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EFFECTIVENESS REDUCING AMMONIA LEVELS FROM WASTE SANGKURIANG CATFISH (*Clarias gariepinus*) CULTIVATION USING THE PHYTOREMEDIATION METHOD USE WATER HYACINTH (*Eichhornia crassipes*), Water lettuce (*Pistia stratiotes*) and *Azolla microphylla*

EFEKTIVITAS PENURUNAN KADAR AMONIA DARI LIMBAH BUDIDAYA IKAN LELE SANGKURIANG *(Clarias gariepinus)* MENGGUNAKAN METODE FITOREMEDIASI DENGAN TANAMAN ECENG GONDOK *(Eichhornia crassipes)*, KIAMBANG *(Pistia stratiotes)*, DAN AZOLLA MICROPHYLLA

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Abstract

Water quality is a crucial factor in the cultivation of Sangkuriang catfish (Clarias gariepinus). One of the main issues in catfish farming is the increase in ammonia levels in the water, which can negatively impact fish health and the environment. This study aims to analyze the effectiveness of the phytoremediation method using Eichhornia crassipes (water hyacinth), Pistia stratiotes (water lettuce), and Azolla microphylla in reducing ammonia levels from catfish farming wastewater. The research employed an experimental method with a completely randomized design (CRD), consisting of three treatments using each plant type and a control group without treatment. The results showed that the phytoremediation method using water hyacinth was the most effective in reducing ammonia levels, achieving an efficiency of 99.35%. Water lettuce and Azolla microphylla also demonstrated effectiveness in absorbing ammonia, with efficiencies of 98.2% and 96.4%, respectively. Additionally, water quality parameters such as temperature, pH, dissolved oxygen (DO), phosphate, and nitrate were within the optimal range for fish farming. Based on these findings, the phytoremediation method using aquatic plants can be an environmentally friendly solution for managing catfish farming wastewater. Further research is needed to optimize environmental conditions and the number of plants used in the phytoremediation process.

Keywords: *Ammonia, Azolla microphylla, Catfish Farming, Water Hyacinth, Phytoremediation*

Abstrak

Kualitas air merupakan faktor penting dalam budidaya Ikan Lele Sangkuriang (Clarias gariepinus). Salah satu permasalahan utama dalam budidaya Ikan Lele adalah peningkatan kadar amonia dalam air, yang dapat berdampak negatif terhadap kesehatan ikan dan lingkungan. Penelitian ini bertujuan untuk menganalisis efektivitas metode fitromediasi menggunakan tanaman Eceng Gondok (Eichhornia crassipes), Kayu Apu (Pistia stratiotes), dan Azolla microphylla dalam menurunkan kadar amonia dari limbah budidaya ikan lele. Metode yang digunakan dalam penelitian ini adalah eksperimen dengan rancangan acak lengkap (RAL) yang terdiri dari tiga perlakuan menggunakan masing-masing jenis tanaman serta satu kelompok kontrol tanpa perlakuan. Hasil penelitian menunjukkan bahwa metode fitromediasi dengan Eceng Gondok memberikan hasil terbaik dalam menurunkan kadar amonia, dengan efisiensi mencapai 99,35%. Kayu Apu dan Azolla microphylla juga menunjukkan efektivitas dalam menyerap amonia dengan efisiensi masing-masing 98,2% dan 96,4%. Selain itu, parameter kualitas air seperti suhu, pH, oksigen terlarut (DO), fosfat, dan nitrat berada dalam rentang optimal untuk budidaya ikan. Berdasarkan hasil penelitian ini, metode fitromediasi menggunakan tanaman air dapat menjadi solusi ramah lingkungan dalam pengelolaan limbah budidaya ikan lele. Penelitian lebih lanjut diperlukan untuk mengoptimalkan kondisi lingkungan dan jumlah tanaman yang digunakan dalam proses fitromediasi.

Kata kunci: *Amonia, Azolla microphylla, Budidaya ikan Lele, Eceng Gondok, Fitromediasi*

1. Introduction

Sangkuriang catfish (*Clarias gariepinus*) is a promising aquaculture commodity due to its ease of cultivation and high nutritional value. However, what becomes obstacle in

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Cultivating Sangkuriang Catfish (*Clarias gariepinus*) namely water quality. There are still many cultivators complain problem water quality is one of them improvement level ammonia. High ammonia levels result in existence decline water quality in the cultivation media of Sangkuriang Catfish (C *larias gariepinus*) (Latuconsina, 2020).

Ammonia is compounds produced by waste remainder settled feed at the bottom waters and become waste in cultivation. Increase ammonia is very potential bad in activity cultivation. According to (Putri et al., 2022), in processing waste catfish farming if cultivators have limitations knowledge will result in damage environment as well as Power support declining environment. In development cultivation fishery needed principle base ecological that is effort in defense Power support environment , because with existence Power support good environment then cultivated biota will experience growth as well as good development as well as will have Power resistant to attack disease , if if happen on the contrary water quality is experiencing decrease 1 damage waste organic , then will happen decline Power support environment , as well as biota will with quickly infected disease that causes decline performance growth as well as its survival (Latuconsina , 2020). Efforts in remediate ammonia in waste Sangkuriang Catfish Cultivation namely with the Phytoremediation method (Putri et al., 2022).

2. Materials and Methods

2.1. Time and Place

The study was conducted from December 2024 to January 2025 at the Fish Seed and Cultivation Center, Muntilan, Magelang, Central Java. The design used in this study was a Completely Randomized Design (CRD) consisting of 3 treatments and a control with 3 replications. The three treatments carried out were treatment K (no treatment), Treatment A (Water hyacinth weighing 75 grams), B (Water lettuce weighing 75 grams), and C (*Azolla microphylla* weighing 75 grams). The reason for choosing a plant weight of 75 grams is because this weight is the weight that can make growth optimal and the chemical composition in the plant has been formed which can have an influence on this research.

2.2. Tools and Materials

The tools used in this study were used gallon jugs, digital scales, pH meters, *thermometers* , *beakers* , droppers, test tubes, stationery, laptops, nitrate and *phosphate test papers* , and mobile phones. The materials used in this study were catfish cultivation wastewater, pumice wood, water hyacinth, and *Azolla microphylla*.

2.3. Research Procedures and Stages

The research procedures and stages are:

a. Preparation of research containers from used 15 liter gallon jugs.
b. Take 12 liters of catfish farming wastewater using a bucket, then put it into a gallon jug.
c. Take plants from the population, then wash them and select plants in good physical condition.
d. Plants are acclimatized with clean water for 5 days.
e. After acclimatization, the plants were placed in research gallons.

2.4. Observed parameters

The parameters observed during the research were:

a. Ammonia Test

Ammonia levels in Sangkuriang catfish cultivation waste were tested using a test kit, before and after the addition of water hyacinth, water lettuce, and Azolla microphylla. Ammonia (NH3) levels were calculated using the formula (Febrianty, 2022).

$$\text{Ammonia content (mg N/L)} = C \times fp$$

Description :
C = Level obtained from measurement results (mg/L)
fp = Dilution factor

The efficiency of reducing ammonia (NH3) levels in samples is calculated in (%) using the formula (Nwe et al., 2020).

$$Ef = \frac{Ci - Ce}{Ci} \times 100$$

Description :
Ef = efficiency (%)
C_i = concentration before treatment (mg/L)
C_e = concentration after treatment (mg/L)

b. Relative Growth Rate (RGR)

The relative growth rate was calculated in units of g/day using the formula (Prasetyo et al., 2021).

$$RGR = \frac{(lnMT2 - lnMT1)}{T}$$

Information :
RGR = relative growth rate (gr/day)
MT1 = wet weight of the three plants on day 0 (g)
MT2 = wet weight of the three plants on the nth day (g)
T = observation time (days)

2.5. Data Analysis

The research results obtained need done analysis, in order to find out study what parameters are measured? influential in a way significant or not. For do testing analysis test was carried out analysis of variance (ANOVA) with data requirements must be met normally distributed, homogeneous and additive. Normality test, data additivity test weretested with using SPSS. If the results of the analysis of variance (ANOVA) test show difference, then to be continued with Tukey and Ducan tests for determination treatment best. Based on results study the will processed with use SPSS 30.0 application.

3. Results and Discussion

a. Ammonia Test

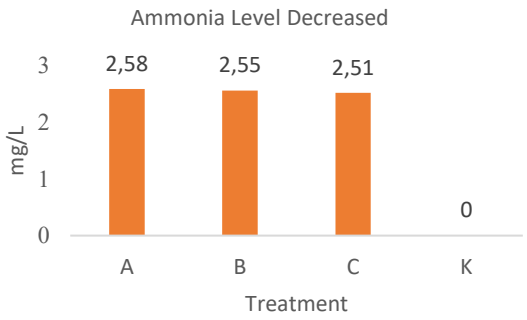

Figure 1. Chart ammonia test results on waste catfish farming

Based on the results of the Normality test on the ammonia reduction test data in waste catfish cultivation, the Shapiro Wilk Sig. test value was 0.130 > 0.05, which means the research data was normal. The Homogeneity test with a result of 0.146 > 0.05 can be interpreted that the data has the same variance (homogeneous). The results of the ANOVA test sig. 0.126 > 0.05 can be interpreted that the treatments (A, B, C) did not differ significantly in reducing ammonia levels. Also based on the

calculated F value obtained of 3.208, where the calculated F value <F table, so it means that the treatments (A, B, C) did not differ significantly in reducing ammonia levels. However, when compared with the Control, the difference in treatments (A, B, C) was significant.

This is suspected Because According to (Saputra et al, 2023) , Water Hyacinth can adaptation and doing absorption with Good to content material organic in waste the catfish after that material this organic can reliable optimally to be carried out photosynthesis. This is supported by (Kusrinah et al., 2016) Water hyacinth own root fiber with function as handle and anchor plants , these roots will absorb substances contained in in water and is needed by plants in parts end root is colored bags red that can gather mud or particles that can dissolved in water.

b. Efficient Ammonia Level Reducer

Based on the Normality Test in Appendix 3 which has been implemented show that is Efficiency plant treatment (A) Water hyacinth own Shapiro – Wilk Sig. value 0.132 > 0.05 indicates that the data is normal Next namely the Homogeneity Test, with the result of 0.146 > 0.05 means that the data has the same variance (homogeneous). Based on ANOVA test results obtained sig. value 0.126 > 0.05, can it is said results treatment A, B, C does not influential real on efficiency decline ammonia levels. However, if compared to with Control, treatment A, B, C have an effect real.

Table 1.
Efficiency Data decline level ammonia

Test	Treatment			
	A	B	C	K
1	99.61	98.46	98.07	0
2	99.23	98.84	92.30	0
3	99.23	97.30	98.84	0
Average	99.35 [b]	98.2 [b]	96.40 [b]	0 [ab]
Standard Deviation	0.219393	0.802246	3.574385	0

According to (Saputra et al., 2023) that ammonia concentration is capable lowered Because existence absorption by roots plants, mechanisms phytotreatment that is utilized is rhizodegradation and phytodegradation, mechanisms rhizodegradation that is existence ammonium degradation by microorganisms in the rhizosphere or area rooting, after that results ammonium degradation will done absorption by plants.

c. Growth Rate Relative (RGR)

In accordance with results study show that the growth rate data Plant show that rate its growth No significant, even in the treatments (B) Water lettuce and (C) Azolla microphylla the data shows minus numbers that can interpreted plant The same very No grow and get bigger reduce Because happen death in plants.

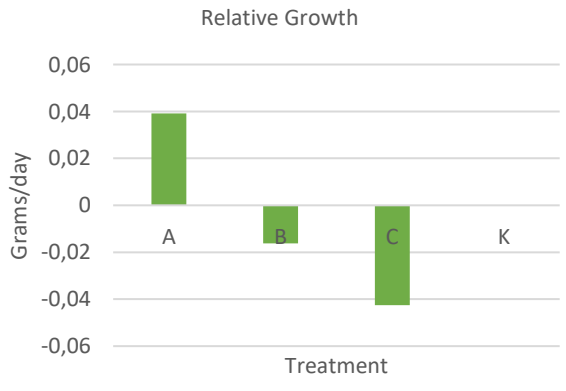

Figure 2. Graph rate relative growth of aquatic plants

This occurs due to external factors, namely a lack of sunlight which prevents plants from growing and causes death, so that the data obtained is negative. In Treatment (A) Water Hyacinth experience growth daily with an average of 0.0392 grams/ day. Growth plant phytoremediation in this study was the best is in treatment (A) Water Hyacinth.

This is suspected Because Water hyacinth goiter is plants that can life free on the surface of the water, this plant can grow and develop with fast. This can strengthen results study Why results best occurred in the treatment (A) Water Hyacinth (Mawarni , 2016) In the treatment of Water lettuce and *Azolla microphylla* its value negative and experienced decline growth , due to Lots dead plants , leaves rotting and plants Already is at at the point saturated and not capable Again absorb toxic substances optimally . This has a significant impact on the rate of growth relatively plants. Greulach and Adams (1962) stated that climatic factors influence growth plant among them is temperature, light, humidity air, composition of gases in the atmosphere, movement air, pressure air and precipitation.

d. Water Quality

Measurement results water quality during maintenance show that range obtained Still considered optimal. Measurement Quality water that is done every day that is measurement temperature, pH, DO, while nitrate and phosphate done a week once. From the results study level nitrate in catfish farming wastewater Still high.

Table 2.
Water quality data

No.	Parameter	Results	Unit	Reference
1.	Temperature	25 - 27	℃	26 - 32℃ (Fadillah et al., 2019) (
2.	pH	5.7 – 7.0	-	Optimum pH 6 - 8.5 (Kusumawati et al., 2018)
3.	DO	4.2 – 6.8	Mg/L	< 5 Mg/ L (Tatangidatu et al., 2013)
4.	phosphate	0.5 - 3	Mg/L	2 – 50 mg/L (Suraya et al., 2021)
5.	Nitrate	2 - 25	Mg/L	0.2-1 mg/L (Sinaga *et al.,* 2021)

This is suspected Because Lots aquatic plants used or phytoremediation many died so that increase level nitrate in water. According to Sinaga et al., (2021) levels good nitrate is in the range of 0.2 -1 mg/L.

4. Conclusion

Phytoremediation method use aquatic plants such as Water Hyacinth, Water lettuce, and Azolla microphylla show success in lowerlevel ammonia in waste catfish farming Sangkuriang. Treatment with Water hyacinth give results best with average decrease in levels ammonia of 2.58 mg/ L. Efficiency decline level ammonia highest achieved by Eceng with an average decrease of 99.35%, followed by Water lettuce 98.2% and Azolla microphylla 96.4%. Water hyacinth shows growth relatively more Good compared to with Water lettuce and Azolla microphylla, although third plant experience change physique like chlorosis and necrosis consequence interaction with waste. Parameterswater quality such as temperature, pH, oxygen dissolved oxygen (DO), phosphate, and nitrate is at in optimal range for catfish farming, although A little fluctuations happen during study.

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