthropogenic elements. We have tested different water quality parameters, before and after introducing bio-enzymes into the water samples. The experimental results point towards the improvement in the quality of the water samples. We have observed the different water quality parameters for a regular interval after adding bio-enzymes. We have collected the data after 7, 14, 21 days of adding bio-enzyme to the water samples. The changes were: a decrease in the chloride content from 470 ppm to 143.3 ppm, a decrease in hardness from 336 ppm to 248.32 ppm, a decrease in alkalinity from 674 ppm to 410 ppm and a decrease of TDS 579 ppm to 461 ppm within 21 days (Table 1). The pH value was maintained between 8.2 to 7.5.

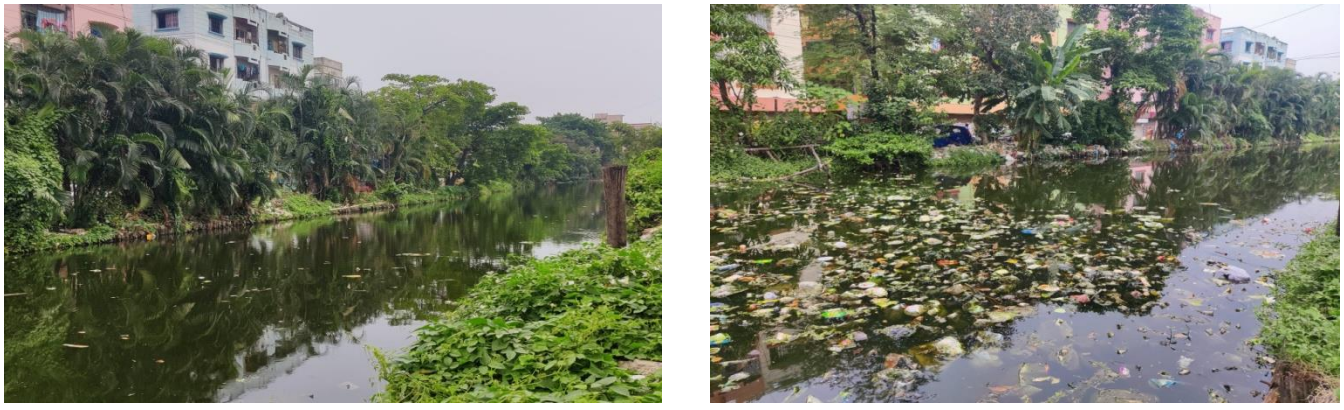

Fig. 2 Water bodies adjacent to our college campus from where water sample was collected for WQI checking

Table 1: Water Quality Parameters: Before and after the introduction of bio-enzyme

Parameters	Before introduction of bio-enzyme	After the introduction of the bio-enzyme		
		7 days	14 days	21 days
Chloride content	470 ppm	215 ppm	192.76 ppm	143.3 ppm
Hardness	336 ppm	326 ppm	294 ppm	248.32 ppm
Alkalinity	674 ppm	577.5 ppm	523.65 ppm	410 ppm
pH	8.2	7.5	7.5	7.5
Total dissolved Solid	579 ppm	520 ppm	480 ppm	461 ppm

4.0 CONCLUSION

Water bodies play a very significant role as wetland ecosystem and thus fall under the Wetland Conservation and Management Rules 2017. We want to restore and rejuvenate the water bodies, adjacent to our college campus, which can play an important role as potential aquatic ecosystem with the help of the bio-enzymes which have its own beneficial purposes that can serve our mentioned aim. We have checked the different water quality parameters for the water sample of the aforementioned water bodies before and after the introduction of the bio-enzymes prepared from citrus fruit peels. The visible changes depicted in the table clearly point out the need of bio-enzymes which rapidly digest the organic pollutants. We can execute our plan of bio-remediation for the water bodies by spraying the solution of bio-enzymes after cleaning up garbage from there. Using bio-enzyme is a productive and cost effective way to restore and rejuvenate the water bodies instead of using harmful chemicals to improve the water quality parameters so that we can pass the rich legacy to the future generations.

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