

EFFECT OF FLOW RATE ON WATER QUALITY PARAMETERS AND
PLANT GROWTH OF WATER SPINACH (*Ipomoea aquatica*)
IN AN AQUAPONIC FLOW THROUGH SYSTEM

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Thesis Submitted in Partial Fulfilment of the
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DEDICATION

This is especially dedicated to my beloved parents,
Mr. Mamat Zawawi bin Kadir and Mdm. Faridah bte Safiee,
For their never ending love and who always pray for my success and guided me
through life.

To my friends,

Fathurrahman bin Lananan, Mohd. Mukriz bin Mohd. Kassim, Mohd. Fazhan bin
Mohd. Hanafiah, Abdul Al-Hafiz bin Ismail, Khor Wai Ho, Ainnu binti Danial and
Norasmah binti Mantali.

- Thank you very much -

Abstract of thesis presented to the Senate of Universiti Malaysia Terengganu in fulfilment of the requirement for the degree of Master of Science

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Flow-through aquaculture system (FTAS) are system where fish are held in ponds, tanks, raceways or other specially designed apparatus which have water constantly passing through them. These systems can be used to grow either fresh or marine species. The flow of water through the culture system supplies oxygen to the fish and carries dissolved and suspended wastes out of the rearing system. In this study, a prototype of an aquaponic system was built at the Freshwater Hatchery Unit in the campus of University Malaysia Terengganu. The system consists of a fish rearing tank, hydroponic trough, sand filter and water holding tank. Hydroponic troughs were planted with water spinach (*Ipomoea aquatica*) that had been used to treat wastewater from aquaculture system stocked with African catfish (*Clarias gariepinus*). The effect of two different water flow rates (0.8 and 1.6 L min⁻¹) was tested in order to evaluate the relationship between nutrients removal and water quality with plant growth performance. The results showed that water spinach grew well and showed a positive response to aquaculture wastewater applications in terms of growth and biomass production. The final effluent in the flow rate of 0.8 L min⁻¹ to 1.6 L min⁻¹ showed their influence on water quality parameter of 5-day biochemical oxygen demand (2.53 to 2.25 mg L⁻¹), total suspended solids (20.93 to 17.27 mg L⁻¹), total ammonia nitrogen (3.79 to 2.8 mg L⁻¹), nitrite-nitrogen (0.167 to 0.112), nitrate-nitrogen (6.25 to 4.96), and total phosphorus (3.087 to 2.663 mg L⁻¹). In term of remediation, the results showed that the FTAS system removed 5-day biochemical oxygen demand (54-59 %), total suspended solids (60- 63%), total ammonia nitrogen (61-72%), nitrite-nitrogen (62-65%), nitrate-nitrogen (61-72%), and total phosphorus (62-64%) and demonstrated positive correlated with flow rates. It was found from this study that both plant growth and water quality parameter were better at a flow rate of 1.6 L min⁻¹ than at flow rate of 0.8 L min⁻¹.

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**KESAN KADAR ALIR TERHADAP KUALITI AIR DAN KADAR
TUMBESARAN KANGKUNG (*Ipomoea aquatica*) SECARA AKUAPONIK
MELALUI SISTEM ALIRAN TERUS**

**MOHD FAUZAN BIN MAMAT ZAWAWI
NOVEMBER 2010**

Sistem aliran terus (FTAS) adalah sistem di mana ternakan ikan dibela di dalam kolam, tangki atau sistemlain yang direka khas untuk mempunyai ciripengaliran air secara terus-menerus. Sistem ini boleh digunakan untuk tumbesaran sama ada spesies air tawar atau laut. Aliran air membekalkan bekalan oksigen untuk sistem ikan dan membawa oksigen terlarut dan sisa buangan keluar dari sistem tangki ikan. Dalam kajian ini, sebuah prototaip sistem akuaponik telah dibina di Unit Hatcheri Air Tawar, kampus Universiti Malaysia Terengganu. Sistem ini terdiri daripada tangki ternakan ikan, tapak semaian hidroponik, pasir penapis dan tangki simpanan air. Tapak semaian hidroponik ditanam dengan kangkung (*Ipomoea aquatica*) yang telah digunakan untuk menyerap nutrien terlarut dari sistem akuakultur yang mengandungi ternakan ikan keli afrika (*Clarias gariepinus*). Pengaruh dari dua kadar alir air yang berbeza (0.8 dan 1.6 L min^{-1}) telah dilakukan untuk mengkajiperkaitan antara penghapusan nutrisi dan kualiti air dengan kadar pertumbuhan tanaman. Keputusan kajian menunjukkan bahawa kangkung tumbuh dengan baik dan menunjukkan respons positif untuk aplikasi sisa akuakultur dalam menggalakkan pertumbuhan tanaman dan peningkatan penghasilan biojisim. Keputusan akhir parameter effluen bagi kadar alir 0.8 L min^{-1} dan 1.6 L min^{-1} adalah masing-masing: BOD_5 (2.53 - 2.25 mg L^{-1}), TSS (20.93 - 17.27 mg L^{-1}), TAN (3.79 - 2.8 mg L^{-1}), nitrit-nitrogen (0.167 - 0.112 mg L^{-1}) nitrat-nitrogen (6.25 - 4.95 mg L^{-1}) dan fosforus (3.087 - 2.663 mg L^{-1}). Keputusan kajian juga menunjukkan bahawa aliran aquaponik melalui sistem ini menyumbang kepada pengurangan BOD_5 (54 - 59%), sisa terampai (60 - 63%), ammonia nitrogen total (61 - 72%), nitrit-nitrogen (62 - 65%), nitrate-nitrogen (61 - 72%) dan fosforus (62 - 64%) dan menunjukkan toleransi yang positif dengan kadar alir. Hasil daripada kajian ini menunjukkan bahawa kadar tumbesaran tanaman dan kualiti air adalah lebih baik pada kadar alir 1.6 L min^{-1} .