Nitrate Removal From Synthetic Medium With aquatic Macrophytes

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수생식물을 이용한 질산염 제거에 관한연구

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Abstract
The removal of nitrate from aqueous solutions of a synthetic medium was examined using two different aquatic plants, such as *Hydrocharis dubia* and *Salvinia* sp. The selected macrophytes were incubated in the laboratory in the container containing a previously prepared soultion of NH4NO3. *Hydrocharis dubia* reduced the nitrate level to 60.4% in a synthetic medium containing 100mg/L of nitrate . The efficiency of nitrate removal was further increased 78% with initial nitrate concentration of 300mg/L.

1.Introduction

Nitrate is a water soluble molecule made up of n itrogen and oxygen. It is formed when nitrogen fr om ammonia or others sources combines with oxy genated water. The growth of the industries and major agricultural enterprises to supply the human demands from their increasing population causes a s annihilation of water ecosystems and an augme ntation of water pollutions. These are the main so urces of nutrient supplements in water resources. There are the various method used to treat pollut ed water, one of the effective method is wetland t reatment, where the various aquatic plants are us ed for purifying the water and wastewater from e xcess nutrient. The use of wetland technologies is increasingly employed for wastewater treatment b ecause of its positive green house results, also its being relatively low cost and energy efficient. We tlands are also more efficient at removing nitrate from water(Knight et al; 1990). Nitrate removal in wetlands occurs through plant uptake and by deni trification. With high nitrate loading rates typical of treatment wetlands, denitrification is generally considered the dominant mechaniism of nitrate los s. Wetlands have two environmental characteristic s that promote denitrification (1) The sediments a re anoxic, a requisite condition for denitrification (redox potential, 300mv) and (2) Plant growth pro vides a source of carbon fuel for denitrification. G iven these characteristics, wetlands should be an excellent natural treatment system for waters cont aminated mainly with nitrate. First, wastewater tr eatment wetlands usually receive most of their nit rogen in the form of ammonia or organic nitroge n. These forms of N must be converted to NO_3^- before denitrification can occur. Much of the inorg anic carbon needed for denitrification in wastewat er wetlands and provided by the wastewater itsel f. Aquatic macrophytes have been widely used to remove nitrogen from both wetlands and wastewa ter(Maine, et al; 2006). Aoi, T and Hayashi, T; 19 96 performed nitrate removal experiments with bo th water lettuce(*Pistia stratoites*) and water hyaci nth(*Eichhornia crassipes*). However only limited e xperiments have been performed on the removal o

f nitrate from synthetic medium by means of aqu atic plants.

2. Materials and Methods

2.1 Preparation of aquatic plants

The aquatic macrophytes used for the removal o f nitrate from synthetic medium are *Hydrocharis dubia* and *Salvinia* sp. These species are collected from pond and washed throughly with distilled w ater to remove the particles adhering to the plants and than are grown in the laboratory prior to the experiment

2.2 Nitrate Removal Experiment

Nitrate removal experiments are performed with synthetic nitrate solutions. Nitrate solutions were prepared with three different concentrations (100, 200, 300 mg/L), using NH_4NO_3, and kept in contai ner(40h× 30w × 30l). The cleaned plants were intr oduced into the containers, with the roots submer ged in the solutions, and kept in laboratory condit ion for 20 days. Fluorescence lamps were used as a light source to activate photosynthetic process i n test plants. the light intensity was constantly m aintained during the day periods of experimentatio n. Control experiments were also performed the s ame nitrate solutions concentrations, but without a quatic plants. The nitrate level in the synthetic so lution was sampled 5 times over a 20 days perio d, on day 3, 7, 11, 15, 20. Nitrate nitrogen was de termines by Brucine Method with test kit. For th e nitrate test 0.5 ml of sample was put in the tes t kit tube and 0.5 ml of solution was added. Imm ediately , kit was made ten times upside down an d heated for 20 minute at 100°C in thermoreactor. The solution was cooled for 5 minute and measur e the value by portable Spectrophotometer (model# HACH-DR-2800) at 410 nm.

3. Results and Discussion

The nitrate removal efficiencies from the syntheti c solutions with *Hydrocharis dubia* and *Salvinia* s p during 20 days of experiments are illustrated in Fig1. The nitrate concentrations in the synthetic s olutions both before and after treatment are also presented in Table

Fig1. Nitrate Removal from synthetic solution by *Hydrocharis dubia* and *Salvinia* at different concentratioon

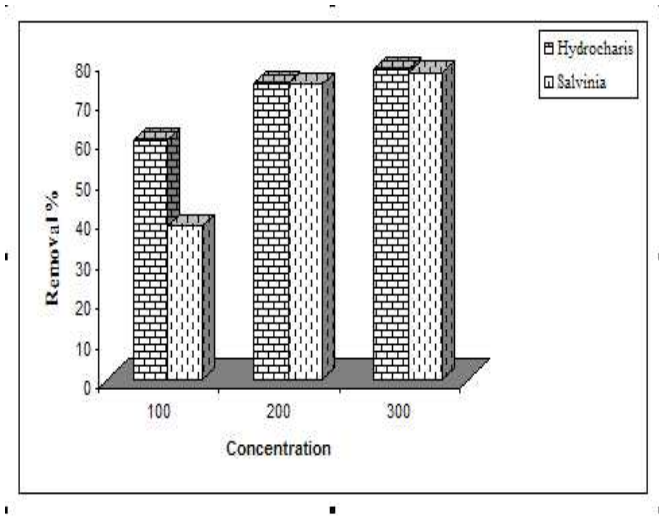

Table1. Nitrate concentrations (mg/L) in synthetic solutions be fore and after treatment with aquatic plants

Before	After (20 day)	
	Hydocharis dubia	*Salvi nia*
100	39.6	45.5
200	51.45	50.65
300	67.23	68

Regardless of the initial nitrate concentrations, the removal efficiencies showed increasing tendencies with the growing period of two different aquatic plants. The removal efficiencies of all the aquatic plants showed maxima with 300 mg/L. our result showed that *Hydrocharis dubia* gave the highest nitrate removal efficiency from the synthetic soluti ons. For *Hydrocharis dubia*, the removal efficienc y increased with increasing nitrate concentrations within the range 100 - 300 mg/L, with the maxi mum removal efficiency of 78%. Though the maxi ma removal efficiency was found in 300 mg/L but the plant growth did not increase in same magnit ude. At the end of experiment in 300 mg/L plant started to turn in brown and going to be die. So

it was concluded that above 300 mg/L plant could not survive, an unable to remove nitrate because of high concentration of nitrate affecting the upta ke of nitrate in the root system. Similar result wa s observed by Ayyasamy et al; 2009. From nitrat e removal experiments in wetland microcosm Inge rsoll and Baker, 1998 reported a removal efficienc y of over 90% with an initial nitrate concentration s of 30 mg/L. The removal efficiencies ranged fro m 31 to 51% for water lettuce and from 18 and 3 6% for *Salvinia* sp. However, our result showed b y *Salvinia* was just double.

4. Conclusions

In this study, the possible reduction of nitrate con tent in a synthetic medium, mainly consisting of NH_4NO_3 solution was investigated using two diffe rent aquatic plants; *Hydrocharis dubai* and *Salvini a* sp. It was concluded that the nitrate content wa s reduced by *Hydrocharis dubia*. The nitrate remo val efficiency from the synthetic medium increase d from 60.4 - 78%, when the initial nitrate concen tration was increased from 100 - 300 mg/L. this suggest that the optimum initial nitrate concentrat ions in the medium to be treated by *Hydrocharis dubia* was 300mg/L

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