DEPIK
Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan
Journal homepage: www.jurnal.unsyiah.ac.id/depik

Reducing ammonia levels in catfish cultivation water using several aquatic plants: Short communication

Mustaqim Mustaqim[1,*], Mutasar Mutasar[2], Yusrizal Akmal[3], Mida Wahyuni[1], T. Irfan Fajri[2], Zaitun Ritaqwin[4]

[1]*Animal Husbandry, Faculty of Agricultural and Animal Sciences, Indonesian National Islamic University, Indonesia.*
[2]*Informatics, Faculty of Computer and Multimedia, National Islamic University of Indonesia, Indonesia.*
[3]*Aquaculture, Faculty of Agriculture, Al Muslim University, Indonesia*
[4]*Agricultural Sciences, Faculty of Agriculture and Animal Sciences, Indonesian National Islamic University, Indonesia.*

ARTICLE INFO

Keywords:
Ammonia
Water plants
Catfish

DOI: 10.13170/depik.11.3.27723

ABSTRACT

Catfish farming is one of the businesses that is very much in demand by the community, because it can improve the community's economy. However, not all catfish farming businesses can produce maximum results. This can be caused by several factors, both from feed, management and water quality. Decrease in water quality can be caused by feces and fish feed residue. Poor water quality can cause the growth process, physiology and level of fish behavior to be disturbed. Efforts that can be done is to use aquatic plants as phytoremediation. The plants used in this study were *Azolla* sp, *Eichhornia crassipes*, *Lemna* sp, Ipomoea aquatic. The design used in this study was a completely randomized design with 4 treatments and 3 replications. The parameters observed in this study were ammonia levels, pH, and plant population. The results showed that *Eichhornia crassipes* and *Lemna* sp were able to reduce ammonia levels in catfish cultured water by <0.01 mg/l at the end of the study.

Introduction

One of the fishery commodities that are very prospective to be cultivated on an industrial and household scale is catfish (*Clarias sp*). In Indonesia, catfish has several regional names, including kalang fish (Padang), lele fish (Gayo, Aceh), pintet fish (South Kalimantan), keeling fish (Makassar), cepi fish (Bugis), lele or lindi (Jawa Tengah). Middle) (Jatnika *et al*., 2014). Cultivation of catfish is very easy to do in large land or narrow land by paying attention to stocking density. The increase in high stocking densities and the use of artificial feed in aquaculture can increase nitrogen waste in the waters from the accumulation of fecal organic matter and uneaten feed residues.

Wastewater from catfish farming can produce several substances, namely organic solvents, dissolved solids and suspended soild (Said, 2017). Liquid waste can cause microbial growth in water, causing oxygen levels in water to decrease. In addition, liquid waste that contains a lot of suspended substances can cause the water to become cloudy and smelly. The accumulation of this waste can cause a decrease in water quality in the surrounding environment and affect the physiological processes, behavior, growth, and mortality of fish (Effendi *et al*., 2015.a). To maintain water quality in catfish farming, it is possible to use aquatic plants as phytoremediation. One of the management efforts to improve water quality and optimize the use of aquaculture water is by applying phytoremediation in recirculation system (Effendi *et al*., 2015.b).

Phytoremediation is the use of plants to remove some pollutants from contaminated waters (Rodonuwu, 2014). Phytoremediation techniques are innovative and economical technologies, and are relatively safe for the surrounding environment (Sidauruk and Sipayung, 2015). Phytoremediation has advantages as a waste treatment technology,

* Corresponding author.
Email address: mustaqimt48@gmail.com

p-ISSN 2089-7790; e-ISSN 2502-6194
Received 24 August 2022; Received in revised from 14 November 2022; Accepted 16 November 2022
Available online 24 November 2022

namely the natural process, lower costs, permanent reduction of organic matter, synergistic relationships occur between plants, organisms, and the environment and using low-cost technologies, where plants use their roots as material to absorb nutrients in the water (Paz-Alberto and Sigua, 2013). Aquatic plants that are usually used as phytoremediators are watercress (*Lactuca sativa L*), water hyacinth (*Eichornia crassipes*), apu wood (*Pistia stratiotes*), kiambang (*Salvinia molesta*). From the above discussion,

Materials and Methods

Location and time of research

The research was carried out in June-July 2022, which was carried out at the Laboratory of the Faculty of Agricultural and Animal Sciences, National Islamic University of Indonesia, Blang Blahdeng, Bireuen, Aceh.

Experimental design

The method used in this study was a completely randomized design method using 4 treatments and 3 replications, where the treatment applied was the use of aquatic plants such as Azolla sp, Eichhornia crassipes, Lemna sp, and Ipomoea aquatic.

Container preparation

The container used is a 40 cm diameter bucket with a water capacity of 15 liters, before use the container is cleaned with detergent and rinsed thoroughly, then the container is filled with 12 liters of catfish culture wastewater, and ammonia checks are carried out at the beginning as initial research data.

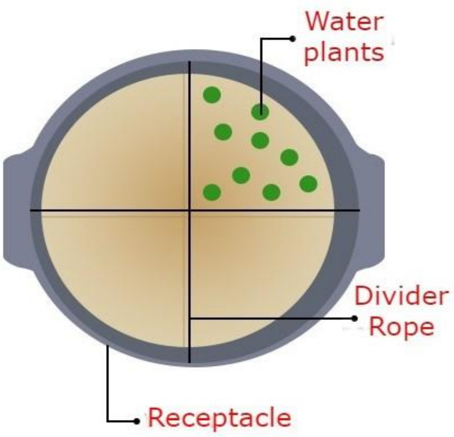

Figure 1. Plant population calculation design.

Plant preparation

The aquatic plants used are water hyacinth, *Azolla* sp., *kale* and *Lemna* sp. Before being put into a container containing catfish waste cultivation water, the plants are first washed with clean water or soaked for 1-2 hours to be free from germs, then 25% of each plant was put into a container that already contained waste water from catfish cultivation Figure 1.

Observation Parameter

Ammonia

Measurements were carried out using two bottles containing pure sample water (control) and treatment water samples added with reagents. Then use calorimetry by entering the number or code51 then enter the control bottle, press zero to get the number 0.00, then enter the treatment sample bottle, press read number, and the ammonia content value will appear. The measurement results listed in the calorimetry are recorded. During the study, observations of ammonia were carried out at the beginning and end of maintenance. Ammonia checking was carried out at the beginning of the study before the plants were put into a container filled with catfish culture wastewater and checking was carried out at the end of the study. Ammonia measurement was carried out using a calorimetry tool.

pH

Measurement of pH using a tool in the form of litmus paper. Checking the pH at the beginning of the study before putting the plants into a container filled with catfish culture wastewater and checking at the end pH checks were also carried out at the end of the study. Standard pH for fish life ranges from 6-8.

Plant population growth

Before the plants are put into the research container, the number of plants to be studied is calculated before the plants are placed in the research container, and a recount is carried out at the end of the study.

Data analysis

The data analyzed in this study were Ammonia level, as well as population of water hyacinth, kale, Lemna sp., and Azolla sp. which is presented in tabular form

Results

Ammonia

Ammonia levels during the study are presented in Table 1. The 25 days observation shows that Eichhornia crassipes and Lemna sp. are two plants that can lower the pH level in catfish culture water, with a final output of <0.01. This was due to the *Eichhornia crassipes* and *Lemna sp* plants that were well developed at the time of the study.

pH

The pH levels during the study are presented in Table 2. The results of observations for 25 days show that the use of plants *Eichhornia crassipes,*and *Lemna sp* is also a plant that is able to lower the pH level in catfish culture water with a final yield of 7, while in *Azolla sp* and 6.5 and Ipomoea aquatic 6.

Plant population

The results showed that the plant population was presented in Table 3. The aquatic plants placed in the research container were 25% of the circumference of the container, and the results of the plant population at the end of the study showed a good plant population, namely Eichhornia crassipes, Lemna sp and Ipomoea aquatic.

Table 1. Ammonia levels in catfish cultivation water.

Treatment	Ammonia Level (mg/l)		Raw Standard
	Beginning	End	
A (*Azolla sp*)	2.5	1.5	0.1
B (*Eichhornia crassipes*)	2.5	<0.01	
C (*Lemna sp*)	2.5	<0.01	
D (*Ipomoea aquatica*)	2.5	0.12	

Table 2. pH levels in catfish culture water.

Treatment	Ammonia Level (mg/l)		Raw Standard
	Beginning	End	
A (*Azolla sp*)	8	6.5	6.5-8
B (*Eichhornia crassipes*)	8	7	
C (*Lemna sp*)	8	7	
D (*Ipomoea aquatica*)	8	6	

Table 3. Plant population in water catfish cultivation.

Treatment	Plant Population (%)	
	Beginning	End
A (*Azolla sp*)	25%	0%
B (*Eichhornia crassipes*)	25%	65%
C (*Lemna sp*)	25%	90%
D (*Ipomoea aquatica*)	25%	50%

Discussion

Ammonia is a product of fish excretion resulting from the catabolism of dietary protein, and is excreted through the gills as un-ionized ammonia. The amount of ammonia excreted is directly related to the level of feeding and protein in the feed. Some nitrogen is used to form proteins (including muscle), some is used to produce energy, and some is excreted through the gills as ammonia (Wahyuningsih and Gitarama, 2020). Ammonia is toxic to commercially farmed fish at concentrations above 1.5 mg N/l, even in some cases an acceptable concentration of as little as 0.025 mg N/l. Fish have several mechanisms to tolerate excess ammonia and reduce ammonia toxicity including excretion and conversion (Cheng *et al.,* 2015).

The use of aquatic plants as phytoremediation to reduce ammonia levels in catfish culture water in this study showed that good plants in reducing ammonia levels are *Eichhornia crassipes* and *Lemana sp* plants, this is because these plants are able to neutralize ammonia content in fish culture water. catfish. Ammonia value at the end of the study on *Eichhornia crassipes* and *Lemana sp* plants was 1.5, while in *Azolla sp* was 1.5 and Ipomoea aquatic was 0.12. The decrease in ammonia levels in this treatment was identified because *Eichhornia crassipes* and *Lemna sp* plants have roots that are able to absorb organic matter so that they can reduce ammonia concentrations in water. Water hyacinth plants are able to adapt and absorbwell the content of organic matter in catfish waste which is then used optimally for photosynthesis. The formula for photosynthesis in tamanam is as follows 12 H2O +6 CO2 → C6H12O6 +6 O2 ↑ +6 H2O; ΔG ° '= -2880 kJ / Mol Glukosa (Astuti & Inriatmoko, 2018).

The ability of Eichhornia crassipes to absorb dissolved substances in water is due to the presence of vacuoles in the cell structure. According to Villamagna and Murphy (2010) and Setyowati *et al.* (2015), Eichhornia crassipes has the ability to form phytokelatins where the peptide compounds produced by Eichhornia crassipes are able to tolerate heavy metals, organic contaminants and nutrients in large amounts of water. The presence of absorbed materials causes the vacuole to swell and push the cytoplasm to the periphery of the cell so that the protoplasm gets closer to the cell surface causing the exchange or absorption of materials between the cell and its surroundings to be more efficient. This is in line with previous research, Djo *et al.* (2017), which stated that the absorption of *Eichhornia crassipes* in the phytoremediation system for Cr 0.0051 mg/g, COD is 0.1232 mg/g, and Cu is 0.0015 mg/g. Indah *et al.* (2014), also reported that Eichhornia crassipes was able to reduce the organic matter of tofu industrial waste to the remaining 195±48.61 mg/l.

Lemna can utilize dissolved N in cultivation media through nutrient uptake in its roots. The absorbed nutrients will then be stored in the body's tissues in the form of proteins that are used for growth and survive in adverse environmental conditions. The concentration of N in lemna tissue depends on the amount of N in the culture medium (Okomoda *et al.* 2012). Similarly, research by Sakdiah (2009), that the uptake and absorption of N by seaweed is affected by the concentration of dissolved inorganic N in the water as well as ecological fluctuations of N in plant tissues and growth rate.

The value of pH levels in the research media at the end of each study was in the category of standard standards that could be tolerated by fish with a value of 6-7. Manunggal *et al*. (2015) reported that the pH value between 7 ± 9 was very adequate for life for pond water. Yuni and Mustaqim (2020), also reported that optimum pH value for aquatic biota is 7.2-9.5, but there are some species that can survive at a pH tolerance of 11%. Similarly, Lestari (2013) highlighted the same point that the optimum pH for plant growth is 5.5-7, because at that pH the absorption of nutrients can take place well.

The plant population in the research media showed a very good population of *Lemna sp* plants and *Eichhornia crassipes* and *Ipomoea aquatic* plants also showed good populations from the beginning of the study to the end, while the plant population that is not good is found in *Azzola sp,* where the final population *of Azzola sp* plants all die. A good water planting population is also caused by nutrients that are able to be absorbed by plants and do not interfere with the development of these plants. This is in accordance with Rusyani's statement (2014), that aquatic plants that are able to tolerate and release nutrients from their roots into the water will be able to develop well. Meanwhile, *Azolla sp* plants showed poor plant population, where at the end of the study, all *Azolla sp* plants died. This is due to the high content of solutes in the water media for catfish cultivation which cannot be tolerated by *Azolla sp.*

Conclusion

The use of aquatic plants as phytoremediation in catfish culture water shows good results, where plants *Eichhornia crassipes* and *Lemna sp* were able to reduce ammonia levels in catfish culture water, and neutralize the pH level of the water as evidenced by the high plant population from the first study.

Acknowledgments

My gratitude to the Ministry of Education, Culture, Research and Technology which has funded this research, especially for the XIII academic area, the Indonesian National Islamic University for supporting this research so that it runs smoothly and Animal Husbandry Study Program students who are late to help in this research.

References

Astuti, L.P., Indriatmoko. 2018. Kemampuan beberapa tumbuhan air dalam menurunkan pencemaran bahan organik dan fosfat untuk memperbaiki kualitas air. Jurnal Teknologi Lingkungan, 19(2): 183-190.

Cheng, C.H., F.F. Yang, R.Z. Ling, S.A. Liao, Y.T. Miao, C.X. Ye, A.L. Wang. 2015. Effects of ammonia exposure on apoptosis, oxidative stress and immune response in pufferfish (*Takifugu obscurus*). Aquatic Toxicology, 164: 61-71.

Djo, Y.H.W., D.A. Suastuti, I.E. Suprihatin, W.D. Sulihingtyas. 2017. Fitoremediasi limbah cair upt laboratorium analitik universitas udayana menggunakan tanaman eceng gondok (eichhornia crassipes) ditinjau dari penurunan nilai COD dan kandungan logam berat Cu dan Cr. Jurnal Media Sains, 1(2): 63-70.

Effendi, H., B.A. Utomo, G.M. Darmawangsa, D.A. Hanafiah. 2015.a. Wastewater treatment of freshwater crayfish (*Cherax quadricarinatus*) culture with lettuce (*Lactuca sativa*). International Journal of Applied Environmental Sciences, 10(1): 409-420.

Effendi, H., B.A. Utomo, G.M. Darmawangsa, E.K. Rebo. 2015.b. Fitoremediasi limbah budidaya ikan lele (*Clarias sp.*) dengan kangkung (*Ipomoea aquatica*) dan pakcoy (*Brassica rapa chinensis*) dalam sistem resirkulasi. Ecolab, 9(2): 47-104.

Indah, L.S., B. Hendrarto, P. Soedarsono. 2014. kemampuan eceng gondok (*Eichhornia sp.*), kangkung air (*Ipomoea sp.*) dan kayu apu (*Pistia sp.*) dalam menurunkan bahan organik limbah industri tahu (skala laboratorium). Journal of Maquares, 3(1): 1-6.

Jatnika, D., K. Sumantadinata, H.P. Nora. 2014. pengembangan usahan budidaya ikan lele (*Clarias sp*) di lahan kering di Kabupaten Gunungkidul, Provinsi Daerah Istimewa Yogyakarta. Jurnal Manajemen IKM, 9(1): 96-105.

Manunggal, A., R. Hidayat, S. Mahmudah, D. Sudinno, A. Kasmawijaya. 2018. Kualitas air dan pertumbuhan pembesaran ikan patin dengan teknologi biopori di lahan gambut. Jurnal Penyuluhan dan Kelautan, 12(1): 11-19.

Nilamsari, D.D., F. Rachmadiarti. 2019. Kemampuan *Azolla microphylla* dalam menyerap logam berat tembaga (Cu) pada konsentrasi yang berbeda. Lentera Bio, 8(3): 207-212.

Okomoda, V.T., S.G. Solomon, G.A. Ataguba. 2012. Potential uses of the family lemnaceae. Journal of Agriculture and Veterinary Sciences, 4(1): 1-14.

Rondonuwu, S.B. 2014. Fitoremediasi limbah merkuri menggunakan tanaman dan sistemreaktor. Jurnal Ilmiah Sains, 14(1): 52-59.

Said, N.I. 2017. Teknologi pengolahan air limbah teori dan aplikasi. Erlangga, Jakarta.

Sakdiah, M. 2009. Pemanfaatan limbah nitrogen udang vanamei (*Litopennaeus vannamei*) oleh rumput laut (*Gracillaria verrucosa*) pada sistem budidaya polikultur, Tesis, Departemen Budidaya Perikanan, Fakultas Perikanan dan Kelautan, Institut Pertanian Bogor, Bogor, 20 April.

Setyowati, S., H.S. Nanik, W. Erry. 2015. Kandungan logam tembaga (Cu) dalam eceng gondok (*Eichhornia crasipes*) perairan dan sedimen berdasarkan tata guna lahan di sekitar Sungai Banger Pekalongan. Bioma, 7(1): 1-8.

Sidauruk, L., P. Sipayung. 2015. Fitoremediasi lahan tercemar dikawasan industri Medan dengan tanaman hias. Jurnal Pertanian Tropi, 2(2): 178-186.

Sinha, A.K., H.J. Liew, M. Diricx, R. Blust, G.D. Boeck. 2012. The interactive effects of ammonia exposure, nutritional status and exercise on metabolic and physiological responses in gold fish (*Carassius auratus L.*). Aquatic Toxicology, 109(1): 33-46.

Villamagna, A.M., B.R. Murphy. 2010. Ecological and socio-economic impacts of invasive water hyacinth (*Eicchornia crassipes*). Freshwater Biology, 55(2): 282-298.

Wahyuningsih, S., A.M. Gitarama. 2020. Amonia pada sistem budidaya ikan. Jurnal Ilmiah Indonesia, 5(2): 112-125.

Yuni, Mustaqim, M. 2020. Study kelimphan fitoplankton dengan ketinggian air tambak yang berbeda di Desa Jangka Alue Bie. Jurnal Ilmiah Program Studi Perairan, 2(1): 13-20.

How to cite this paper:
Mustaqim, M., M. Mutasar, Y. Akmal, M. Wahyuni, T. I. Fajri, Z. Ritaqwin. 2020. Reducing ammonia levels in catfish cultivation water using several aquatic plants. Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan, 11(3): 295-298.