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Potential of Water Spinach (*Ipomea aquatica* Forsk.) as A Phytoremediator of Household Water Waste in Geger Arum

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ABSTRACT

Household waste is one of the significant sources of environmental pollution in various urban areas, including in the waters of Geger Arum Area, Bandung. The use of water spinach (Ipomea aquatica Forsk.) for phytoremediation of household waste is an environmentally friendly and potentially effective alternative. This research aims to investigate the potential of Ipomoea aquatica Forsk. in phytoremediation of household waste. The method employed is a Completely Randomized Design experiment by testing Ipomoea aquatica plants to improve the quality of household wastewater. Treatments given include dilution of waste by 25%, 50%, and 75%. Based on statistical tests, physical and chemical parameters have a significant effect on the quality of household liquid waste. The results showed that the most optimum treatment was the treatment with 50%. dilution. Thus, the application of phytoremediation using water spinach has the potential to be a solution to overcome pollution of household wastewaters.

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1. INTRODUCTION

Rapid population growth and urbanization in Bandung City (BPS, 2020) and the increasing amount of household waste (Saputra, *et al.,* 2023) have negatively impacted water quality and the surrounding environment. Household waste is a source of environmental pollution that requires serious and significant attention in various urban areas, including the Geger Arum Waters area of Bandung. Household waste pollution can cause various problems, such as declining water quality, damage to aquatic ecosystems, and potentially harm the health of humans and other organisms (Andriyanto, *et al.,* 2023).

A new, easier, more economical, and environmentally friendly waste management method known as phytoremediation is currently being developed (Sari, 2018). One plant that has the ability to phytoremediate household waste is *Ipomoea aquatica* Forsk., also known as water spinach. This aquatic plant is often found growing around wastewater drains located near residential areas. The use of water spinach as a phytoremediator for heavy metals in waste and wastewater treatment is a promising option (Najwa, *et al.,* 2023).

Water spinach is known for its rapid growth, smooth leaf surface, and ability to grow submerged in water, as well as long roots (Putri, *et al.,* 2024). These characteristics make water spinach an attractive candidate for use in phytoremediation of household waste. The use of water spinach for phytoremediation of household waste is an environmentally friendly and potentially effective alternative to reduce the impact of environmental pollution. This study aims to investigate the potential of *Ipomoea aquatica* Forsk. in phytoremediation of household waste and to analyze the potential effect of water spinach on improving water quality by measuring dissolved oxygen levels, water turbidity, pH, and temperature in the Geger Arum Waters, Bandung. Through this research, it is hoped that sustainable solutions can be found to reduce the negative impacts of household waste and improve the quality of the aquatic environment in the area.

2. METHODS

The sample used was wastewater taken from the waters of Geger Arum, Bandung **(Figure 1)**. The reactor used is a container containing household wastewater with 25%, 50%, 75% dilution treatment.

Figure 1. Waste waters of Geger Arum

This research was conducted in the Greenhouse, Botany, UPI. The tools used include DO meters to measure dissolved oxygen levels, TDS meters to measure dissolved solids, and pH meters and thermometers. The method used was a completely randomized design by testing *Ipomea aquatica* plants to improve the quality of household water waste.

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Procedures carried out before being given the treatment, water spinach was maintained on water growing media for one week to adapt. After that, the plants were grown in a container containing aquatic waste that was in accordance with the treatment. Plants were maintained for nine days and then tested for physical and chemical properties. The physical quality measured is temperature while the chemical quality measured includes pH, Dissolved Oxygen (DO), and Total Dissolved Solids (TDS) (Najwa, *et al.,* 2023).

Observations were made for three days at a time. The data obtained were statistically analyzed using the Normality and Homogeneity Test followed by the ANOVA test if normally distributed and homogeneous.

3. RESULTS AND DISCUSSION

3.1. Physical and Chemical Properties

Statistical tests were conducted to determine the effect of water spinach as a photoremediator on chemical and physical factors of wastewater. Based on the One-Way ANOVA test results for DO and TDS parameters, it was found that both parameters were significantly influenced by the water spinach phytoremediator. Likewise, the temperature and pH parameters tested using the Kruskal Walis test were significantly affected by the water spinach phytoremediator. Significant changes in pH, DO, and TDS indicate that water spinach can be influential in changing these aspects of water (Brown *et al.,* 2018; Li *et al.,* 2017; Smith *et al.,* 2019).

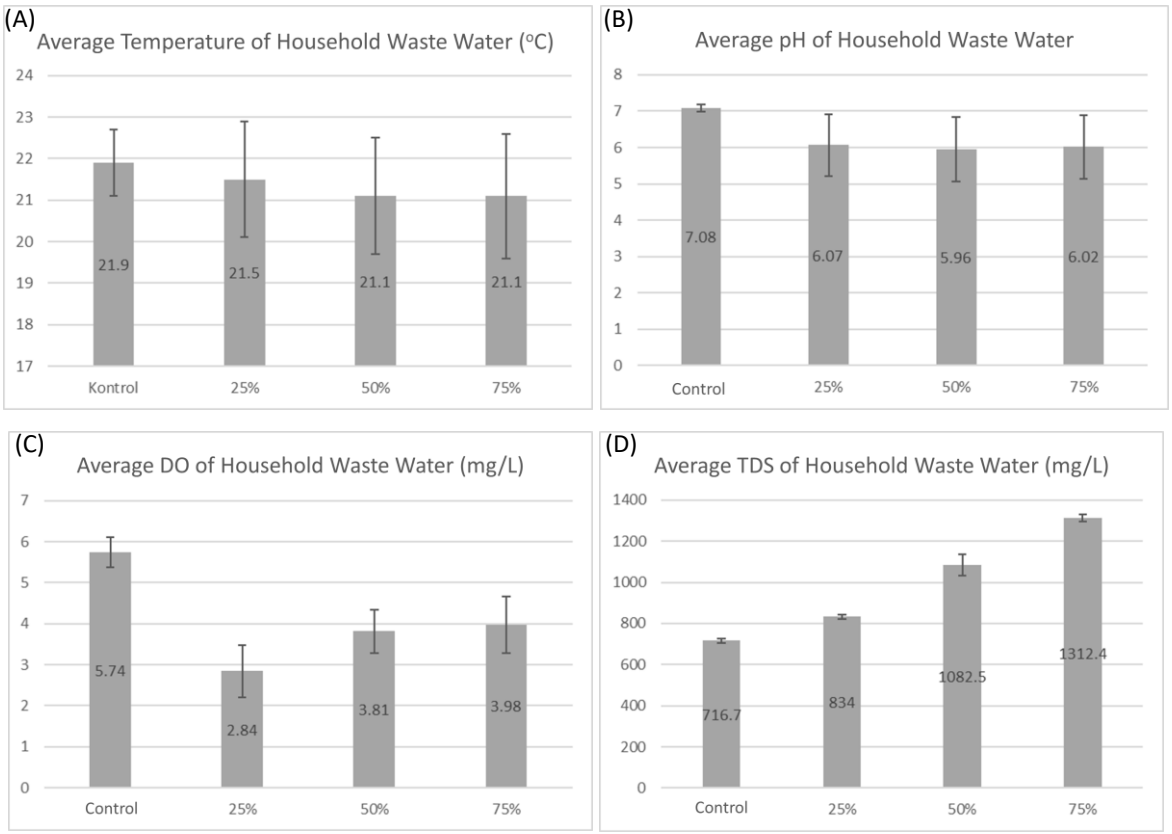

Figure 2. Average physico-chemical properties of Geger Arum household wastewater (A. Temperature, B. pH, C. DO, D. TDS)

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The water temperature in **Figure 2.A** tended to stabilize at around 21.9°C for both the control (clean water) and the variation of household water effluent dilution. The relatively constant temperature can be interpreted as an indication that water spinach is able to tolerate temperature changes caused by effluent dilution. This is in line with findings in a previous study (Smith et al., 2019), which showed that phytoremediator plants, including water spinach, are able to adapt to temperature fluctuations that occur in the domestic wastewater environment. Kale can affect the temperature of wastewater through the evaporation process that occurs on its leaves. This process can cause a decrease in water temperature. In addition, the plant can absorb heat through the roots, which can also contribute to a decrease in the ambient temperature of the plant (Fitriah, *et al.,* 2023).

Significant changes were seen in the pH parameter in **Figure 2.B**. Dilution of household water effluents caused a decrease in pH from 7.08 (control) to 5.96 (50% dilution). A significant decrease in pH can be explained by the ability of phytoremediator plants to absorb heavy metals that cause a decrease in pH. Water spinach can increase the pH of wastewater through the process of hydrogen ion (H+) absorption by plant roots. This process can cause an increase in pH in the soil substrate. A decrease in pH can indicate heavy metal accumulation in plants, which in turn can reduce heavy metal levels in effluents *(Suhar, et al., 2022)*.

Furthermore, the dissolved oxygen (DO) level in the water (**Figure 2.C**) showed a decreasing trend with increasing dilution of the effluent. The control had the highest DO value of 5.74 mg/L, while the 75% dilution showed the lowest value of 3.98 mg/L. Decreasing DO levels can be caused by oxygen consumption by microorganisms involved in the decomposition of organic matter in the effluent (Brown *et al.,* 2018). The photosynthesis process that occurs in water spinach leaves produces oxygen as a by-product. This oxygen is released into the water, increasing the DO concentration (Lamantia, 2024). These results show a negative impact on oxygen availability in the water, which can affect aquatic life.

Regarding the total dissolved solids (TDS) in **Figure 2.D**, there was a consistent increase as the dilution of the effluent increased. The control showed a TDS value of 716.7 ppm, while at 75% dilution, the value increased to 1312.4 ppm. The increase in TDS can be attributed to an increase in the concentration of heavy metals or dissolved organic compounds in the effluent (Hao, *et al.*, 2024). Kale can absorb and accumulate dissolved solids through its roots and plant tissues. This process can lead to a decrease in TDS concentration in wastewater (Nurhidayanti, *et al.*, 2021). This means that although kale can reduce some waste components, the increase in TDS can be an indicator of other solutes produced during phytoremediation.

4. CONCLUSION

In the observation of phytoremediation of household waste in the waters of Geger Arum Bandung using water spinach, it was concluded that this plant is effective in reducing pollutant levels in household wastewater. Based on the observation, it is known that the most optimal treatment is the treatment with 50% dilution. The application of phytoremediation using water spinach has the potential as a solution to overcome household wastewater

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pollution in the region. Further steps are needed to optimize phytoremediation efficiency and continuous monitoring to maintain environmental balance.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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