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Research article

Effectiveness of Kiambang Plants (*Salvania molesta*) in Reducing BOD (Biological Oxygendemand) Levels

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Abstract

Industry plays an important role in economic development, but its growth often has a negative impact on the environment. One industry that contributes to pollution is the tofu industry, which is mostly household-scale and not equipped with a wastewater treatment system. Tofu wastewater contains organic and inorganic materials that exceed environmental quality standards, such as BOD, COD, and TSS, which can pollute water bodies and cause health problems.. The BOD level based on secondary data from the Tofu Industry in Moyoretno Village, Matesih District, was 191.1 mg/L, this result exceeds the wastewater quality standard. Phytoremediation is a wastewater treatment method that utilizes aquatic plants to absorb, decompose, and stabilize pollutants in wastewater. The kiambang plant (*Salvinia molesta*) was chosen to have high hyperaccumulator ability and fast growth, so it is effective in reducing pollutant levels in wastewater. The purpose of this study was to determine the effectiveness of kiambang plants to reduce BOD levels in the Tofu Industry in Moyoretno Village, Matesih District. This type of research is a true experiment with a pretest-posttest with control research design. The location of the study was in the Tofu Industry in Moyoretno Village, Matesih District. Phytoremediation using 4 plants, 6 plants, 8 kiambang plants was carried out for 7 days in 15 liters of wastewater. The average results of the effectiveness of BOD levels after treatment were 40.45%; 61.41%; 73.13%. The statistical test used was One Way Annova. The results of the study showed that kiambang plants were effective in reducing BOD levels in wastewater with an effective dose of 8 plants (p-value 0.001). This method can be applied to small and medium industries to reduce environmental pollution due to the disposal of tofu waste that is not properly processed. This study is also expected to be the basis for further development in the application of phytoremediation technology in various other food processing industries.

Keywords: phytoremediation, *Salvinia molesta*, Biological Oxygen Demand, soybean curd wastewater.

1. Introduction

The industrial sector plays a crucial role in supporting regional development. Many countries consider industrialization an important step to ensure long-term economic renewal, stable and sustainable economic growth, which ultimately increases per capita income each year. The process of economic development that takes place over a long period of time can cause major changes in the economic aspects and environmental conditions of a country. Rapid growth of the industrial sector in a region can cause pollution in the surrounding environment. The majority of tofu businesses in Indonesia operate on a small household scale and do not have access to adequate wastewater treatment facilities, so untreated waste is discharged directly into nearby water sources or the surrounding environment (Kholisah et al., n.d.). Therefore, extensive measures are needed to reduce increasing pollution levels in order to ensure a sustainable and environmentally friendly ecosystem (Morin & Santi, 2020).

Liquid waste containing suspended solids or compounds capable of undergoing physical, chemical, and biological transformation can produce harmful substances or become a breeding ground for pathogenic microorganisms. This waste often turns dark brown and emits a foul odor, which can cause respiratory problems and other health issues. When discharged into rivers, untreated wastewater can contaminate water sources and increase the likelihood of waterborne diseases, including skin irritation, diarrhea, and nausea. Indicators such as BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), and other metrics are commonly used to assess the level of wastewater pollution. The high organic content in tofu wastewater has the potential to disrupt aquatic ecosystems if discharged without treatment, making effective wastewater management crucial to reducing environmental hazards. Without proper treatment, tofu waste can cause environmental pollution, become a source of disease, and damage aquatic ecosystems.

Increased demand for tofu has led to an increase in the volume of wastewater discharged into the environment. This wastewater is characterized by parameters such as pH, COD, BOD, and Total Suspended Solids (TSS). BOD refers to the amount of dissolved oxygen required by microorganisms, particularly bacteria, to break down organic compounds under aerobic conditions. BOD indicates the rate at which microorganisms consume oxygen when decomposing biodegradable organic matter (Pungus et al., 2019). Wastewater with high BOD concentrations cannot support aquatic life that depends on oxygen. High BOD levels deplete oxygen in the water, leading to anaerobic conditions (Bhutiani, 2019).

Phytoremediation is a method of utilizing aquatic plants to clean up or reduce pollution, such as heavy metals, pesticides, hazardous chemicals, and wastewater from landfills (Juhriah & Alam, 2016). Water hyacinth plants have the ability to absorb and remove harmful heavy metals (Rai & Singh, 2016). In addition, these plants are also effective in reducing the content of ammonia, fat, oil, nitrite, and nitrate, which often exceed the permissible limits in liquid waste standards (Kasman et al., 2018). According to (Faisal et al., 2016), tofu wastewater usually contains BOD levels ranging from 6,000 to 8,000 mg/l, COD levels between 7,500 and 14,000 mg/l, a pH value of 5–6, and a temperature ranging from 40°C to 46°C, all of which can have a negative impact on the environment. This pollution is mainly caused by liquid waste from tofu curds, commonly known as whey. Wastewater treatment can be carried out through physical, chemical, or biological methods. Phytoremediation is one feasible approach to treating tofu production wastewater.

Phytoremediation uses a combination of physical, chemical, and biological mechanisms to manage liquid waste, with this method known as a biological treatment technique. Phytoremediation relies on the ability of plants to stimulate or enhance microbial activity in the rhizosphere (phytostimulation), which facilitates the breakdown of pollutants in soil or water through root exudates (Wuran et al., 2018). Despite its many advantages, phytoremediation is still underutilized in industrial wastewater treatment due to the lack of effective implementation strategies (Shrestha et al., 2019). Various methods are available for wastewater treatment, but plants used in phytoremediation must have specific characteristics, including strong growth and development, high tolerance to pollutants, and strong absorption and accumulation capabilities for contaminants (Febriani & Hadiyanto, 2018).

Salvinia molesta (water fern) is a plant species suitable for phytoremediation. This plant was chosen for its ability to thrive in low-nutrient environments and its rapid reproduction rate, with growth occurring in less than three days. *Salvinia molesta* thrives in tropical and subtropical climates with favorable temperatures. This plant is commonly found in calm aquatic environments such as ponds, lakes, slow-flowing rivers, and canals (Pribadi & Zaman, 2016). The hyperaccumulation ability and rapid growth rate of water fern make it effective for treating organic and inorganic waste. *Salvinia molesta* shows a strong capacity to absorb inorganic contaminants while facilitating the decomposition of organic matter (Wuran et al., 2018).

Based on the challenges and data presented, this study aims to evaluate the efficiency of *Salvinia molesta* in reducing BOD levels and examine its growth rate in treating wastewater from the tofu industry in Moyoretno Village, Matesih District.

2. Research Methods

This study is classified as a true experiment because it uses a pretest-posttest design with a control group as a comparison. The study focuses on the entire population of tofu wastewater produced by households involved in tofu production in Moyoretno Village, Matesih District. Samples were taken from the wastewater disposal points of tofu-producing households in the area.

Sampling was conducted in the morning, with 15 liters of wastewater collected per bucket in 12 buckets, bringing the total sample volume to 180 liters. The sampling technique used was quota sampling, with samples obtained directly from the wastewater discharge channel. To ensure representative results and reduce the possibility of error, the experiment was repeated three times.

3. Results and Discussion

3.1 Univariat Analysis

3.1.1. pH

The results of pH measurements in the groups before and after treatment are presented in Table 1.

Table 1. pH test results before and after processing

Repetition	Control		Treatment					
			4 Kiambang		6 Kiambang		8 Kiambang	
	pre	post	pre	post	pre	post	pre	post
1	6	6	6	6	6	6	6	6
2	6	6	6	6	6	6	6	6
3	6	6	6	6	6	6	6	6
Total	18	18	18	18	18	18	18	18
Average	6	6	6	6	6	6	6	6

Table 1 shows that there was no decrease in pH value for the control and treatment groups. The pH level remained at 6 before treatment and consistently remained at 6 after treatment was applied.

3.1.2. Temperature

The table presents the results of temperature measurements taken before and after processing using the Kiambang plant in the treatment and control organizations.

Table 2. Results of temperature level checks before and after processing

Repetition	Control		Treatment					
			4 Kiambang		6 Kiambang		8 Kiambang	
	Pre (°C)	Post (°C)	Pre (°C)	Post (°C)	Pre (°C)	Post (°C)	Pre (°C)	Post (°C)
1	24	24	24	24	24	24	24	24
2	24	24	24	24	24	24	24	24
3	24	24	24	24	24	24	24	24
Total	72	72	72	72	72	72	72	72
Average	24	24	24	24	24	24	24	24

In Table 2, the temperature remained unchanged in the control and treatment groups during the experiment. Specifically, the temperature in the treatment group consistently remained at 24°C, showing no variation during the observation period.

3.1.3. Control

Results of BOD (Biological Oxygen Demand) measurements before and after treatment in the control group.

Table 3. Results of BOD level tests before and after treatment in the control group

Repetition	Control (mg/l)		Difference (mg/l)	Reduction in BOD Levels (%)
	Pre	Post		
1	291,9	246,7	45,2	15,48
2	278,6	220,5	58,1	20,85
3	248,9	198,6	50,3	20,21
Total	819,4	665,8	153,6	56,54
Average	273,1	221,9	51,2	18,84

Table 3 shows the difference in BOD levels in the control group before and after treatment. In this group, liquid waste from the tofu industry was left for 7 days without using water hyacinth plants. During this process, the average BOD level decreased by 18.84%.

3.1.4. Addition of 4 Kiambang Plants

Findings from BOD measurements taken before and after treatment for 7 days with four Kiambang factories.

Table 4. Results of BOD 4 level testing for water hyacinth plants

Repetition	Control (mg/l)		Difference (mg/l)	Reduction in BOD Levels (%)
	Pre	Post		
1	228,1	145,9	82,2	36,04
2	202,8	139,6	63,2	31,16
3	273,4	125,3	148,1	54,17
Total	704,3	410,8	293,5	121,37
Average	234,7	136,9	97,8	40,45

In Table 4, the third group showed the most significant decrease in BOD levels, showing a remarkable decrease of 148.1 mg/l or 54.17%.

3.1.5. Addition of 6 Kiambang Plants

Results of BOD measurements before and after 7 days of treatment with six Kiambang plants in the treatment group.

Table 5. Results of BOD measurements for 6 Kiambang plants

Repetition	Control (mg/l)		Difference (mg/l)	Reduction in BOD Levels (%)
	Pre	Post		
1	245,1	76,5	168,6	68,79
2	214,4	91,2	123,2	57,46
3	205,5	86,3	119,2	58,00
Total	665	254	411	184,25
Average	221,6	84,6	137	61,41

In Table 5, the largest decrease in BOD levels was recorded in the first stage, which experienced a decrease of 168.6 mg/l or 68.79%, as shown in Table 5.

3.1.6. Addition of 8 Kiambang Plants

The data presented in the table shows BOD measurements before and after treatment for 7 days with eight Kiambang plants in the treatment group.

Table 6. Results of BOD measurements for 8 Kiambang plants

Repetition	Control (mg/l)		Difference (mg/l)	Reduction in BOD Levels (%)
	Pre	Post		
1	232,6	72,3	160,3	68,92
2	293,2	81,2	212	72,30
3	285,6	62,3	223,3	78,19
Total	811,4	215,8	595,6	219,4
Average	270,4	71,9	198,5	73,13

Table 6 highlights the changes in BOD levels before and after the seven-day treatment period. The most significant decrease in BOD levels occurred when eight water hyacinth plants were used to treat industrial tofu waste, underscoring their effectiveness in phytoremediation. This highest decrease was observed in the third repetition, with a decrease of 223.3 mg/l or 78.19%.

Table 7 shows the average BOD levels for the control and treatment groups, measured before and after the 7-day treatment period, providing a clear comparison of the effectiveness of the treatment. The data includes the average BOD levels before and after treatment for the control and treatment groups, with four, six, and eight factories used during the 7-day period, illustrating the factory-dependent dose effect.

Table 7. Average BOD results for the addition of 4 plants, 6 plants, and 8 plants

No	Treatment	Pre	Post	Difference (mg/l)	Reduction in BOD Levels (%)
1	Control	273,1	221,9	51,2	18,84
2	4 plant	234,7	136,9	97,8	40,45
3	6 plant	221,6	84,6	137	61,42
4	8 plant	270,4	71,9	198,5	73,13

Table 7 shows that the control and treatment groups experienced a decrease in BOD values during the 7-day observation period. However, the control group still had BOD values that exceeded the limits set by Minister of Environment Regulation No. 5 of 2014 for wastewater quality standards. On the other hand, in the treatment with the addition of 4 plants, some results still exceeded the quality standards, especially in the first, second, and third repetitions, which occurred with the addition of 6 and 8 plants, respectively. These results confirm that the data meet the established standards, which require BOD values below 150 mg/l. The most significant reduction occurred in the treatment with the addition of 8 water hyacinth plants, with an average effectiveness of 73.13%, based on the data shown in Table 7.

3.2. Bivariat Analysis

Given that the sample size was less than 50, the Shapiro-Wilk test was used to assess the normality of the data distribution. Homogeneity was also tested using the Homogeneity of Variance test to ensure that the data followed a consistent pattern across all groups. The results of the Shapiro-Wilk test are provided below.

Table 8. Shapiro Wilk Normality Test

Treatment	**Shapiro-Wilk**		
	Statistic	**Df**	**Sig.**
Pre Control A	0,954	3	0,586
Pre Kiambang 4 A	0,975	3	0,698
Pre Kiambang 6 A	0,908	3	0,412
Pre Kiambang 8 A	0,842	3	0,220
Post Control A	0,997	3	0,902
Post Kiambang 4 A	0,952	3	0,579
Post Kiambang 6 A	0,964	3	0,637
Post Kiambang 8 A	0,999	3	0,936

Based on Table 8, the lowest significance value was found in the Pre Kiambang 8 A treatment with a value of 0.220, and the highest value was found in the Post Kiambang 8 A treatment with a value of 0.936, indicating that all research data passed the Shapiro-Wilk normality test, with a significance value > 0.05.

The next test is the paired difference test. The paired difference test aims to test whether there is a difference in the mean between two paired data groups.

Table 9. Paired Difference Test

Treatment Group	N	Mean (Behaviour Score)	Std. Deviation	P value (sign.)
Before Treatment	12	250,008	33,7	0,001
After Treatmnet	12	128,867	62,8	

Based on Table 9, it is known that before the treatment, the average was 250.008, while after the treatment, there was a change in value of 128.867. Based on the statistical test, a p-value of 0.001

(<0.05) was obtained, so it can be concluded that there was a difference in attitude before and after the treatment.

The next test conducted was the Homogeneity of Variance test, which tests whether the variance in several populations is consistent. If the significance value (p-value) is significantly less than 0.05, the data is considered non-homogeneous. If the significance value exceeds 0.05, the data is considered homogeneous. The results of the homogeneity test are shown in the table below:

Table 10. Homogeneity Test

		Levence Statistic	Df 1	Df 2	Sig.
Pre Result	Based on Mean	0,642	3	8	0,609
	Based on Median	0,159	3	8	0,921
Post Result	Based on Mean	1,336	3	8	0,329
	Based on Median	1,020	3	8	0,433

Based on Table 10, the mean and median pretest values have significance values of 0.609 and 0.921, respectively. Because both values are > 0.05, the significance value of the posttest results based on the mean is 0.640, while based on the median is 0.082. The homogeneity test results show that the demographic data for the groups studied are homogeneous, indicating consistent characteristics across all groups.

The data were then analyzed using ANOVA (Analysis of Variance), a statistical method used to compare means across groups to determine whether there are significant differences. A significance value (p-value) > 0.05 indicates no significant difference between group means. However, if the p-value < 0.05, it indicates a difference between group means.

Table 11. ANOVA Test

	F Hitung	Sig.	Keterangan
Hasil Pre	2,421	0,141	Mempunyai pengaruh bermakna
Hasil Post	66,547	0,001	Mempunyai pengaruh bermakna

Based on Table 11, the results of the posttest ANOVA test in this study obtained a calculated F value of 66.547 and a significance value of 0.001. Thus, the value is < 0.05, indicating that there is a significant effect between each treatment, namely the 4 Kiambang, 6 Kiambang, and 8 Kiambang treatments in this study.

Wastewater refers to residual water discharged from homes, factories, or other public facilities, which usually contains pollutants or contaminants that are harmful to human health and the environment (Lumunon, 2021). The problem of waste has been caused by low active community participation and differences in perception, where some people consider waste management to be solely the responsibility of the government (Riogilang, 2020). As a result of this pollution, there have been many disturbances to the beauty of the environment, such as unpleasant odors and disturbing changes in water color.

BOD measures the amount of dissolved oxygen required by microorganisms to break down organic matter under aerobic conditions, while COD refers to the amount of dissolved oxygen required to oxidize chemical agents to break down various organic compounds (Mefiana, 2021). Therefore, an alternative solution to this problem is needed. The alternative we propose is phytoremediation using the water fern (*Salvinia molesta*). According to (Ulfah et al., 2022), *Salvinia molesta* is an excellent phytoremediation agent for reducing BOD and COD levels, with a reduction of up to 73% (Hanafiah et al., 2018). Phytoremediation is a treatment method that utilizes plants to break down, absorb, or remove contaminants from soil and water. Aquatic plant-based phytoremediation techniques can also biologically absorb heavy metals and nutrients from wastewater while improving water quality (Dixit et al., 2011; Potensi et al., 2015). Previous research by (Chan, 2017) identified various aquatic plants with phytoremediation potential, including *Salvinia molesta*, *Pistia stratiotes*, *Azolla pinnata*, *Hydrilla verticillata*, *Pteris vittata*, *Rumex acetosa*, and *Sebertia acuminata*.

The investigation of liquid waste in Moyoretno Village, Matesih District, Karanganyar Regency involved measuring the BOD, pH, and temperature of tofu factory wastewater, which provided insight into the characteristics of wastewater and its potential environmental impact. To determine the effect of water hyacinth plants in the management of tofu wastewater on the reduction of BOD levels, different treatments were applied to variations of water hyacinth plants, namely 4 plants, 6 plants, and 8 plants. Data collection was carried out with 3 replicates (repetitions).

According to (Herman et al., 2017), phytoremediation plays an important role in absorbing organic pollutants. Plants are able to absorb pollutants within the range of their root growth. This process occurs because plant roots adsorb pollutants both in the root zone and from the pollutant solution around the roots. This can be seen in the treatment with 100% coverage, which shows a decrease in BOD values, both with and without an aerator, compared to the treatment with 50% coverage with an aerator. According to (Puji, 2023), the decrease in BOD levels can occur due to the phytodegradation process, in which organic contaminants are absorbed through plant roots and then decomposed through metabolic processes in the plant. According to (Pramyani et al., 2020), the degradation of organic matter by microbes can cause a decrease in dissolved oxygen levels, which contributes to a reduction in the organic content of wastewater, thus highlighting the importance of microbial action in wastewater treatment.

The average initial BOD level in the control group exceeded the quality standard set by Minister of Environment Regulation No. 5 of 2014, which sets a BOD threshold of 150 mg/l. The pre-test BOD level was recorded at 273.1 mg/l. Even without using water hyacinth plants, the control group in this study observed a decrease in BOD levels, resulting in a BOD value of 221.9 mg/l, which is a decrease of 18.84%.

The decrease in BOD levels is associated with the electrocoagulation system, which produces coagulant species from ions generated by anodic oxidation and dissolved electrodes, which facilitate the removal of contaminants. These species have the ability to capture and break down contaminants in the form of suspended particles found in water and wastewater. As the water circulates for a longer period of time, the decrease in Biological Oxygen Demand (BOD) levels increases, driven by microorganisms that break down these pollutants over time.

Based on the results of the One Way Anova test, a p-value of 0.001 (<0.01) was obtained, indicating that the addition of 4, 6, and 8 water hyacinth plants had a significant effect on liquid waste from the tofu factory in Moyoretno Village. As a result, the null hypothesis (Ho) was rejected, while the alternative hypothesis (Ha) was supported. The addition of eight water hyacinth plants in the third replication, in 15 liters of wastewater, resulted in the greatest reduction, reaching an efficacy level of 78.19%.

The inclusion of water hyacinth plants caused a substantial decrease in BOD levels. Introducing 4 plants resulted in an average reduction of 40.45%, leaving a post-treatment BOD level of 136.9 mg/l. With 6 plants, the average reduction increased to 61.42%, lowering the BOD to 84.6 mg/l. Meanwhile, the addition of 8 plants caused a 73.13% decrease in BOD levels, with a post-treatment BOD level of 71.9 mg/l. All of these results meet the optimal standards set in Minister of Environment Regulation No. 5 of 2014, which sets the maximum allowable BOD level at 150 mg/l for wastewater.

The significant decrease in BOD levels observed after treatment with water hyacinth indicates that this plant is very effective in reducing BOD levels in wastewater. Plants play an important role in the phytoremediation process by helping to reduce BOD levels in wastewater. During this process, plant roots play an important role in reducing or absorbing contaminants present in wastewater. Plants are able to absorb pollutants as far as their roots can reach.

(*Salvinia molesta*) has been proven to be a highly effective phytoremediator for organic and inorganic waste due to its extraordinary hyperaccumulation capacity and rapid growth rate (Simatupang et al., 2015). The process of removing contaminants from wastewater using aquatic plants requires collaboration between the plants and the microorganisms that interact with them, thereby forming a synergistic relationship.

In this study, the pH level remained consistent at 6 before and after treatment for both the control and treatment groups. The pH was measured using a pH stick. Very low or high pH levels can affect the growth of watercress plants and the survival of microorganisms in wastewater. Therefore, it is important to maintain the pH of wastewater within an acceptable range of 6 to 8. The ideal pH level for optimal water lettuce growth is 6. Both the control and treatment groups maintained pH values that met the environmental quality standards for wastewater, as stipulated in Minister of Environment Regulation No. 5 of 2014. According to this regulation, the pH threshold is set at 6. Consequently, pH was not considered a confounding variable in this study because it remained stable throughout the experiment. The number of water lettuce plants used in this study influenced the BOD reduction results. The more plants used, the more significant the decrease in BOD levels observed.

This study confirms the effectiveness of water hyacinth phytoremediation in reducing BOD levels in industrial wastewater from tofu production in Moyoretno Village. The more plants there are, the more BOD levels can be reduced to meet quality standards, because the addition of only four plants in the first and second repetitions still exceeded the required limit. This study proves that the water hyacinth phytoremediation technique is effective in reducing BOD levels in liquid waste from the tofu industry in Moyoretno Village.

The timing of wastewater collection during the study should be carefully considered in accordance with the characteristics of the wastewater to be studied, as suggested by (Asmadi & Suharto, 2012), in order to obtain optimal research results. Each stage of implementation should be considered in terms of nature, timing, process, and accuracy. Waste collection should pay more attention to the right time, which is the peak of activity that causes the content or characteristics of the waste to be at its maximum. The time when water is used most, whether for cleaning or washing, can be used as the optimal time for sampling during research. Wastewater sampling at the Tofu Factory in Moyoretno Village was carried out at around 10:00 a.m. Sampling was carried out at this time because the pressing process at the Tofu Factory had been completed, and the BOD came from the organic material contained therein.

Based on the research conducted from bivariate analysis, water hyacinth plants are effective in reducing BOD levels in liquid waste from the tofu industry in Moyoretno Village, Matesih District, Karanganyar Regency. The results of the research location survey show that this research can be implemented at the research location, namely in the drainage channel owned by the Tofu Industry House in Moyoretno Village, Matesih District, Karanganyar Regency. The addition of water hyacinth plants can be applied to the final reservoir owned by the Tofu Industry House in Moyoretno Village.

Based on research involving four, six, and eight water hyacinth plants, if this method is applied to the industrial wastewater drainage channel for tofu production in Moyoretno Village, water hyacinth plants must be added to the final reservoir. To calculate the number of plants needed for the final retention pond (approximately 9 m^2), divide by the area of the basin (2.38 m^2) and multiply by eight (the only variation). The result is a total of 30 plants.

The use of water hyacinth in industrial wastewater treatment systems for tofu production must be optimized by regularly monitoring plant growth to ensure that BOD levels remain below the specified quality standards. Regular monitoring and control of duckweed growth must be carried out to prevent eutrophication. Routine monitoring and regulation of duckweed growth is also necessary to avoid oxygen depletion in the water, which can occur if the surface water is completely covered by plants.

3. Conclussion

Research shows that the use of water hyacinth plants can effectively reduce BOD levels in industrial tofu wastewater in Moyoretno Village. Variations in the number of water hyacinth plants used (4, 6, and 8 plants) yielded significant results. The addition of six and eight water hyacinth plants significantly reduced BOD levels in industrial tofu wastewater in Moyoretno Village ($p < 0.01$). However, despite adjusting the number of plants, BOD levels did not decrease sufficiently to meet quality standards because the addition of four plants in the first and second replicates still exceeded the permissible limit. Before treatment, the average BOD level in the system containing four, six, and eight water hyacinth plants was 2731.1 mg/l. After treatment, the average BOD level in the wastewater with these variations was:

a. After treatment with four water hyacinth plants, the average BOD level was 136.9 mg/l.

b. After treatment with six water hyacinth plants, the average BOD level decreased to 84.6 mg/l.

c. After treatment with eight water hyacinth plants, the average BOD level decreased to 71.9 mg/l.

The results of the study show that the use of four water hyacinth plants successfully reduced the BOD level in industrial wastewater. The results of the study show that the average BOD level of 136.9 mg/l meets the quality standards set by the Minister of Environment Regulation. Wastewater treatment using four water hyacinth plants meets environmental quality standards because the BOD level of 136.9 mg/l is below the threshold of 150 mg/l.

The phytoremediation process using six and eight water hyacinth plants proved effective in reducing BOD levels in industrial tofu wastewater in Moyoretno Village, Matesih District. The results of the study show that BOD levels were successfully reduced to below the quality standard set by the Minister of Environment, which is 150 mg/l. The phytoremediation process using water hyacinth plants achieved optimal results by using eight plants in 15 liters of wastewater with a success rate of 71.9%.

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Conflict of interest

All authors declare that they have no conflicts of interest.

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