



Comparative Study On The Ability Of Water Hyacinth And Basil In Purifying Wastewater

S.Sandeep¹, Sherin.K.S², Jithin Sajan³, Priya. P. Nair⁴, Ansu M Daniel⁵

¹ UG Student, Civil Engineering, ² UG Student, Civil Engineering, ³ UG Student, Civil Engineering, ⁴ UG Student, Civil Engineering, ⁵ Assistant Professor, Civil Engineering

¹Rajadhani Institute of Engineering And Technology, Thiruvananthapuram, India

Abstract: The study aimed to evaluate the ability of water hyacinth (*Eichhornia crassipes*) and basil (*Ocimum bacilicum*) in waste water purification. The capability of these plants was investigated by measuring Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Turbidity, Colour, Hardness, Total Dissolved Solids (TDS), and pH of medium. Hydroponics is used for the growth of basil. Water samples are collected from Karamana river. These plant species are transplanted in wastewater for 30 days. Then various physical and biological parameters of water is assessed. The highest percentage elimination in BOD (76%), COD (60.25%), turbidity (13%), colour (39%), hardness (44%), pH (38%), TDS (33%) was noted with the use of these plants. Taking into account of the obtained results water hyacinth can be used to treat the wastewater in Karamana river.

Key Words- TDS, BOD, COD, Water hyacinth, Basil

I.INTRODUCTION

Karamana river is highly polluted in Thiruvananthapuram, Kerala. Farmers are forced to use polluted sewage and industrial water, harming ecosystems and human health. Pollutants like heavy metals, nitrates, and pathogens contaminate water, affecting plant growth. Domestic wastewater accounts for 90% of clean water consumption and contains harmful pollutants. Conventional treatment methods are ineffective, costly, and energy-intensive. Phytoremediation, using plants to purify water, offers a solution. This ecofriendly technology is low maintenance and cost-effective. The study aimed to evaluate the ability of water hyacinth and basil to purify wastewater. This research focused on utilizing natural solutions to mitigate water pollution. Generally, aquatic plants have been found to be effective in removing pollutants from wastewater. They absorb and accumulate various contaminants in different parts of the plant, effectively cleaning the water.

To assess the plants effectiveness, several key parameters were measured. These included Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Turbidity, Total Dissolved Solids (TDS), and pH levels. By investigating the capabilities of these plants, this study aims to identify efficient, plant-based solutions for wastewater treatment, contributing to a more sustainable approach to water pollution management.

II.LITERATURE REVIEW

Andrea Monro Lichy.et.al.,(2024), Unlocking the potential of *Eichhornia crassipes* for wastewater treatment, phytoremediation of aquatic pollutants, and advancing Sustainable Development Goal 6 (clean water), highlights *Eichhornia crassipes*, also known as water hyacinth, has emerged as a valuable tool in wastewater treatment and phytoremediation of aquatic pollutants. Research shows that this aquatic plant

effectively removes pollutants such as heavy metals, nutrients, and organic compounds from wastewater, improving water quality. Wastewater treatment and phytoremediation, Aquatic ecosystem restoration, Climate change mitigation, are the key benefits of water hyacinth explained by the author in this journal.

Akshay Kushawaha.et.al.,(2024), Urban small-scale hydroponics: A compact, smart homebased hydroponics system, highlights Urban small-scale hydroponics offers a sustainable solution for city dwellers to grow their own food. Research shows that compact, smart homebased hydroponic systems increase crop yields while minimizing water usage (up to 90% reduction). This also highlights increased food production in urban areas, Reduced water consumption, Year around crop growth, Improved crop quality, Enhanced urban food security. High initial investment costs, Limited crop selection, Energy consumption, Limited scalability are the challenges mentioned by the author in this journal.

Dwi Ratnani.et.al.,(2024), Exploring the potential of water hyacinth weed (*Eichhornia crassipes*) as an environmentally friendly antifungal to realize sustainable development in lakes: A Review, highlights Water hyacinth weed, notoriously known for its invasive nature, has surprisingly shown promise as an eco-friendly antifungal agent in lake conservation. Research reveals that extracts from this aquatic plant exhibit potent antifungal properties, effective against various fungal pathogens. Environmentally friendly alternative to chemical antifungals, Cost-effective and sustainable solution, Broad-spectrum antifungal activity, Potential for lake ecosystem restoration, Aquatic fungal pathogens (e.g., *Fusarium*, *Aspergillus*), Waterborne fungal diseases (e.g., fungal infections in fish), Lake ecosystem fungal pollution are key benefits of water hyacinth explained by the author in this study

AbebeWorkua.et.al.,(2024), Phytoremediation potential of *Duranta erecta* in cascade hydroponics for effective domestic wastewater treatment, highlights *Duranta erecta*, a popular ornamental plant, has remarkable potential for phytoremediation in domestic wastewater treatment. When used in cascade hydroponics, *Duranta erecta* effectively removes pollutants such as Heavy metals (lead, copper, zinc), Nutrients (nitrogen, phosphorus), Organic compounds (COD, BOD), Bacteria and viruses. *Duranta erecta*'s phytoremediation efficiency is up to 90% removal of heavy metals, 80% removal of nutrients, 70% removal of organic compounds. Benefits of using *Duranta erecta* in phytoremediation include, Low maintenance and cost effective, High growth rate and adaptability, Aesthetic appeal, Potential for biofuel and fertilizer production.

Jatin Kumar, Megha Choudhary.et.al.,(2024), Recent advancements in utilizing plant-based approaches or water and waste water treatment technologies, highlights plant-based approaches have gained significant attention for water and wastewater treatment due to their eco-friendly, cost-effective, and sustainable nature. Phytoremediation, a process that utilizes plants to remove pollutants from water, has been extensively researched and applied in various wastewater treatment technologies. Advanced plant-based approaches, such as phytofiltration, phytostabilization, and phytoextraction, have shown promising results in removing a wide range of pollutants, including heavy metals, pesticides, and industrial contaminants. Additionally, plant-based biofiltration systems have been developed, which utilize plants and microorganisms to remove pollutants from water. Recent studies have also explored the potential of aquatic plants, such as water hyacinth and duckweed, for wastewater treatment. Furthermore, the integration of plant-based approaches with conventional wastewater treatment technologies has been shown to enhance treatment efficiency and reduce environmental impacts. However, despite these advancements, there is still a need for further research on the optimization of plant based approaches, their scalability, and their long-term sustainability.

III. METHODOLOGY

The methods adopted for the waste water treatment using aquatic and terrestrial plants includes:

1. Material collection
2. Initial water testing
3. Growing of terrestrial plants in hydroponics system using collected waste water
4. Growing of aquatic plants using collected waste water and final testing of water after 30 days of plant growth.

The experiment was designed to study the role of water hyacinth and basil plant in waste water treatment. The experiment was conducted by collecting waste water from Poonthura coastal region Thiruvananthapuram Kerala. Water was collected from Moonnattumukku area in Poonthura, the junction where Parvathyputhanaar and Karamana river merges. Then water was transferred to a hydroponic medium for the growing of basil plant. The experiment lasted for 30 days arranged under three factor factorial arrangement (time, plant species and waste water treatment) for waste water analysis. Water sample was collected and sent for testing of the initial BOD, COD, TDS.

3.1 Water Hyacinth

It effectively changes the levels of COD, BOD, Turbidity and TDS in waste water^[1]. Water hyacinth can also help remove nitrates, phosphates, and ammonia from wastewater. Water hyacinth can remove up to 90% of nitrogen from wastewater. It can remove up to 60% of organic pollutants such as pesticides, herbicides, and industrial contaminants from wastewater. It can also remove up to 50% of bacterial and viral contaminants from wastewater.



Fig no 3.1: water hyacinth growth in tub

To start growing water hyacinth, take a large tub or container that's at least 12 inches deep and 24 inches wide. Clean the tub thoroughly and rinse it with dechlorinated water. Fill the tub with collected sample, leaving about 2-3 inches at the top. Water hyacinth was obtained from Akkulam lake Thiruvannathapuram. Then placed the water hyacinth plants on the surface of the water, spreading them out evenly. Water hyacinth prefers partial shade to full sun, so place the tub in a spot that receives indirect sunlight. Regularly checked the water level and added sample as needed to maintain the desired level. Also, regularly inspect the tub for signs of pests or diseases.

3.2 BASIL

It can effectively change the levels of BOD, COD, DO, TDS, Turbidity and pH in the waste water. Basil has been found to remove nitrates and phosphates from wastewater, which can help reduce eutrophication in water bodies. It can remove organic pollutants such as phenol and pesticides from wastewater. Basil has antimicrobial properties, which can help remove bacterial and fungal contaminants from wastewater.



Fig no 3.2: Basil grown in hydroponics tower

To start growing Basil plants on a hydroponics tower, begin by preparing the tower and its components. Ensured the tower is clean and free of any debris. Planted the mint seeds in the hydroponics tower's net pots or grow cups, filled with a soilless growing medium like coco coir. Spaced the seeds about 1-2 inches apart. Placed the net pots or grow cups into the tower's slots, ensuring they are securely held in place. Provided the basil plants with the necessary light. Ensured that hydroponics system is providing adequate oxygen and water circulation to the roots. Basil leaves reached 4-6 inches in height, within 2-3 weeks after planting.

III. PRELIMINARY ANALYSIS RESULT

Table 3.1: Preliminary Analysis result of sample

SL:NO	PARAMETERS	METHOD OF ANALYSIS	ACCEPTABLE LIMIT AS PER IS 10500-2012	RESULT	UNIT
1.	pH	IS 3025:1983	6.5 to 8.5	4.9	-
2.	Turbidity	IS 3025:1984	1	15.3	NTU
3.	Total Dissolved Solids	IS 3025:1984	500	530.0	mg/L
4.	BOD	IS 3025:1993	<3	105.0	mg/L
5.	COD	IS 3025:2006	250 to 500	680.0	mg/L
6.	DO	IS 3025:2003	6	4.0	mg/L
7.	Hardness	IS 3025:2003	200	507.5	mg/L
8.	color	IS 3025:2003	5	45.0	TCU
9.	E.coli	IS 15185:2016	Shall not be detected/100ml	Present	No.of E.coli/100ml

IV. RESULT AND DISSCUSSION

Table 4.1 :Test result of water hyacinth

SL NO:	PARAMETERS	ACCEPTABLE LIMIT AS PER IS 10500-2012	INITIAL RESULT	RESULT	UNIT
1.	pH	6.5 to 8.5	4.9	6.76	-
2.	Turbidity	1	15.3	13.32	NTU
3.	Total Dissolved Solids	500	530.0	355.1	mg/L
4.	BOD	<3	105.0	25.2	mg/L
5.	COD	250 to 500	680.0	270.3	mg/L
6.	DO	6	4.0	6.52	mg/L

7.	Hardness	200	507.5	284.2	mg/L
8.	Color	5	45.0	29.25	TCU
9.	E. coli	Shall not be detected/100ml	Present	present	No of E.coli/100ml

Table 4.2:Test result of Basil

SL NO:	PARAMETERS	ACCEPTABLE LIMIT AS PER 10500-2012	INITIAL RESULT	RESULT	UNIT
1.	pH	6.5 to 8.5	4.9	6.46	-
2.	Turbidity	1	15.3	14.97	NTU
3.	Total Dissolved Solids	500	530.0	469.58	mg/L
4.	BOD	<3	105.0	49.81	mg/L
5.	COD	250 to 500	680.0	360.4	mg/L
6.	DO	6	4.0	6.04	mg/L
7.	Hardness	200	507.5	340.02	mg/L
8.	Color	5	45.0	28.84	TCU
9.	E. coli	Shall no be present/100ml	Present	Absent	No of E.coli/100ml

4.1 VARIATION OF WATER HYACINTH AND BASIL WITH POLLUTED WATER SAMPLE

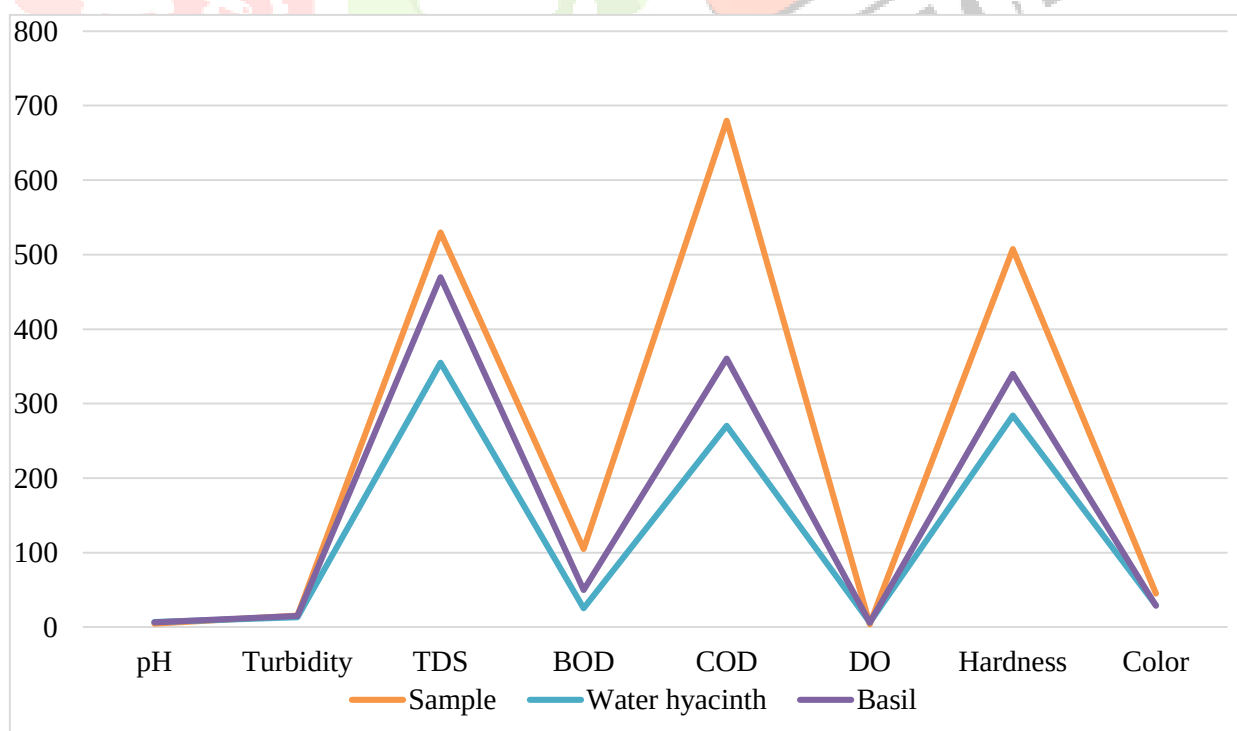


Fig no: 4.1 Graphical representation of result

The vertical axis represents the measurement value of each parameter. The horizontal axis lists the different parameters being compared. The change in level of parameters in the raw sample and the treated water is shown in comparison. There is a considerable decrease in each parameters compared to the raw sample and water treated using both water hyacinth and basil plant. Comparatively higher decrease in BOD by 76%, COD by 60.25%, DO is increased by 63% and higher decrease in other parameters are observed in water treated using aquatic plant water hyacinth.

V. CONCLUSION

- This study examines a fresh approach to water purification that requires less energy, labour, and financial resources.
- The comparative study on the ability of aquatic and terrestrial plants in purifying wastewater revealed that both types of plants have significant potential in removing pollutants from wastewater.
- The study also highlighted the importance of selecting the right type of plant for wastewater treatment, depending on the type and characteristics of the wastewater.
- Water hyacinth were found to be more effective in removing pollutants from wastewater with high levels of BOD and COD, while terrestrial plants were more effective in removing pollutants from wastewater with high levels of E.Coli and colour.
- The use of plants for wastewater treatment also provides additional benefits such as aesthetic value, habitat creation, and carbon sequestration.
- As per standards of water, this treated water can be used for irrigation purpose and cleaning purpose.

VI. REFERENCES

- [1].**Andrea Monro Lichy, Liliana Carranza-Lopez, Parra-Guerra, Rosa Acevedo Barrios.**, (2024), Unlocking the potential of Eichhornia crassipes for wastewater treatment: phytoremediation of aquatic pollutants, a strategy for advancing Sustainable Development Goal-06 clean water, ELSEVIER, <http://dx.doi.org/10.1007/s11356-024-33698-9>
- [2].**Akshay Kushawahaa, Divya Shaha, Deepali Voraa, Nilima Zade, Kamatchi Iyer.**, (2024), Urban small-scale hydroponics: A compact, smart home-based hydroponics system, ELSEVIER, <https://doi.org/10.1016/j.mex.2024.102998>
- [3].**Rita, Dwi Ratnani, Forita Dyah, Arianti, Nugroho Adi Sasongko.**, (2024), Exploring the potential of water hyacinth weed (Pontederia crassipes) as an environmentally friendly antifungal to realize sustainable development in lakes: A review, ELSEVIER, Volume 9 100702, <https://doi.org/10.1016/j.cscee.2024.100702>
- [4].**Abebe Worku, Solomon Tibebe, Estifanos Kas sahun.**, (2024), Phytoremediation potential of Duranta erecta in cascade hydroponics for effective domestic wastewater treatment, Results in Engineering, ELSEVIER, Vol 3 <https://doi.org/10.1016/j.rineng.2024.102837>
- [5].**Jatin Kumar, Megha Choudhary, Pritam Kumar Dikshit, Sanjay Kumar.**, (2024), Recent advancements in utilizing plant-based approaches for water and wastewater treatment technologies, cleaner water, ELSEVIER, Vol 2 100030, <https://doi.org/10.1016/j.clwat.2024.100030>