

# Production performance of freshwater redclaw crayfish, *Cherax quadricarinatus*, in an aquaponics system based on phytoremediation technology

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## Abstract

**Background** - The well-known freshwater redclaw crayfish are from the genus *Cherax* (Olszewski 1980). One species of freshwater lobster which is included in the genus *Cherax* is *Cherax quadricarinatus* or commonly known as redclaw crayfish which originates from the northern Australian continent (Queensland and Northern Territory) and southern Papua New Guinea (Munasinghe et al 2004). Freshwater crayfish have a promising future in the fishing industry. Apart from being easy to maintain, crayfish are resistant to disease, omnivorous, grow quickly and have a high egg production capacity. Freshwater crayfish deserve to be widely developed in society in terms of technical aspects of cultivation and market potential, so that they can increase economic value (Jones 1995). The development of the freshwater lobster business cannot be separated from a high market demand, especially the export market. Demand for freshwater crayfish for consumption coming from several countries such as Malaysia, Singapore, Taiwan, Hong Kong, China, Japan and Korea. Australia, New Zealand, France, the Netherlands, Germany, Belgium, Canada and the United States make crayfish a favorite food because they believe it is healthier than seafood (FAO 2016). FAO noted that there are at least 13 largest freshwater lobster producing countries, namely Australia, Mexico, Argentina, Uruguay, Ecuador, Indonesia, Belize, China, Israel, Morocco, Panama, Spain and the United States (Parnes & Sagi 2022). As one of the freshwater lobster producing countries, Indonesia needs efforts to increase production through hatcheries. Freshwater lobster hatchery activities are often hampered by low survival rates and seed rearing techniques that are still difficult to understand (Jones 1995). The problem faced in freshwater crayfish cultivation activities is cultivation waste such as ammonia (NH<sub>3</sub>). This causes a decrease in the quality of cultivation water and can cumulatively cause a decrease in lobster performance and death. The main sources of cultivation waste that have the potential to pollute the cultivation environment are uneaten feed residue and excretory products such as feces, urine and metabolic waste (Cripps & Bergheim 2000). The accumulation of food waste and fish waste during nursery often causes a decrease in water quality in nursery ponds, resulting in toxic effects on fish. The toxicity of ammonia depends on several factors such as the life stage of the fish. Some studies have reported more influence of ammonia on growth performance (Lin et al 2002). Ammonia is the main nitrogenous waste product excreted by aquatic biota, existing in equilibrium as ammonia molecules (NH<sub>3</sub>) and ammonium ions (NH<sub>4</sub><sup>+</sup>) in the aquatic environment (Gomu?ka et al 2014). Conventional water quality management can be done by changing cultivation water periodically, but it is less effective because it requires quite a lot of water and is expensive (Rezagama et al 2017). Cultivation wastewater containing organic materials will be used by plants as nutrients for growth (Sikawa & Yakupiyiyage 2010). The principle of a recirculation system is the reuse of water that has been released from cultivation activities (Effendi et al 2015). The advantage of a recirculation system is that it can minimize the use of water and reduce organic materials such as ammonia, nitrite, and pH buffers (Yanong 2012). Phytoremediation with aquatic plant through aquaponic system is an integrated system between aquaculture and hydroponic using recirculation system. The waste of this system can be absorbed by aquatic plant. In aquaponics, nutrient-rich effluent from fish tanks is used as nutrient source of hydroponic production beds for growing vegetables, herbs, and flowers. This negates the cost of a biofilter used for other recirculating aquaculture systems, and is more environmentally sustainable (Allsopp et al 2009). Phytoremediation is a cheap and energy-saving alternative method that acts on biological processes, where plants are used to remove nutrients and waste from the cultivation medium (McGee & Circha 2000). There are advantages to using phytoremediation: (i) it is economically feasible phytoremediation is an autotrophic system powered by solar energy, so it is easy to manage, and installation and maintenance costs are low, and (ii) it is environmentally friendly, can reduce exposure to pollutants in the environment and ecosystem (Zhang et al 2014). The formulation of the problem in this research is: whether the use of phytoremediation technology by plants is able to reduce waste (zero waste) from crayfish cultivation activities and whether reducing this waste can improve crayfish growth performance. This research aims to determine the ability of phytoremediation of freshwater crayfish waste by water spinach and mustard greens plants, to determine the physiological profile and performance of crayfish maintained using a phytoremediation-based aquaponics system. Comparative physiological studies of hematology and blood biochemistry of several lobster species are of great interest. A number of cultivable crustacean species have been examined for hematological properties to determine the range of normal values and deviations, which may indicate disturbances in physiological processes (Lesmana et al 2022).

**Purpose** - This research aims to determine the ability of phytoremediation of freshwater redclaw crayfish (*Cherax quadricarinatus*) waste by water spinach and mustard greens, to determine the physiological profile and performance of *C. quadricarinatus* maintained with the system of phytoremediation-based aquaponics.

**methodology** - Material and Method Containers and media research. The experiment was conducted in an indoor laboratory using 20 containers (for 5 treatments in 4 replications) of 56 x 40 x 18 cm<sup>3</sup> in aquaponic systems. The treatment consisted of four containers without plant, four containers with 5 water spinach plant, four containers with 10 water spinach plant, four containers with 5 mustard greens plant and four containers with 10 mustard greens plant. Crayfish. Specimens of *C. quadricarinatus* an average body weight of 17 g ind<sup>-1</sup>, served as experimental animal. *C. quadricarinatus* were obtained from Ciherang Lobster Farm catches in West Java Province, Bogor District, Indonesia.

**Findings** - Parameters that were observed include plant growth performance, phytoremediation profile by plants, physiological profile and growth performance of freshwater crayfish. Aquaponic system using water spinach and mustard greens reduced wastewater in freshwater *C. quadricarinatus* culture, particularly the nitrate and ammonia (NH<sub>3</sub>), by 83.33-90.91% and 38.09-59.09%, respectively. In this study, the AST and ALT values in the controls were higher compared to treatments, this shows that *C. quadricarinatus* is experiencing stress. The cultivation wastewater containing unused *C. quadricarinatus* feed and feces could support the growth of spinach and mustard green at aquaponic system without nutrient addition

**Originality** - Parameters that were observed include plant growth performance, phytoremediation profile by plants, physiological profile and growth performance of freshwater crayfish. Aquaponic system using water spinach and mustard greens reduced wastewater in freshwater *C. quadricarinatus* culture, particularly the nitrate and ammonia (NH<sub>3</sub>), by 83.33-90.91% and 38.09-59.09%, respectively. In this study, the AST and ALT values in the controls were higher compared to treatments, this shows that *C. quadricarinatus* is experiencing stress. The cultivation wastewater containing unused *C. quadricarinatus* feed and feces could support the growth of spinach and mustard green at aquaponic system without nutrient addition

Keywords: phytoremediation, crayfish, cultivation waste, plant, growth performance.

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