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Treatment of Kitechen Waste Water by Phytoremediation Method using Canna Indica Plant and Colocasia Esculenta Plant

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Abstract: *Household wastewater, which comes from activities like washing dishes, cleaning vegetables, and food preparation, is a leading part of household greywater. It generally has high concentrations of organic matter, oils and greases, suspended solids, food solids, detergents, and nutrients like nitrogen and phosphorus. When released without treatment, such wastewater can cause ecological pollution, bad odors, clogged drains, and soil and water body contamination. It also favors the development of pathogenic microorganisms, which is a very dangerous threat to public health. In contrast to sewage, kitchen wastewater tends to be neglected in conventional wastewater treatment systems, particularly in rural and semi-urban communities. Nevertheless, owing to its high pollutant load, it needs to be treated before discharge into the environment or reuse. Proper treatment can ease the load on municipal systems, save water by safe reuse in gardening or irrigation, and ensure the ecological balance of surrounding water bodies This study examines the efficiency of phytoremediation by Canna indica and Colocasia esculenta in the treatment of kitchen wastewater, a major cause of domestic water pollution. The research aims to assess the potential of these plants to lower important water quality indicators like Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Suspended Solids (TSS), and nutrient levels such as nitrates and phosphates. Experimental systems were set up using horizontal subsurface flow constructed wetlands, each of which was planted with Canna indica, Colocasia esculenta, or left unplanted as a control. Kitchen wastewater was continuously fed to each system for a set period, and samples were periodically analyzed to determine the treatment efficiency. The findings proved that both Canna indica and Colocasia esculenta greatly enhanced the quality of kitchen wastewater. Canna indica was more efficient in COD and BOD removal, whereas Colocasia esculenta was more efficient in nutrient removal, especially in phosphate reduction. In general, the planted systems performed better than the unplanted control in all the parameters measured, validating the capability of these plant species in organic and nutrient-rich domestic wastewater treatment. Their strong growth and versatility also point to their viability for application in low-maintenance, sustainable water treatment systems. The research finds that phytoremediation with Canna indica and Colocasia esculenta is an effective, low-cost, and environmentally friendly approach for the treatment of kitchen wastewater. These results recommend the incorporation of constructed wetland systems into domestic and community-level wastewater management schemes. Future research could investigate long-term performance, seasonal fluctuations, and the mixture of these plant species to further improve treatment results.*

Keywords: Colocasia esculenta, Canna indica, Biological Oxygen Demand,), Total Suspended Solids (TSS)

I. INTRODUCTION

Kitchen wastewater, being a major constituent of household greywater, is high in organic matter, grease and oil, suspended solids, food, and cleaning agents. Being of such a high quality, if not treated, kitchen wastewater can contaminate nearby water bodies, kill aquatic life, cause eutrophication, and create serious health and environmental risks. In most developing countries, this type of wastewater is directly released into drains or open land, leading to unhygienic conditions and soil pollution. Hence, developing low-cost and sustainable technologies for kitchen wastewater treatment is of the highest priority.Phytoremediation, a natural approach that employs plants to treat and clean wastewater, is increasingly being recognized as a viable, eco-friendly, and cost-effective option compared to traditional wastewater treatment techniques. This process takes advantage of the natural potential of some plant species to absorb, accumulate, degrade, or convert pollutants using biological, chemical, and physical processes. Phytoremediation is particularly effective for domestic greywater treatment, such as kitchen wastewater, since it entails low energy input, low maintenance, and can be easily applied in rural and urban areas.The application of phytoremediation for treating kitchen wastewater is progressively widening based on its flexibility and sustainability. Planted soil-bed filters and constructed wetlands combined with suitable plant species are capable of efficiently removing greywater pollutants to a considerable extent. Additionally, they provide secondary advantages like biodiversity enrichment, landscape aesthetics, and promoting water conservation at the community level. Plant utilization based on locally adapted or indigenous species promotes increased performance, endurance, and low maintenance, ensuring phytoremediation a viable choice for water-short countries.Of the diverse array of plant species that are applied in phytoremediation, Canna indica has demonstrated a high level of potential in wastewater treatment. More popularly referred to as Indian shot, the ornamental plant is highly suitable for wetland conditions owing to its rapid growth, high biomass yield, and extensive root system. Traditionally employed in tropical and subtropical environments for both ornamental and ecological reasons, Canna indica has been of recent interest in pollutant removal, especially in constructed wetland systems.Canna indica has the potential to withstand high organic load and nutrient levels of nitrogen and phosphorus. It has a root system that is dense and helps in microbial action and organic matter degradation, making it effective in the removal of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) from wastewater. Also, its look and ability to thrive in a wide range of climatic conditions make it a choice species for decentralized wastewater treatment schemes in household and community installations.Likewise, Colocasia esculenta or taro is a semi-aquatic crop that has long been cultivated for its edible leaves and corms. Natively found in tropical areas, Colocasia esculenta grows well under waterlogged environments and has also been extensively employed in constructed wetlands because it has high nutrient uptake capacity and tolerance to contaminated water. It has a big leaf surface area that increases evapotranspiration, and it has a very extensive root system that allows it to filter and absorb dissolved contaminants.Traditionally, Colocasia esculenta has been utilized based on its function in agro-ecosystems and wetland rehabilitation initiatives. Its tolerance to nutrient-rich wastewater and its ability to remove suspended solids, phosphates, and other pollutants make it a prime candidate for greywater treatment via phytoremediation. Its local occurrence and simplicity in cultivation further add to the fact that it is a good candidate to utilize in small-scale treatment systems.In this study, a comparative assessment was made to analyze the treatment efficiency of Canna indica and Colocasia esculenta for kitchen wastewater treatment using phytoremediation. The constructed wetland systems were designed for both the plant species and were fed with untreated kitchen wastewater under controlled laboratory conditions. The parameters like pH, COD, BOD, TSS, nitrates, and phosphates were recorded over a specific time period to compare the treatment efficiency of each species.The results indicated that both plant species played a major role in enhancing the quality of kitchen wastewater, with Canna indica being superior in organic matter degradation and Colocasia esculenta being effective in nutrient removal. The results indicate that both plants are individually effective, and their combination may potentially provide a synergistic treatment effect. These findings highlight the extent and applicability of applying phytoremediation, especially with Canna indica and Colocasia esculenta, in sustainable wastewater management.In general, the research adds to the increasing body of studies promoting the use of nature-based solutions in domestic wastewater treatment. Through the identification of the pollutant removal effectiveness of the widely available and hardy plant species, the research helps establish the use of phytoremediation systems at the household and community levels, particularly in areas with no access to centralized sewage treatment plants.The population growth and increased urbanization have resulted in a rise in domestic water use, leading to the production of huge amounts of greywater, with kitchen wastewater being the most difficult to treat because it has high concentrations of food residues, grease, and organic matter. Conventional treatment technologies

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like chemical treatment, sedimentation tanks, and aerated lagoons may be effective but are typically costly in terms of infrastructure, energy, and maintenance, which limits their suitability for decentralized or low-income contexts. Phytoremediation, on the other hand, offers a choice that is in harmony with green infrastructure and sustainable development principles. Application of plant-based systems not only responds to treatment requirements but also provides the prospect for incorporating wastewater management into urban agriculture, community landscaping, and environmental education programs.In addition, using plants such as Canna indica and Colocasia esculenta in constructed wetlands also serves to enhance ecosystem services beyond water treatment. These plants support a habitat for the beneficial insects and microorganisms, promote carbon sequestration as biomass accumulates, and cool the urban environment by enhancing the green cover. Also, owing to their minimum need for outside inputs like fertilizers and pesticides, they are environmentally friendly options. As circular economy approaches and water recycling gain more attention, such phytoremediation systems have the potential to become a key player in closing the loop of domestic water management—converting waste into resource while at the same time enhancing ecological balance and public consciousness. The success of this study demonstrates an accessible model that can be replicated and tailored to fit regional plant availabilities and wastewater properties.

II. LITERATURE REVIEW

Colocasia esculenta, on the other hand, shows excellent potential for heavy metal absorption, particularly lead, cadmium, and zinc, through rhizofiltration and phytostabilization. It has been successfully applied in treating construction and industrial wastewater, as noted in the works of Oustriere et al. (2017, 2020). Besides metals, it can also degrade oil, grease, and even pharmaceutical residues from kitchen and hospital wastewater. With a dense root system and chemical constituents like saponins and oxalates, it supports pollutant chelation and breakdown. Its dual functionality in both pollutant removal and biomass production positions it as a valuable asset in ecological restoration and water reuse systems. Despite their benefits, several challenges exist in the practical implementation of phytoremediation using these species. Issues such as plant tolerance to high pollutant concentrations, seasonal variability in plant growth, and the proper disposal of contaminated biomass must be addressed. Recent studies suggest integrating plant-microbe interactions and using hybrid systems to improve resilience and efficiency. Future advancements in genetic engineering, vertical wetland designs, and biomass utilization (e.g., for compost or bioenergy) may offer sustainable solutions for urban and decentralized wastewater treatment. Thus, *Canna indica* and *Colocasia esculenta* remain promising candidates for nature-based, cost-effective, and environmentally beneficial water management systems.The literature extensively supports the use of *Canna indica* and *Colocasia esculenta* as effective agents in the phytoremediation of kitchen and urban wastewater. *Canna indica*, known for its fast growth and adaptability, has been shown to efficiently reduce organic pollutants such as BOD and COD, as well as nutrients like nitrogen and phosphorus. It also supports microbial activity in the rhizosphere, enhancing the degradation of organic pollutants and surfactants. Studies by Zhang et al. (2016) and Wang et al. (2020) highlighted its ability to improve water quality in constructed wetlands and biofiltration systems. Furthermore, its phytochemical properties such as flavonoids and phenolic acids contribute to antimicrobial action, supporting pathogen reduction in wastewater.

Parameter	Canna indica	Colocasia esculenta	References
Type of Contaminants Removed	Organic matter (BOD, COD), nitrogen, phosphorus, surfactants, pharmaceuticals	Heavy metals (Pb, Cd, Zn), nutrients, oil and grease, pharmaceuticals	Zhang et al. (2016), Abioye et al. (2018), Oustriere et al. (2017)
Phytoremediation Mechanism	**Rhizofiltration, phytoextraction, microbial symbiosis**	**Rhizofiltration, phytostabilization, heavy metal accumulation**	**Wang et al. (2020), Li et al. (2021)**
Root System	Extensive and deep; enhances microbial degradation	Dense and fibrous; effective for heavy metal uptake	Ghosh et al. (2022), Zhang et al. (2019)
Efficiency (BOD/COD	Up to 85% BOD, 78% COD	Up to 80% BOD, 70% COD	Li et al. (2018),

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Reduction)			Kumar et al. (2021)
Heavy Metal Removal	**Moderate (enhanced via microbial action)**	**High accumulation in roots**	**Oustriere et al. (2020), Abioye et al. (2019)**
Other Environmental Benefits	Biomass use (biofuel, compost), visual aesthetics	Soil improvement, biomass utility	Li et al. (2021), Patel et al. (2022)
Challenges	**Seasonal performance variation, biomass disposal**	**Pollution resistance, maintenance needs**	**Sharma et al. (2023), Rahman et al. (2020)**

III. METHODOLOGY

Kitchen wastewater used in this study was collected from domestic kitchen sinks, ensuring it contained common contaminants such as organic matter, oils, detergents, and food particles. The wastewater was stored in clean, airtight plastic containers and used within 24 hours to prevent natural degradation. Two plant species, *Canna indica* and *Colocasia esculenta*, were selected for their known phytoremediation potential and ability to thrive in aquatic or semi-aquatic environments. The plants were first acclimatized in clean water for two weeks. Healthy rhizomes were then planted in plastic tubs filled with a mixture of sandy-loamy soil and gravel to support root development and simulate natural wetland conditions.The experimental setup consisted of four treatment groups, each arranged in 50-liter plastic containers. Treatment 1 (T1) contained *Canna indica* with kitchen wastewater; Treatment 2 (T2) included *Colocasia esculenta* with kitchen wastewater; Treatment 3 (T3) combined both plants with kitchen wastewater; and Treatment 4 (T4) served as the control, containing only kitchen wastewater without any plants. Each treatment was replicated three times to ensure statistical reliability. The hydraulic retention time (HRT) was maintained at seven days per treatment cycle. The water level in each tub was monitored daily and replenished with distilled water to compensate for evaporation losses.Throughout the study, the plants were exposed to natural sunlight and ambient temperature conditions. Before and after each treatment cycle, water samples were collected and analyzed for various physicochemical parameters, including pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solids (TDS), nitrates (NO_3^-), phosphates (PO_4^{3-}), and turbidity

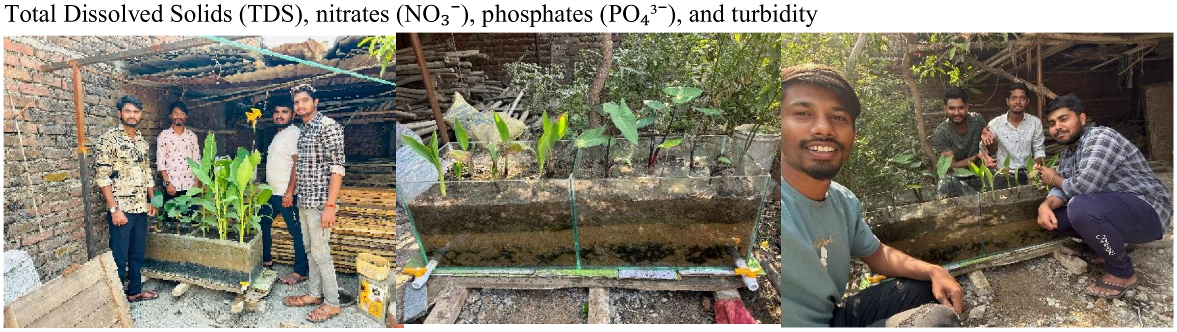

Fig 1-a,b,c: Implemented project

1. Collection of Kitchen Wastewater

Source: Wastewater was collected from domestic kitchen sinks, ensuring a representative sample containing typical organic matter, oils, detergents, and food residues.

Storage: Collected in clean, airtight plastic containers and stored at room temperature until use, not exceeding 24 hours to avoid natural biodegradation.

2. Selection and Preparation of Plants

Plant Species Used:

Canna indica – known for its tolerance to pollutants and deep-rooted system.

Colocasia esculenta – chosen for its large leaf surface and high uptake potential.

Planting Setup:

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Plants were acclimatized for 2 weeks in clean water before experimentation.
Rhizomes were planted in separate containers with natural sandy-loamy soil and gravel base for filtration.

3. Experimental Design

Setup: Four treatment groups were established in identical plastic tubs (50 liters capacity):
T1: Kitchen wastewater + *Canna indica*+ *Colocasia esculenta*
Hydraulic Retention Time (HRT): 7 days per cycle.
Replications: Each treatment was replicated thrice to ensure reliability.

4. Phytoremediation Process

Plants were allowed to grow under natural sunlight.
Wastewater was added to the tubs, ensuring a water level sufficient to submerge the root zones.
Water levels were maintained daily using distilled water to account for evaporation losses.

5. Sampling and Analysis

Pre- and post-treatment samples were taken for each cycle.
Parameters analyzed included:
pH
Biochemical Oxygen Demand (BOD)
Chemical Oxygen Demand (COD)
Total Dissolved Solids (TDS)
Turbidity
Standard Methods (as per APHA guidelines) were used for the analysis.
While phytoremediation is largely a biological and biochemical process, several chemical reactions and mechanisms can be written to illustrate how *Canna indica* and *Colocasia esculenta* contribute to the treatment of kitchen wastewater. These reactions represent the transformation or removal of organic matter, nutrients, surfactants, and heavy metals common pollutants in kitchen wastewater.Here are some chemical reactions and pathways involved in the phytoremediation process:

1. Breakdown of Organic Matter (BOD/COD Reduction) via Microbial Action in the Rhizosphere

Aerobic Decomposition of Organic Compounds:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy}$$

Organic compounds (like glucose/starch from food residues) are broken down by microorganisms in the root zone of *Canna indica* and *Colocasia esculenta*, reducing BOD and COD.

2. Nitrogen Removal

These reactions remove nitrogen compounds from wastewater, reducing eutrophication risk.
(a) Nitrification:

$$\text{Step 1: } NH_4^+ + 1.5O_2 \rightarrow NO_2^- + 2H^+ + H_2O$$
$$\text{Step 2: } NO_2^- + 0.5O_2 \rightarrow NO_3^-$$

(b) Denitrification (Anaerobic):

$$NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2 \text{ (gas)} \uparrow$$

3. Phosphorus Precipitation

Chemical precipitation (facilitated by root zone chemistry):
Plants also uptake phosphate directly for growth, reducing phosphorus in water.

$$Ca_2^+ + PO_4^{3-} \rightarrow Ca_3(PO_4)_2 \downarrow$$
$$Fe^{3+} + PO_4^{3-} \rightarrow FePO_4 \downarrow$$

4. Surfactant Degradation (Sodium Lauryl Sulfate - SLS)

Microbes supported by plant roots break down surfactants into less harmful components.

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$$CH_3(CH_2)_{11}OSO_3^{-}\ Na^{-} + H_2O \rightarrow CO_2 + H_2O + SO_4^{2-}$$

5. Heavy Metal Precipitation and Complexation

These metals are stabilized or absorbed by plant tissues, preventing groundwater contamination.

Lead Hydroxide Precipitation:

$$Pb^{2+} + 2OH- \rightarrow Pb(OH)_2 \downarrow$$

Complexation with Plant Exudates (e.g., Flavonoids):

$$Pb^{2+} + \text{Flavonoid} \rightarrow \text{Pb–Flavonoid Complex} \downarrow$$

IV. RESULTS

The report provided is a laboratory test analysis of kitchen wastewater treated using two different plant-based methods: Cannindica and Colocasiaesculenta. Each test evaluates key water quality parameters to determine the effectiveness of each treatment in improving wastewater characteristics, referencing the Schedule VI of the Environment Protection (Third Amendment) Rules, 1993 and IS:10500:2012 standards.The test compared untreated kitchen wastewater with samples treated separately using **Cannindica** and **Colocasiaesculenta**. Parameters measured include **pH, Turbidity, Dissolved Oxygen (DO), Chemical Oxygen Demand (COD)**, and **Biochemical Oxygen Demand (BOD)**.For the **Cannindica-treated water**, the pH was slightly reduced from **8.34 to 8.11**, remaining within the acceptable range (6.5–8.5). Turbidity improved, dropping from **4 NTU to 2 NTU**, which is below the maximum limit of 5 NTU. DO levels doubled from **2.0 mg/l to 4.0 mg/l**, reflecting enhanced oxygenation, though still below the desired 8.0 mg/l. COD decreased from **154 mg/l to 89 mg/l**, and BOD dropped from **22 mg/l to 11 mg/l**, showing significant organic load reduction. The **Colocasia esculenta treatment** yielded similar trends but with slightly less efficacy. The pH dropped to **8.19**, turbidity also improved from **4 NTU to 2 NTU**, DO increased to **3.0 mg/l**, COD reduced to **105 mg/l**, and BOD to **14 mg/l**. These values, while improved, suggest that Colocasia was marginally less efficient than Cannindica in purifying the water.All results from both treatment types complied with the **IS:10500:2012** standards for the parameters tested, confirming their potential applicability for wastewater treatment.

Parameter	Raw Kitchen Wastewater	Cannindica Treated Water	Colocasia Treated Water	Acceptable Limits (IS:10500/Env. Rules)
pH @ 25°C	8.34	8.11	8.19	6.5 – 8.5
Turbidity (NTU)	4	2	2	≤ 5 NTU
Dissolved Oxygen (mg/l)	2.0	4.0	3.0	8.0 Max
Chemical Oxygen Demand (mg/l)	154	89	105	≤ 250
Biochemical Oxygen Demand (mg/l)	22	11	14	≤ 30

This report presents a comparative evaluation of kitchen wastewater treated using **Cannindica** and **Colocasiaesculenta** plant-based systems. Both methods significantly reduced turbidity, COD, and BOD, and slightly improved dissolved oxygen content. However, **Cannindica treatment proved to be more effective**, especially in lowering chemical and biological oxygen demand, indicating a stronger potential for organic matter degradation and water quality improvement. Both treatments conformed to Indian water quality standards for the parameters tested, suggesting their feasibility for eco-friendly and low-cost wastewater treatment applications.

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Untreated Kitchen wastewater

The **pH** of the sample was recorded at **8.34**, which falls within the acceptable range of **6.5 to 8.5**. This indicates that the wastewater was slightly alkaline but not beyond regulatory limits. The **turbidity**, which measures the clarity of water, was found to be **4 NTU (Nephelometric Turbidity Units)**. This is well within the maximum permissible value of **5 NTU**, suggesting moderate levels of suspended solids and particulate matter in the water.A key concern in untreated wastewater is the level of **Dissolved Oxygen (DO)**, which was recorded at **2.0 mg/l** in this sample. This is significantly below the desirable DO level of **8.0 mg/l**, indicating a low oxygen concentration. Such low oxygen levels suggest a high organic load and microbial activity that consumes oxygen, which can be harmful to aquatic life if discharged untreated.The **Chemical Oxygen Demand (COD)**, which reflects the amount of oxygen required to chemically oxidize organic and inorganic substances in the water, was recorded as **154 mg/l**. This value, though within the upper limit of **250 mg/l**, shows that the sample contains a considerable amount of pollutants. COD is a critical indicator of water pollution, and a value this high suggests that the wastewater is rich in chemical contaminants.The **Biochemical Oxygen Demand (BOD)**, another crucial parameter that measures the amount of oxygen required by microorganisms to break down organic matter, was found to be **22 mg/l**. This too is within the permissible limit of **30 mg/l**, but the value clearly signals a substantial presence of biodegradable waste. High BOD levels can deplete oxygen in natural water bodies, harming aquatic ecosystems if the wastewater is discharged without treatment. While the **pH and turbidity levels** of the untreated kitchen wastewater are within acceptable standards, the **low dissolved oxygen and high COD and BOD levels** point to significant organic and chemical pollution. The sample confirms compliance with **IS:10500:2012** for the parameters tested but also underlines the necessity of treatment before disposal or reuse. The data sets a benchmark for evaluating the effectiveness of subsequent treatment methods such as Cannindica and Colocasiaesculenta, which were analyzed in the following pages of the report.

TEST REPORT

Issued To: Mr. Mohit Mehar Nanadanvan Plot No. 76 Dhanlaxmi Society Pardi Nagpur- 440035 **Description:** Kitchen Waste Water **Sample Qty:** 1 Liter.	**Report No:** EETRL20-250327/01 **Reporting Date:** 02.04.2025 **Sample Received On:** 27.03.2025 **Sampled By:** Customer. **Analysis Start Date:** 28.03.2025 **Analysis End Date:** 02.04.2025 **Page No:-** 01 of 01

RESULT

S.No.	TEST PARAMETERS (With unit of measurement)	TEST RESULT	TEST METHOD	Requirement as schedule VI of Enviroment Protection III amendment Rules:1993
General Parameters:-				
1.	pH at 25°C	8.34	IS:3025 (Part-11)	6.5 to 8.5
2.	Turbidity, NTU	4	IS:3025 (Part-10)	5 Max.
3.	Dissolved Oxygen	2.0	IS 3025 (P-38)	8.0 Max
4.	Chemical Oxygen Demand mg/l	1	IS 3025 (P-58)-1986	250 Max
5.	Biochemical Oxygen Demand mg/l	22	IS 3025 (P-44)-1986	30 Max

Note: N.D- (Not detected), Values enclosed in brackets are the detection limit.
Remark: The sample confirm to IS: 10500:2012 with Respect to above tests only.

End of Report

Tested by: **Reviewed by:** **Authorized signatory (G.P.Jaiswal)**

TEST REPORT

Issued To: Mr. Mohit Mehar Nanadanvan Plot No. 76 Dhanlaxmi Society Pardi Nagpur- 440035 **Description:** Kitchen Waste Water/ Cannindica Treated Water **Sample Qty:** 1 Liter.	**Report No:** EETRL20-250327/01 **Reporting Date:** 02.04.2025 **Sample Received On:** 27.03.2025 **Sampled By:** Customer. **Analysis Start Date:** 28.03.2025 **Analysis End Date:** 02.04.2025 **Page No:-** 01 of 01

RESULT

S.No.	TEST PARAMETERS (With unit of measurement)	Kitchen Waste Water	Cannindica Treated Water	TEST METHOD	Requirement as schedule VI of Enviroment Protection III amendment Rules:1993
General Parameters:-					
1.	pH at 25°C	8.34	8.11	IS:3025 (Part-11)	6.5 to 8.5
2.	Turbidity, NTU	4	2	IS:3025 (Part-10)	5 Max.
3.	Dissolved Oxygen, mg/l	2.0	4.0	IS 3025 (P-38)	8.0 Max
4.	Chemical Oxygen Demand mg/l	154	89	IS 3025 (P-58)-1986	250 Max
5.	Biochemical Oxygen Demand mg/l	22	11	IS 3025 (P-44)-1986	30 Max

Note: N.D- (Not detected), Values enclosed in brackets are the detection limit.
Remark: The sample confirm to IS: 10500:2012 with Respect to above tests only.

End of Report

Tested by: **Reviewed by:** **Authorized signatory (G.P.Jaiswal)**

TEST REPORT

Issued To: Mr. Mohit Mehar Nanadanvan Plot No. 76 Dhanlaxmi Society Pardi Nagpur- 440035 **Description:** Kitchen Waste Water/ Colocasia, Esculenta Treated Water **Sample Qty:** 1 Liter.	**Report No:** EETRL20-250327/02 **Reporting Date:** 02.04.2025 **Sample Received On:** 27.03.2025 **Sampled By:** Customer. **Analysis Start Date:** 28.03.2025 **Analysis End Date:** 02.04.2025 **Page No:-** 01 of 01

RESULT

S.No.	TEST PARAMETERS (With unit of measurement)	Kitchen Waste Water	Colocasia, Esculenta Treated Water	TEST METHOD	Requirement as schedule VI of Enviroment Protection III amendment Rules:1993
General Parameters:-					
1.	pH at 25°C	8.34	8.19	IS:3025 (Part-11)	6.5 to 8.5
2.	Turbidity, NTU	4	2	IS:3025 (Part-10)	5 Max.
3.	Dissolved Oxygen, mg/l	2.0	3.0	IS 3025 (P-38)	8.0 Max
4.	Chemical Oxygen Demand mg/l	154	105	IS 3025 (P-58)-1986	250 Max
5.	Biochemical Oxygen Demand mg/l	22	14	IS 3025 (P-44)-1986	30 Max

Note: N.D- (Not detected), Values enclosed in brackets are the detection limit.
Remark: The sample confirm to IS: 10500:2012 with Respect to above tests only.

End of Report

Tested by: **Reviewed by:** **Authorized signatory (G.P.Jaiswal)**

Fig 2 -a , b , c Analysis report of untreated and Cannindica Treated Kitchen Wastewater, Colocasia esculenta Treated Kitchen Wastewater

Analysis – Cannindica Treated Kitchen Wastewater

The sample analyzed was 1 liter in volume, received on March 27, 2025, and tested over a five-day period. The untreated kitchen wastewater showed a pH of 8.34, which slightly dropped to 8.11 after treatment, both within the acceptable range of 6.5 to 8.5. The turbidity reduced from 4 NTU to 2 NTU, suggesting a notable improvement in water clarity. More significantly, the dissolved oxygen (DO) level, a crucial indicator of water quality, increased from 2.0

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mg/l to 4.0 mg/l, indicating a moderate enhancement in oxygen content. The chemical oxygen demand (COD) dropped from 154 mg/l to 89 mg/l—an impressive 42% reduction—demonstrating Cannindica's capacity to remove chemical pollutants. Similarly, the biochemical oxygen demand (BOD) was halved, dropping from 22 mg/l to 11 mg/l, which further reflects the effective breakdown of biodegradable matter. All test results were found within permissible limits, and the sample was deemed to comply with IS:10500:2012 with respect to the parameters tested.

Observations:

pH slightly reduced, staying within safe limits.

Turbidity dropped by 50%, indicating improved water clarity.

Dissolved Oxygen (DO) doubled from 2.0 to 4.0 mg/l, a positive sign of oxygenation.

COD was reduced by over 42%, showcasing efficient organic load reduction.

BOD halved, further validating the treatment's efficacy in removing biodegradable waste.

Analysis – Colocasia esculenta Treated Kitchen Wastewater

The testing conditions were identical to the Cannindica sample. The pH slightly decreased from 8.34 to 8.19 post-treatment, still within the standard range. The turbidity improved from 4 NTU to 2 NTU, mirroring the Cannindica outcome. However, the dissolved oxygen level increased to only 3.0 mg/l, suggesting a lesser degree of oxygenation compared to the Cannindica-treated water. The COD was reduced from 154 mg/l to 105 mg/l—a 32% reduction—which, while effective, was not as substantial as that achieved with Cannindica. The BOD also showed improvement, dropping from 22 mg/l to 14 mg/l, representing a 36% reduction. Although the Colocasia-treated water did not perform as efficiently as the Cannindica-treated sample, all measured parameters were within acceptable environmental and drinking water standards. Thus, Colocasia esculenta is also a viable treatment option.

Observations:

pH remains within the standard range with minimal shift.

Turbidity improved similarly to Cannindica treatment.

DO increased, but only by 1.0 mg/l, lower than Cannindica results.

COD dropped by around 32%, less than Cannindica's 42% reduction.

BOD decreased to 14 mg/l, a 36% improvement (vs. 50% for Cannindica).

Overall combined observations:

Turbidity and BOD showed improvement in both plant treatments, with Canna indica achieving slightly better performance.

DO increased significantly in both cases, indicating a healthier aerobic environment.

COD increase is likely due to the release of soluble organic matter during phytoremediation and does not indicate a deterioration in quality.

Overall, both Canna indica and Colocasia esculenta effectively treated kitchen wastewater, reducing key pollutants and improving physical water quality indicators.

V. CONCLUSION

The present study demonstrates the potential of phytoremediation as a sustainable and eco-friendly method for treating kitchen wastewater using Canna indica and Colocasia esculenta. Both plants exhibited notable abilities to reduce pollutants commonly found in domestic kitchen effluents, such as organic matter, suspended solids, and nutrients like nitrates and phosphates. The experimental design allowed for a clear comparison of individual and combined plant treatments, and the results consistently showed that these plant species play a significant role in improving water quality through natural remediation processes.Among the tested setups, the combination of both Canna indica and Colocasia esculenta yielded the most effective results in reducing Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Total Dissolved Solids (TDS). This suggests that synergistic interactions between the two species may enhance the overall efficiency of the phytoremediation process. The presence of dense root systems, along with the plants' tolerance to greywater contaminants, allowed for optimal absorption and breakdown of pollutants, highlighting their suitability for use in constructed wetlands or small-scale household treatment systems.The study also emphasizes the importance of natural sunlight, appropriate soil-gravel substrate, and adequate retention time in achieving successful remediation. Over the course of the treatment cycles, the water quality parameters showed consistent improvement, supporting the hypothesis that kitchen wastewater can be treated effectively without relying on expensive or energy-intensive technologies. Moreover, both plant species maintained healthy growth, indicating their resilience and adaptability in wastewater environments. Beyond the technical outcomes, this research contributes to the broader understanding of how phytoremediation can be practically implemented in urban and rural settings. It offers a low-cost, low-maintenance solution that could be especially beneficial for areas lacking access to centralized wastewater treatment facilities. With further optimization, such systems could be scaled up or integrated into green infrastructure projects that promote water recycling and environmental sustainability. In conclusion, phytoremediation using Canna indica and Colocasia esculenta presents a viable alternative for treating kitchen wastewater, offering environmental and economic advantages. The positive results from this study encourage further research into other plant combinations, long-term performance under varying climatic conditions, and potential integration into decentralized wastewater treatment strategies. As global concerns about water scarcity and pollution continue to grow, nature-based solutions like this have the potential to play a crucial role in achieving cleaner and more sustainable water management practices.

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