Effect of Bio enzymes on fish culture waste water treatment

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Abstract— This study investigated the potential of bio-enzymes derived from fruit and vegetable peels, as well as citrus peels, for the biological treatment of fish culture waste water. The waste water, containing organic and inorganic compounds from fish farming, can have detrimental environmental and health impacts if not managed properly. The experiment involved testing the two bio-enzymes separately, with 0.8% concentration, and analyzing the results on the 5th and 10th day of digestion. The citrus peel bio-enzyme showed superior effectiveness in reducing parameters like pH, TDS, total alkalinity, green algae, and blue-green algae. While both enzymes increased turbidity and total hardness similarly, the citrus peel bio-enzyme performed better. These findings highlight the potential of bio-enzymes, particularly citrus peel bio-enzyme, as an eco-friendly solution for fish culture waste water treatment, promoting environmental sustainability in fish farming systems.

Key words: Fish culture waste water, bio-enzymes, fruit &vegetable peels, citrus peels Environmental sustainability

I. INTRODUCTION

Aquaculture has experienced significant growth worldwide to meet the increasing demand for fish and seafood. However, intensive fish farming practices often generate wastewater containing organic matter, nutrients, and pollutants, necessitating effective and sustainable treatment methods. This study focuses on evaluating the effects of citrus bioenzyme and fruit vegetable mix bioenzyme on water parameters in the treatment of fish culture wastewater in a tarpaulin sheet culture system in Kakinada, Andhra Pradesh, India—a region renowned for aquaculture activities. Bioenzymes derived from natural sources offer a promising approach for wastewater treatment, as they contain enzymes that facilitate the breakdown of complex organic compounds present in fish culture wastewater. The study aims to assess how the bioenzymes impact various water parameters, such as pH, TDS, total hardness, total alkalinity, chlorides, turbidity, green algae, and blue-green algae. It is hypothesized that the application of citrus bioenzyme and fruit vegetable mix bioenzyme will lead to improved water quality by reducing organic matter and pollutants. The findings will contribute to the understanding of bioenzyme applications in aquaculture wastewater treatment, providing valuable insights for eco-friendly and sustainable solutions in the industry.

OBJECTIVES OF THE CURRENT STUDY

1. To reuse fruit waste and vegetable waste from juice centers, hostels, fruit vendors and vegetable vendors

2. Preparation of citrus bio enzyme and fruit vegetable mix bio enzyme

3. To investigate the effects of citrus bio enzyme and fruit vegetable mix bio enzyme on the water quality parameters of fish culture waste water in a tarpaulin sheet culture system.

II. REVIEW OF LITERATURE

A Systematic Review on Enzyme Extraction from Organic Wastes and its Application" by Indrani Barman et al. (2022): This study explores the extraction of enzymes from organic waste and their potential applications in wastewater treatment, cleaning agents, fertilizers, and hand sanitizers.

"Production of Enzyme Bio-cleaner from Fruit Waste by Yeast" by Mercy John et al. (2022): The study investigates the production of enzyme bio-cleaners using yeast and fruit waste, specifically citrus limetta and punica granatum peels. The enzymes produced can be used as effective cleaning agents.

"Citrus Bioenzyme Production and Application for Wastewater Treatment" by Mrs. Vishaka V. et al. (2022): This study focuses on cleaning wastewater using citrus bioenzyme produced from citrus peels through fermentation. The bioenzyme shows promising results in reducing pH and chlorine levels in wastewater.

"Production of an Ecofriendly Enzyme Biocleaner from Fruit Wastage" by Aartheeswari S. et al. (2021): The study explores the production of enzyme biocleaners from fruit waste, particularly lemon obtained from local fruit juice stalls. The produced biocleaners demonstrate enzymatic activities suitable for cleaning purposes.

"Production and Utilization of Bioenzyme Using Fruits and Vegetables Peels: A Review" by Amee Patolia et al. (2021): This review discusses various bioenzymes and their role in soil stabilization, construction, and cleaning. It highlights the effectiveness of bioenzymes, such as garbage enzymes, in improving soil properties.

"Aquaculture Wastewater Treatment Technologies and Their Sustainability: A Review" by Asha P. Tom et al. (2021): This review compares different aquaculture wastewater treatment technologies and their contribution to sustainability. It covers topics like recirculation systems, constructed wetlands, microalgae as feedstock, and integrated multi-trophic aquaculture.

"Domestic Wastewater Treatment Using Garbage Enzyme" by Ashish Joseph et al. (2021): The study focuses on developing a garbage enzyme solution from kitchen waste for domestic wastewater treatment. The optimal concentration of the garbage enzyme is determined for effective removal of various water quality parameters.

"Production and Characterization of Eco-Enzyme from Fruit Peel Waste" by Ismi Nurlatifah et al. (2021): This study investigates the production and characterization of eco-enzymes from fruit peels, including watermelon, pineapple, banana, and orange. The eco-enzymes exhibit enzyme-like properties and can be utilized for floor cleaning, fertilizer production, and other applications.

"Study on Soil Stabilization Using Bio-Enzyme: Terrazyme" by Nimi Ann Vincent et al. (2021): The study explores the use of bio-enzyme (Terrazyme) for soil stabilization, specifically focusing on lithomargic clay. The bio-enzyme improves the strength and binding capacity of the soil.

"Wastewater Treatment Using a Natural Coagulant (Moringa Oleifera Seeds): Optimization through Response Surface Methodology" by Wendesen Mekonin Desta et al. (2021): This study investigates the use of Moringa oleifera seeds as a natural coagulant for wastewater treatment. It optimizes the dosage of Moringa oleifera for maximum reduction in turbidity, color, and chemical oxygen demand in wastewater.

Study area

The production and preparation of bio-enzymes (Citrus bio enzyme and fruit and vegetable bio enzyme) took place in a fermentation jar placed in a 6mx8m room at Vidyuth Nagar, Kakinada, East Godavari. The location's coordinates are 16°17'20.17"N latitude and 80°27'21.58"E longitude, with an elevation of 78m above sea level.

Environmental Factors

The study area experiences an average annual rainfall of approximately 200mm. The maximum temperature averages around 35˚C, while the minimum temperature is about 24˚C. The bio-enzymes are effective within a temperature range of 30˚C to 45˚C, with a minimum temperature requirement of 5˚C for optimal performance.

III MATERIALS AND METHODS

FRUIT PEELS

Banana Peels

Banana peels are rich in potassium, phosphorus, and calcium, making them ideal for bio-enzyme production. Fresh, yellow-colored peels should be collected, while decomposed peels should be avoided. Chopped into small pieces before fermentation. One kilogram of fresh banana peels was collected from juice shops in Kakinada.

Figure 1:BANANA PEELS

Pomegranate Peels

Pomegranate peels contain natural enzymes and various nutrients, including polyphenols, tannins, flavonoids, Vitamin C, and Vitamin K. They offer potential health benefits and were collected in 500 grams from juice shops in Kakinada.

Figure 2:POMEGRANATE PEELS

Pineapple Peels

Pineapple peels are rich in vitamins (C, A, B6, E, K), minerals, and antioxidants, making them a nutritious source for bio-enzyme production. 500 grams of fresh pineapple peels were collected from juice shops in Kakinada.

Figure 3:PINEAPPLE PEELS

Custard Apple Peels

Custard apple peels provide nutrients such as carbohydrates, vitamins (E, C, B6), thiamin, and potassium. They also contain dietary fibers that promote the growth of beneficial gut bacteria. 500 grams of fresh custard apple peels were collected from juice shops in Kakinada.

Figure 4:CUSTARD APPLE PEELS

Muskmelon Peels

Muskmelon peels, rich in calories, carbohydrates, vitamins (A, folic acid, C, niacin), and minerals, are a valuable source of enzymes. 350 grams of fresh muskmelon peels were collected from juice shops in Kakinada

Figure 5:MUSKMELON PEELS

Citrus Peels

Citrus peels contain carbohydrates, sugars, and organic acids like citric acid. They were collected in 3 kilograms from juice shops in Kakinada.

Figure 6:CITRUS PEELS

3.4 VEGETABLE PEELS

Cabbage Peels

Cabbage peels, rich in fiber, iron, magnesium, and vitamins (C, D, potassium), provide valuable

enzymes. 200 grams of fresh cabbage peels were collected from the kitchen.

Figure 7:CABBAGE PEELS

Bottle Gourd Peels

Bottle gourd peels are rich in vitamins (C, B, K, A, E), iron, folate, magnesium, and potassium. 100 grams of fresh bottle gourd peels were collected from the kitchen.

Figure 8:BOTTLE GUARD PEELS

JAGGERY

Jaggery, rich in antioxidants and essential minerals, including iron, magnesium, potassium, zinc, and selenium, contributes to the production and regulation of bio-enzymes. One kilogram of jaggery was used.

Figure 9:JAGGARY

3.6 YEAST (SACCHAROMYCES CEREVISIAE)

Yeast is crucial for fermentation as it produces carbon dioxide and converts sugars into alcohol. Five grams of yeast were used for every kilogram of jaggery, three kilograms of fruit peels, and 20 liters of water.

Figure 10:YEAST

WATER

Ten liters of clean water with a pH of 7.2 and a total dissolved solids (TDS) of 116 ppm were collected.

Figure 11:WATER

PLASTIC AIRTIGHT CONTAINERS

Three 20-liter transparent plastic airtight containers were used for bio-enzyme production.

Figure 12

STIRRER

A wooden stirrer was used to agitate the mixture every 24 hours.

Figure 13:WOODEN STIRRER

SIPHON TUBE

A siphon tube facilitated the transfer of bio-enzyme between containers without introducing air bubbles or solid substances.

Figure 14:SIPHONING TUBE

BEAKERS

One-liter capacity beakers were used to collect fish culture wastewater.

Figure 15:BEAKER

COLLECTION OF FISH CULTURE WASTE WATER

Wastewater from a fish culture pond was collected in a one-liter beaker from different areas, ensuring representative sampling and accounting for water quality variations. Precautions were taken to avoid contamination during collection.

Figure 16:FISH CULTURE POND

Figure 17:COLLECTED WASTE WATER

These materials were used for bio-enzyme production, each with their unique properties and contributions.

The methodology consists of two main steps: bio-enzyme preparation and fish wastewater treatment using 0.8% of the bio-enzymes.

Bio-enzyme preparation:

Collect, wash, and extract enzymes from fruit, citrus, and vegetable peels.

Mix peels, jaggery, and water in a ratio of 10:3:1 along with yeast.

Store the mixture in airtight containers and allow fermentation for 3 months.

Siphon the liquid, filter it, bottle the bio-enzymes, and store them in a dry place

Flow chart for the preparation of bio enzyme

Collection of fresh fruits and vegetable peels, Citrus peels

↓

Cutting of peels into pieces

↓

Addition of jaggery, peels & water (1:3:10) into 3/4th container

↓

Agitating the mixture

↓

Add pinch of yeast (3 grams)

↓

Air tightening the container

↓

Fermentation (60 days)

↓

Open the lid & release the filled gases up to 2 months

↓

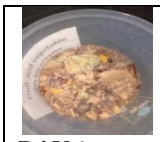
Siphoning & extraction of bio-enzyme

↓

Bottling

↓

Storage of bio-enzyme.


DAY 1


DAY 10


DAY 20


DAY 30


DAY 40


DAY 50


DAY 60


FRUIT VEGETABLE MIX BIOENZYME

FIGURE18:OBSERVATIONS OF FRUIT AND VEGETABLE MIX BIOENZYME


DAY1

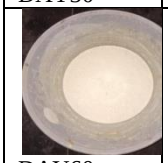

DAY10


DAY20


DAY30


DAY 40


DAY50


DAY60


CITRUS BIOENZYME

FIGURE 19:OBSERVATIONS CITRUS BIOENZYME

.In the fish culture wastewater treatment process, half of the pond water was regularly exchanged every two weeks to remove accumulated waste. The exchanged wastewater samples were divided into two sets and collected in 1-liter beakers. One set was treated with citrus bio-enzyme, while the other set was treated with a bio-enzyme mixture of fruit and vegetables. To treat each set, 8ml of the respective bio-enzyme solution was added to 1000ml of wastewater, ensuring thorough mixing to distribute the enzymes evenly. It was noted that the enzymes are not immediately effective upon treatment and require a digestion period. Therefore, the treated samples were allowed to undergo a digestion period of 10 days to enhance the efficacy of the bio-enzymes in the wastewater. During this digestion period, the characteristics of the treated wastewater were assessed on the 5th and 10th day. Comprehensive water quality analysis tests were conducted, measuring parameters such as pH, total dissolved solids (TDS), total hardness, total alkalinity, chlorides, turbidity, as well as the presence and abundance of green algae and blue-green algae using standard methods. This methodology aimed to investigate the impact of citrus bio-enzyme and fruit vegetable mix bio-enzyme on the water quality parameters of fish culture wastewater, providing valuable data to assess the effectiveness of bio-enzymes in treating fish culture waste and improving water quality in aquaculture systems.



WASTE WATER AFTER ADDING CITRUS PEELS BIOENZYME ON 5TH AND 10TH DAY



WASTE WATER AFTER ADDING FRUIT AND VEGTABLE MIX BIOENZYME ON 5TH AND 10TH DAY

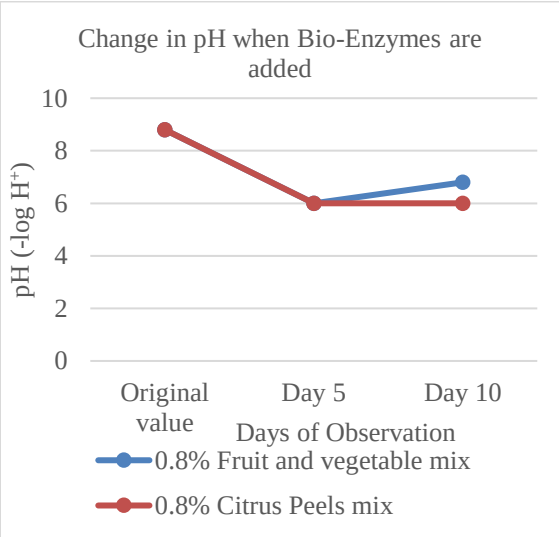
FIGURE20:WASTE WATER AFTER ADDING BIOENZYMES ON 5TH AND TENTH DAY

IV.RESULTS AND DISCUSSION

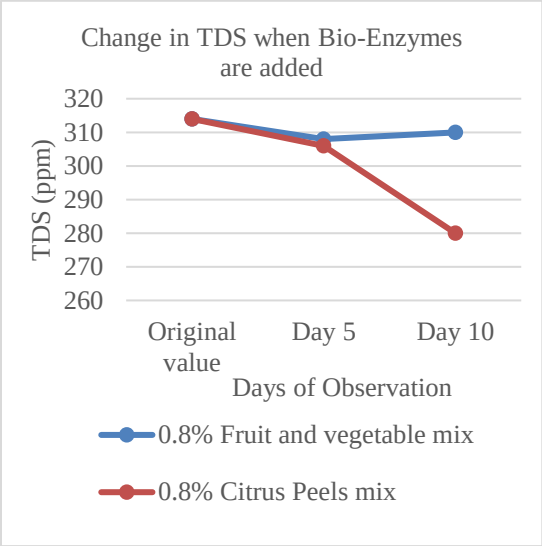
TABLE 1:Characteristics of fish culture waste water			
S. No	Parameters	Unit	values
1	pH	(-logH+)	8.8
2	TDS	ppm	314
3	Total alkalinity	ppm	242
4	Total hardness	ppm	240
5	Turbidity	NTU	27.5
6	Chlorides	ppm	200
7	Green algae	Conc%	60
8	Blue green algae	Conc%	70

TABLE 2:Effluent characteristics after treatment of fish culture waste water using 0.8% fruit and vegetable mix bioenzyme				
S. No	Parameters	Unit	Values	
			Effects after 5 days	Effects after 10 days
1	pH	(-logH+)	6.0	68
2	TDS	ppm	308	310
3	Total alkanity	ppm	180	270
4	Total hardness	ppm	250	250
5	Turbidity	ntu	0	39.2
6	Chlorides	ppm	0	190
7	Green algae	Conc%	40%	50%
8	Blue green algae	Conc%	50%	40%

Graph 1: Changes in pH when Bio-Enzymes are added to the 0.8% Fruit and Vegetable mix & 0.8% Citrus peels mix

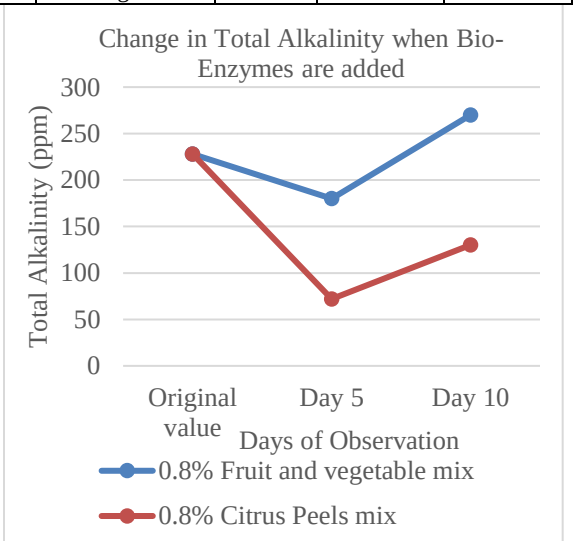


Graph 2**:** Changes in TDS when Bio-Enzymes are added to the 0.8% Fruit and Vegetable mix & 0.8% Citrus peels mix

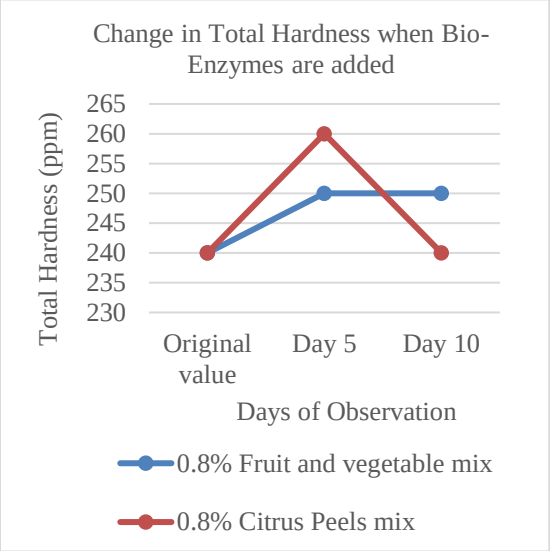


Graph 3: Changes in total alkalinity when Bio-Enzymes are added to the 0.8% Fruit and Vegetable mix & 0.8% Citrus peels mix

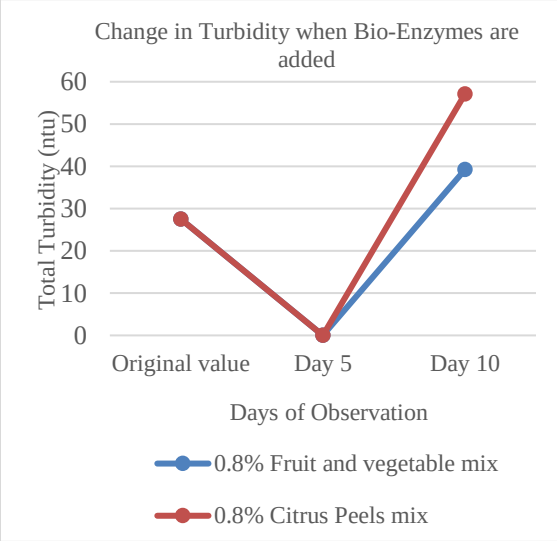
TABLE 3: Effluent characteristics after treatment of fish culture waste water using 0.8% citrus peels bioenzyme				
S. No	Parameters	Unit	Values	
			Effects after 5 days	Effects after 10days
1	pH	(-logH+)	6.0	6.0
2	TDS	ppm	306	280
3	Total alkanity	ppm	72	130
4	Total hardness	ppm	260	240
5	Turbidity	ntu	0	57.1
6	Chlorides	ppm	0	170
7	Green algae	Conc%	30%	50%
8	Blue green algae	Conc%	40%	30



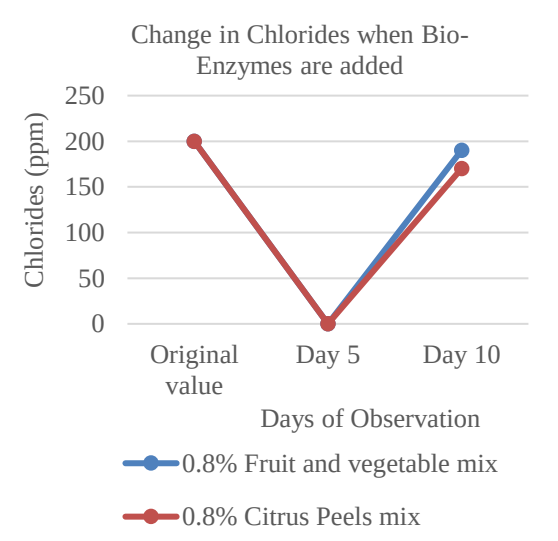
Graph 4**:** Changes in total hardness when Bio-Enzymes are added to the 0.8% Fruit and Vegetable mix & 0.8% Citrus peels mix



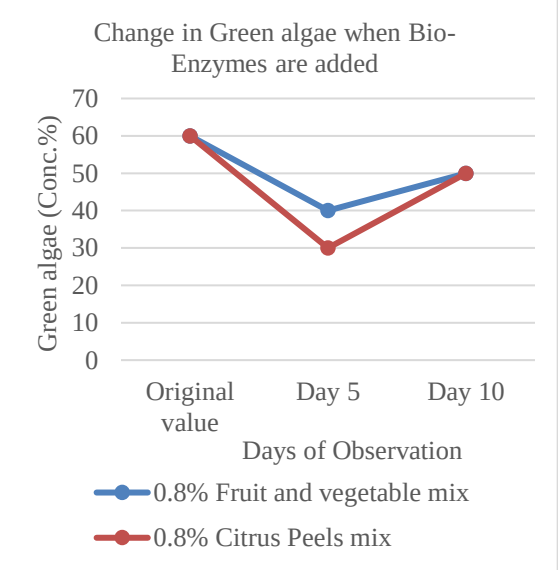
Graph 5: Changes in turbidity when Bio-Enzymes are added to the 0.8% Fruit and Vegetable mix & 0.8% Citrus peels mix



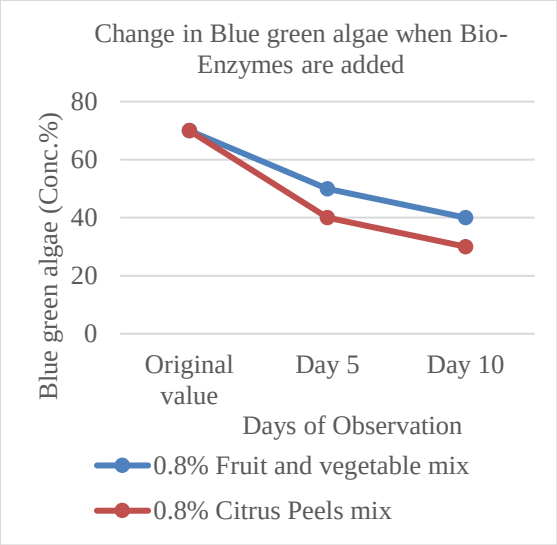
Graph 6: Changes in Chlorides when Bio-Enzymes are added to the 0.8% Fruit and Vegetable mix & 0.8% Citrus peels mix



Graph 7: Changes in Green algae when Bio-Enzymes are added to the 0.8% Fruit and Vegetable mix & 0.8% Citrus peels mix



Graph 8: Changes in blue green algae when Bio-Enzymes are added to the 0. 8% Fruit and Vegetable mix & 0.8% Citrus peels mix



DISCUSSIONS

In this study, two bioenzymes, a fruit and vegetable mix bioenzyme and a citrus peels bioenzyme, were compared for their effectiveness in treating fish culture waste water. The results showed that the citrus peels bioenzyme outperformed the fruit and vegetable mix bioenzyme in several aspects. It effectively reduced the pH levels of the treated water to 6.0 on both the fifth and tenth days, while the fruit and vegetable mix bioenzyme showed fluctuations in pH. The citrus peels bio enzyme also proved more effective in reducing total dissolved solids (TDS) and total alkalinity, demonstrating consistent decreases in concentration over the ten-day period.

Additionally, the citrus peels bioenzyme exhibited better performance in reducing the concentrations of green algae and blue-green algae in the waste water. It resulted in lower percentages of both types of algae on the fifth day, although there was a slight increase on the tenth day. Conversely, the fruit and vegetable mix bioenzyme had less significant effects on algae reduction. However, both bioenzymes had minimal impact on total hardness and increased the turbidity of the treated water, with the citrus peels bioenzyme showing a more pronounced effect.

Overall, the study suggests that the citrus peels bioenzyme holds greater potential for the treatment of fish culture waste water due to its ability to effectively reduce pH, TDS, total alkalinity, and algae concentrations. Further research and optimization may be necessary to address the limited impact on total hardness and the increase in turbidity observed with both bio enzymes.

CONCLUSION

The comparison between a fruit and vegetable mix bio enzyme and a citrus peels bio enzyme for treating fish culture waste water revealed that the citrus peels bio enzyme exhibited superior performance in multiple aspects. It consistently maintained the desired pH level, effectively reduced total dissolved solids (TDS) and total alkalinity, and demonstrated better control over green algae and blue-green algae concentrations. However, both bio enzymes had limited effects on total hardness and increased turbidity in the treated water, with the citrus peels bio enzyme showing a more noticeable impact. These findings suggest that the citrus peels bio enzyme holds promise as an effective solution for improving water quality in fish culture waste water treatment, although further research is needed to address its limitations and optimize its performance.

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