



MINI REVIEW

Nutritional Composition and Antioxidant Activity of Freshwater Lobster in Malaysia: A Short Review

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Freshwater lobster or scientifically known as *Cherax quadicarinatus* is a non-native species from Northern Australia and resided in Malaysia in the early 1980s. Out of species in freshwater crayfish groups, the red claw is the sole tropical species and has received much appreciation for being a top option for aquaculture. Thus, this study reviews *C. quadricarinatus* in Johor, Malaysia in terms of its origin, influence in agriculture, nutritional composition, as well as the antioxidant activity. It can be concluded that the consumption of crayfish lobster offers many health benefits due to its high antioxidant content and nutritional value.

Keywords: Freshwater lobster, Red claw crayfish, *Cherax quadricarinatus*, Antioxidant activity, Nutritional composition.

INTRODUCTION

Freshwater lobster or a crayfish is a native to Northern Australia and south-eastern Papua New Guinea for their river catchments [1]. It is called as freshwater lobster because of its appearance and habitat resembling a lobster [2]. Crayfish is a huge, physically strong omnivore with a wide range of tolerances to different environmental circumstances and it features rapid growth, excellent meat yield, robust stress resistance, as well as a tender flesh [3]. Scientifically called as *Cherax quadricarinatus*, the red crayfish is introduced to Malaysia because of its high tolerance to various environmental settings [4].

In year 2003, this species aquaculture production began in Peninsular Malaysia, specifically in Johor [5,6]. The wild record of it may start by unintentional or deliberate release from aquaculture and aquaria and it is being an invasive non-native crayfish in Malaysia which has successfully established itself, considering Malaysia and their native region have comparable climatic characteristics [7]. Hence, this study aims to review the freshwater lobster in Malaysia, especially in the region of Johor for its origin, influence in agriculture, nutritional composition, as well as the antioxidant activity.

***Cherax quadricarinatus* (Freshwater lobster):** *Cherax quadricarinatus*, an aquatic red claw crayfish, belongs to the family Parastacidae, that can only be found in Australia, New Zealand, New Guinea, Madagascar and parts of South America [8]. The Yabby (*C. destructor*, *C. albidus*), which is found in Australia more southerly central and western areas and the Marron (*C. cainii*, *C. tenuimanus*) have all been evaluated and developed for aquaculture. According to Rigg *et al.* [9], the common name of red claw is derived from the red colouring of a decalcified patch on the outer border of the chelicerae of sexually mature males whereas the scientific name, *Cherax quadricarinatus*, alludes to the four keel-shaped ridges on the cephalothorax.

According to Grosset *et al.* [10], redclaw crayfish has a body with smooth carapace with one pair of long post-orbital ridges producing two keels on the front carapace. The spines on the shoulder of the carapace are noticeable behind the cervical groove and its telson's dorsal surface has no spine with membrane covering on its back half. The length of *C. quadricarinatus* is said to be up to 35 cm or longer. It has crimson spots laterally on abdominal segments, beige and red flecks on joints and body.

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Origin: Red claw crayfish, a Northern group of *Cherax* crayfish, settles in streams, lakes and billabongs in the Northern part of Northern Territory and located far north of Queensland in Australia and the Southern part of New Guinea [11,12]. Haubrock *et al.* [13] reported that several tropical and subtropical nations have successfully received this species and feral populations have developed there.

Breeding environment/cultivation in aquatic systems: The wild populations of *C. quadricarinatus* were predominantly found in the area of Machap dam and Benur river in Johor, Ayer Keroh Lake and Timun river in Melaka, Puchong Perdana Lake in Selangor and streams in Suai, Sarawak, Malaysia (Fig. 1) [2]. The same study has reported based on the interview with the fisherman, fishery officer and local anglers suggesting that the red claw crayfish have been spotted around Johor, notably in the Benut River, since the 1980s, but following a flood in 2006, they entered the region of Machap dam. However, for Yabby, the *C. destructor* and *C. albidus*, according to Fisheries Regulations, Amendment 2012, Fisheries Act 1985, it is prohibited to be imported, sold, cultured or kept in Malaysia as it is deemed as a threat to native aquatic species [7]. Hence, the compliance of rules and regulations under Fisheries Act 1985 and MAQIS Act 2011 (National Committee of Invasive Alien Species Malaysia 2018) must be done with every introduction of any non-native aquatic species into Malaysia [7]. Nonetheless, *C. quadricarinatus* is considered as least concern as assessed by IUCN (2010), meaning no major threats can affect the species or its habitat, as well as population decline which is not likely to happen [14].

Influence in aquaculture: Freshwater ecosystem can be known as the most threatened ecosystems on earth including disproportionate number of threatened species [15]. Crayfish are a various taxonomic group of crustaceans that can be considered as endangered species. The red crayfish can be positively characterized by its biological, ecological and commercial attributes for aquaculture. Othman *et al.* [16] and Khairul [17] stated that studies regarding red claw crayfish are undervalued and the number of research published are finger counted. These species are environmental tolerance and can be either aquaculture or aquarium industries [18,19].

Economic value: After being introduced to Western Australia and New South Wales in late 1980s, this species economic interest in Australia started to grow. Many nations in southern Asia, including China, North and South America, Africa, New Caledonia, Israel and some portions of Europe were granted permission to import juveniles and brood stock earlier in 1990s. Ecuador, Jamaica, Israel, Paraguay, Mexico, Singapore, Puerto Rico, South Africa, Zambia and Thailand are among the countries that have reported having established wild populations [14]. Due to its high demand and gourmet excellence, it might reach high market values [20,21]. According to Halim [22], the global market of lobster in Asia-Pacific was over US \$ 7.68 billion. In year of 2018, the production of crayfish was 82.5 tones which contribute to US \$ 1.17 million. Red claw is mostly produced in Malaysia, with production patterns showing growth from 2013 to 2017 [23]. In Malaysia, it has grabbed an interest from the locals and regarded as a source of income [2], owing to the market price that varies depending on its size and quality, but it may reach up to 30 US \$/kg [7].

Population growth: According to Johan *et al.* [5], the population of these red claw lobsters were recorded in the Malaysian east and west. In addition, this lobster was found in Malaysia since 1980s and expanded since 2011 until 2015. Malaysia culture has facilitated and speed up the hatcheries of lobster with the temperature of 27 °C, which the red claw crayfish maximize climate [2,24]. About 18 million kg of hatcheries are estimated to be grown on the year of 2022 since 2017 and expected to reach the maximum growth on the year of 2029 [22].

Males of freshwater lobster grown faster and has large size of harvest compared to female lobster and it produces 18% income increases of male's lobster [25]. New *et al.* [26] reported that the world growth population of freshwater lobster in the year 2007 was found to around 458 564 tones and 246 tonnes from it are from Malaysia. In previous studies [27-29], it stated that the claw population for red claw depending on size such as 0.1 g to 25.6 g with claw population around 25% to 30%)

Nutritional value: Freshwater lobsters are known to be protein rich aquaculture, furthermore the aquaculture food

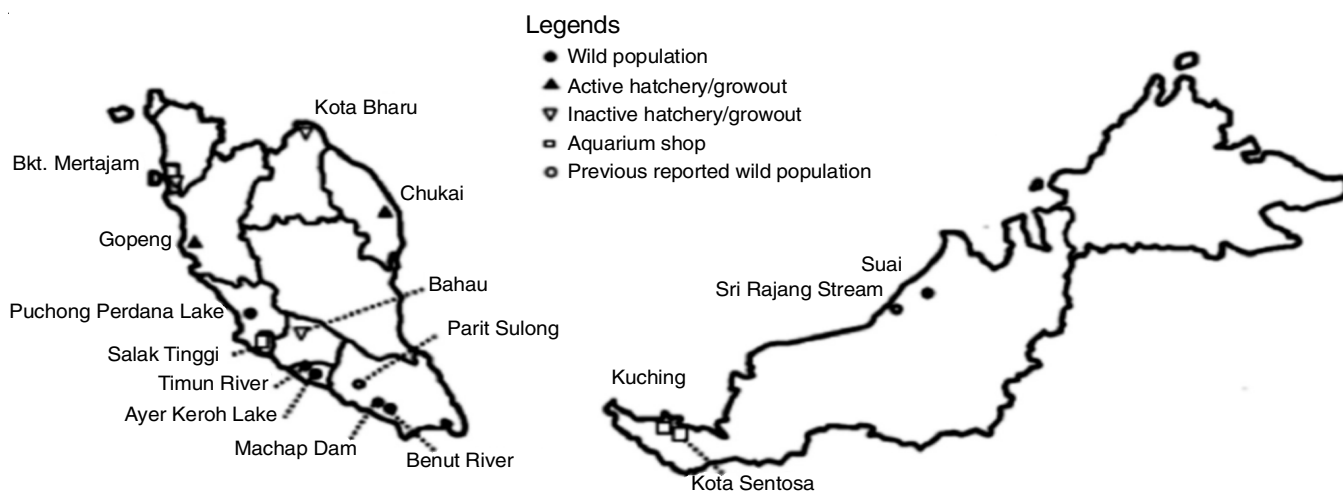


Fig. 1. Marked locations associated with wild red claw population, red claw breeding, culture and trading [Ref. 2]

TABLE-1
NUTRITIONAL COMPOSITION OF MALE AND FEMALE FRESHWATER PRAWN AND RED CLAW CRAYFISH [Ref. 30]

Proximate composition	Giant freshwater prawn		Redclaw crayfish		Two-way ANOVA		
	Male	Female	Male	Female	Gender	Species	Interaction
Moisture (%)	78.03 ± 0.25 ^a	78.33 ± 0.22 ^{ab}	79.17 ± 0.16 ^c	78.87 ± 0.50 ^{bc}	Not significant	P < 0.05	Not significant
Protein (%)	20.02 ± 0.55 ^a	18.34 ± 0.38 ^b	18.71 ± 0.36 ^b	17.78 ± 0.38 ^b	P < 0.05	Not significant	Not significant
Lipid (%)	1.24 ± 0.05 ^a	2.03 ± 0.05 ^b	2.98 ± 0.38 ^c	0.54 ± 0.03 ^d	P < 0.05	Not significant	P < 0.05
Ash (%)	1.44 ± 0.04 ^a	1.25 ± 0.02 ^b	1.66 ± 0.03 ^c	1.32 ± 0.03 ^b	P < 0.05	Not significant	Not significant

Values are presented as mean ± standard error (SE). Values are shown in wet-weight basis. Values in the same row with different superscripts depict significant different (P < 0.05).

sources are known to have a good source of essential nutrients such as omega fatty acids and vitamins. The nutritional composition value is given in Table-1 as estimated by Tee *et al.* [30]. According to data gained from Food Data Central (FDC) (2020) [31], in 100 g of steamed or boiled lobster nutritional value as stated in Table-2. Moreover, the cholesterol content of lobster is not corresponded to fat content where it served 70% of cholesterol [30].

TABLE-2
NUTRITIONAL COMPOSITION OF STEAM OR BOILED LOBSTER [Ref. 31]

Nutritional content	Amount (unit)	Nutritional content	Amount (unit)
Water	77.6 g	Iron	0.26 mg
Energy	88 kcal	Magnesium	36 mg
Protein	18.9 g	Phosphorus	129 mg
Lipid	0.85 g	Potassium	160 mg
Carbohydrates	0 g	Sodium	665 mg
Total fiber	0 g	Zinc	4.02 mg
Calcium	91 mg		

Beneficial aspects of freshwater lobster: Studies has mentioned that consuming shellfish and fish will help to reduce the risk of obesity, diabetes and heart diseases involving reducing the cholesterol level [32]. Red claw crayfish or lobster is a type of shellfish which has the similar characteristics and taste as shrimp and crab that contain high nutritional value [33]. The benefits of freshwater lobster when compared with other crustaceans, the protein contains in it are higher (Table-3). Previous research [34] stated that the protein quality in lobster offers is better or same as milk, soy and red meat.

TABLE-3
NUTRITIONAL COMPARISON OF CRUSTACEANS [Ref. 31]

	Calories	Protein (g)	Fats (g)	Cholesterol (% of the DV)	EPA and DHA (mg)
Lobster	128	27.0	1.2	70	280
Shrimp	307	22.0	16.8	71	186
Crab	97	21.0	0.8	62	197
Crayfish	113	23.3	1.7	38	231

Advantages on health: These species can threaten human health if consumption is not in proper cooking and handling that can causes various diseases such as lung disease [35,36]. These lobsters are believing can promote lower blood cholesterol with proper consumption as it contains ω-3 fatty acid that can protect heart [37]. In addition, lobster contains copper which plays important part in energy and DNA production besides that it can act as anticancer agent due to selenium

contents to protect against chronic diseases [38,39]. Studies conducted by Un *et al.* [40] and Susan *et al.* [41] determined that lobster can prevent stroke due to its EPA and DHA that can lower the blood cholesterol level and reduce the inflammation to prevent atherosclerosis.

Antioxidant activity: The antioxidant activity is a crucial knowledge to understand the response mechanisms of the invertebrates to harmful effects of oxidative stress-induced reactive oxygen species (ROS) [42,43]. Shehata *et al.* [44] reported that the crayfish is believed to be properly developed with vitamin E supplementation to protect against lipid oxidation. The antioxidants supplemented, protect the cells from free radical damage which the antioxidants such as vitamin C and E bind to them and remove their unpaired electrons [44]. When the diets of the aquatic creatures involved vitamin E, it could help the growth and reproduction of the creatures [45,46]. However, a high amount of vitamin E in the diets could cause a high vitamin level, which was found to be bad for the growth and reproduction, as studied on shrimp bodies by Naessens *et al.* [47]. It should be in a limited amount to have a better performance in the biological aspects of red claw crayfish [44]. Moreover, a different study made by Wu *et al.* [48], on the appropriate dietary that includes *Haematococcus pluvialis* (*H. pluvialis*), gives enhancement in the colouration and antioxidant activity of a species called *Eriocheir sinensis*, a Chinese mitten crab.

Conclusion

In conclusion, red claw crayfish is a type of crustaceans that has similar characteristics and taste to shrimp, crabs and shellfish. Due to its environmental tolerance and optimum temperature that are suitable to be grown in Malaysia, this crayfish lobster can be found mostly in Melaka, Johor and Sabah areas of Malaysia. The market potential of these species is proven to catch consumer and breeder interest until it can reach million US dollars in a month. Lobster gives much nutritional value compared to shrimp, crab and other crayfish such as protein content, cholesterol level and ω-3 fatty acids per consumption. Despite high price of these species in the market, the consumption of crayfish lobster offers many human health beneficial due to its protein content and can act as anticancer, prevent lung infections and heart related diseases with proper cooking method. This aquaculture also promotes antioxidant activities to human body with the right amount of consumption per meals due to the present of vitamin E.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this article.

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