

PHYTOREMEDIATION POTENTIAL OF
WATER SPINACH, *IPOMOEA AQUATIC* AND
AQUAPONIC FARMING SYSTEM IN
IMPROVING WATER QUALITY OF HEAVY
METALS CONTAMINATED WATER
RESOURCES

MOHAMAD AZAM BIN RAMLY

UNIVERSITI MALAYSIA PAHANG



SUPERVISORS' DECLARATION

I hereby declare that I have checked the thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Applied Science (Honor) Industrial Biotechnology.

Signature

Name of Supervisor : DR RAMA YUSVANA

Position : LECTURER

Date : 5 JANUARY 2017



STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature

Name : MOHAMAD AZAM BIN RAMLY

ID Number : SB13057

Date : 5 JANUARY 2017

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MOHAMAD AZAM BIN RAMLY

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ABSTRACT

Water spinach, *ipomoea aquatic* which is grows largely in Southeast Asia, Southern China and India may contain heavy metals that come from their surroundings habitats. This study was conducted to determine the concentration of the heavy metals contain in water sample and water spinach sample after growing it in the aquaponic system for 50 days. The study also about the phytoremediation potential of water spinach, *ipomoea aquatic* in restoring water quality of heavy metals contaminated water resources. Two system of aquaponic system were built and using two different type of water which was one using normal water and one from the lake of Universiti Malaysia Pahang (UMP), Pekan Campus which contained metals such as Barium (Ba), Antimony (Sb) and Lead (Pb). To study the capability the water spinach, the plant been collected, dried, grinded and undergo wet digestion process before did the sample analysis. The presence of Lead (Pb) in water spinach sample showed that the plant is actually can absorb the metals contaminated in water sources instead of soil and actually the aquaponic system help in findings the relation in close scale farming system. The results also shows that, for industrial site and manufacturing site mostly is dangerous place to grows plants for consuming by people but suitable as a tools to clean up the nature that environmental friendly.

Key: heavy metals, aquaponic system, phytoremediation

ABSTRAK

Kangkung, *Ipomoea aquatica* yang tumbuh sebahagian besarnya di Asia Tenggara, Selatan China dan India mungkin mengandungi logam berat yang datang dari persekitaran habitatnya. Kajian ini dijalankan untuk menentukan kepekatan logam berat dalam sampel mengandungi air dan sampel kangkung selepas berkembang dalam sistem aquaponic selama 50 hari. Kajian ini juga mengenai potensi Fitopemulihan daripada kangkung, *Ipomoea aquatica* dalam memulihkan kualiti air dari sumber air yg tercemar dengan logam berat. Dua sistem sistem aquaponic dibina dan menggunakan dua jenis yang berbeza air yang merupakan satu daripadanya menggunakan air biasa dan satu lagi menggunakan air dari dalam tasik Universiti Malaysia Pahang (UMP), Kampus Pekan yang mengandungi logam seperti Barium (Ba), Antimoni (Sb) dan Lead (Pb). Mengkaji keupayaan kangkung, tumbuhan itu telah dikumpulkan, kering, dikisar dan menjalani proses penghadaman basah sebelum melakukan analisis sampel. Kehadiran Lead (Pb) dalam sampel kangkung menunjukkan bahawa tumbuhan sebenarnya boleh menyerap logam tercemar dalam sumber air selain daripada tanah dan sebenarnya sistem bantuan aquaponic dalam dapatan hubungan di dekat sistem pertanian tertutup. Keputusan juga menunjukkan bahawa, untuk tapak perindustrian dan tapak pengeluaran kebanyakannya adalah tempat berbahaya kepada tumbuh tumbuhan untuk dimakan oleh manusia tetapi sesuai sebagai alat untuk membersihkan kerana ia bersifat mesra alam sekitar.

Kata kunci: logam berat, sistem aquaponic, fitopemulihan

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LIST OF SYMBOLS

g	-	grams
ppm	-	part per million
ppb	-	part per billion

LIST OF ABBREVIATIONS

Ba	-	Barium
Sr	-	Antimony
Pb	-	Lead
DO	-	Dissolved Oxygen
E.C	-	Electrical Conductivity
TDS	-	Total dissolved Oxygen

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND RESEARCH

In this world, the nature has been polluted everyday and the solutions to overcome it are too slow than the pollution itself. The seriousness of pollutions becomes the major issues in all the countries around the globe with debating cases between them. The pollutions are continuing and started new problems like the global warming, flora and fauna extinctions. In the developing world, the industry become bigger each day and mostly this is become the major contributor in polluting the nature. This contributor is polluting mainly in the water resources and this is become serious issues since water is the source of life that needed by all organism and to balance the ecosystem.

Currently, the uses of biotechnology are widely developed in order to overcome many issues that rise. Many tools and application had been used to restore water quality of polluted water resources. In research history, there were many researches had been done to provide the information on how to cleanup or restoring the quality of polluted water which include the heavy metals for the better environment. The use of plant in phytoremediation is one of the best ways to be applied in this condition. The reason is mostly because of the ability of the plant in absorbing and restoring the pollutants in their biomass.

Plants have several technologies that include the process in handling the pollutant which are Phytoextraction, Rhizofiltration, Phytostabilization, Rhizodegradation, Phytodegradation and Phytovolatilization (Kadukova, Manousaki, Kokkali and Nikolopoupou, 2000). This is obvious to use plants as one of the nature

component to deal with the pollutions as easily grows and have great deal in balancing the environment by absorbing the pollutants (heavy metals) to be stored or transforming it to be release into the harmless form back to the nature.

Plants are been used widely in handling contaminant in land (soil) compared to water. Since the plants are the safest ways in handling contaminant, it becomes the alternatives to be used rather than others technology (Ullah, A., et al, 2015). Heavy metals as one of the elements that can be found in water and they will become treating to the nature if the content are too high. It is also have the effect on the water user or the drinker, by relating it with the research, there are the connection of the chronic disease with the contaminated water supply that contain the heavy metals (Hanaa, M., et al 2000).

Aluminium (Alzaimer's and Parkinson's disease), Arsenic (cancer), Cadmium (kidney damage), Lead (poison to human body) (as cited in Bakare-Odunola, M.T., 2005) and Mercury (effects the hearing, vision, speech and movements)(as cited in Hammer, M.J., and M.J. Hammer, Jr., (2004)), are several common heavy metals that have their own toxicity that will gives the serious problems if they been absorbs by water user (Momodu, MA., and Anyakora, CA. (2010)). Based on the many problems faces by all the country, researchers develop methods where can the heavy metals be removed from the water. Here, phytoremediation plays the important role in balancing the nature by applying their effecting mechanism in dealing with the heavy metals.

Hydroponic has been used widely and also help in restoring water quality become the reason of the research of phytoremediation in hydroponic system at first. The combination of these two are used because phytoremediation is widely used in soil or land, bring the method of using plant as the agent in handling heavy metals in contaminated water will become huge changes towards the nature. Generally, the hydroponic system work by pumping the water (containing nutrients) up from the fish tank at the bottom to the grow bed container to be use by the plants as the nutritional supply and making the suitable condition for the plants growth, then the water will flow back to fish tank through siphon at certain water level.

1.2 PROBLEM STATEMENT

In industrial area, lots of industrial in the world produce waste and pollutants towards the nature. The bigger problem is the industries pollute the water resources including the lake, river and even the ocean by releasing the waste. However there is no effective method that can be used in order to overcome and directly helping in restoring the water quality. The major problems in waste containing in water resources is the heavy metals that are hardly compound to be remove from water. In this case, the methods that had been accepted by humans are importance to be used such as aquaponics system. Aquaponicsystems that have directly contact with the water are believed to be able to restore the water quality by absorbing the heavy metals in its plants biomass. The ability of the plants in absorbing and restoring the water quality in aquaponic system will be observed. The detection of heavy metals in plants sample and water sample using inductively coupled plasma mass spectrometry (ICP-MS) for heavy metals contain in water sample will become major issue here.

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