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Important Aspects of Freshwater Crabs

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ABSTRACT

Freshwater crabs are one of the macro-invertebrate groups that are particularly ecologically important in the inland waters on a global scale. In addition to the ecological significance of freshwater crabs they are also medically important as medical and pharmaceutical materials (i.e. row material in chitin and chitosan production). However, uncooked freshwater crabs are also medically important as a treat for human health in Asia, Africa, and the Neotropics. Furthermore, they are consumed as food and are used as food additive and fertilizer; especially crab processing residues are used as feed additive. Except Eriocheir sinensis, other freshwater crab species are provided only by fishing from natural resources (i.e. river, lake and pond). In recent years, various production methods are employed for the grow-out of E. sinensis. For example, net-pens installed in shallow lakes, earthen ponds, paddy fields, and small lakes and reservoirs are the most common systems employed for grow-out. On the other hand, earthen ponds and paddy fields are commonly used for seed rearing of the crab. In conclusion, this review shows that freshwater crabs have potentials as an edible and culture candidate species.

Keywords: *freshwater crab; chitin-chitosan; nutrition; food consumption; economy; chemical quality; row material; shell*

INTRODUCTION

Freshwater crabs include more than 1300 species worldwide and contain 20% of all the brachyurans (Tsang *et al.*, 2014). They are consist of eight families; Pseudothelphusidae Ortmann, 1893 (Neotropics; Wehrtmann *et al.*, 2010) and Trichodactylidae Milne-Edwards, 1853 (Mexico, Central and South America; Collins & Williner, 2006), Potamonautidae Bott, 1970a (Africa and Madagascar; Cumberlidge & Daniels, 2008), Deckeniidae Ortmann, 1897 and Platythelphusidae Colosi, 1920 (East Africa; Reed & Cumberlidge, 2006), Potamidae Ortmann, 1896 (North Africa, southern Europe, Asia; Brandis *et al.*, 2000), Gecarcinucidae Rathbun, 1904 (Seychelles, Asia; Shih & Ng, 2011), and Parathelphusidae Adcock, 1910 (Asia, Australasia; Ng, 1990).

Freshwater crabs inhabit in tropical and subtropical areas in many parts of the world (Yeo *et al.*, 2008). They can be caught in most freshwater ecosystems, from clear, fast-flowing montane streams to slow-flowing rivers and streams, as well as in peat and freshwater swamps, stagnant ponds and rice fields, and even in pools in tree holes and leaf axils (Cambridge *et al.*, 2009). On the other hand, some freshwater crabs, such as *Potamon* Savigny, 1816, are only found in fresh water and cannot survive or live in salt water for a long time, while other species such as *Parathelphusa* Milne-Edwards, 1853 can also survive immersion in salt water for short periods of time (Yeo *et al.*, 2008). Terrestrial species can live well distant from permanent freshwater sources, either moving among the forest floor litter or, in some cases, even climbing trees (Ng, 1988; Ng & Tay, 2001; Cumberlidge *et al.*, 2005). According to Yeo *et al.*, (2008) terrestrial freshwater crabs do not need continual immersion in fresh water and can take water from food, drinking dew or casual water, or by capillary or osmotic uptake from moist substrata.

In the world's tropical tropics freshwater crabs are one of the most ecologically important macro-invertebrate groups (Dobson et al., 2007a,b). In addition, uncooked freshwater crabs are medically important as a threat to human health (i.e. as intermediate hosts of paragonimiasis in Asia, Africa, and the Neotropics) (Maleewong, 2003; Blair *et al.*, 2008) and as a source of medical and pharmaceutical materials (i.e. chitin and chitosan) (Rinaudo, 2006). It is considered that freshwater crab species in the world are not

merely a direct food resource, but are also utilised food additives and fertilizers; especially crab processing residues are used as feed additive (Bilgin & Fidanbaş 2011). Therefore, some aspects on the importance of freshwater crabs (i.e., chemical analysis, economic and medical uses, and important species as a food commodity) are reviewed in the present study.

Chemical Analysis

The nutritive value of crabs relies on biochemical components such as proteins, carbohydrates, lipids, amino acids, vitamins and minerals. When crabs are compared to fish and mushrooms, they have exceptional and excellent taste, and they rank third in terms of respectable subtleties of prawns and lobsters and fisheries value they support (Saved and Raghavan, 2001). For example, they meat includes many nutrients and is an excellent source of high quality proteins, vitamins and minerals (Bilgin and Fidanbaş 2011; Jeyalakshmi Kala and Chandran, 2014). It has been announced that large numbers of potamids and parathelphusids are eaten in Thailand. Yeo et al. (2008) also noted that potamids are eaten by South American natives to improve health, treat digestive disorders and improve physical injuries. Crabs also have a good resource of protein, carbohydrates and various minerals. For this reason, identification of the proximate and mineral elements of crab species is of great importance as it has a good impact on human health (Jeyalakshmi Kala and Chandran, 2014). Crab meat composition varies according to gender, animal size, season and cooking method.(Bilgin and Fidanbaş 2011; Jeyalakshmi Kala and Chandran, 2014). The chemical analysis of freshwater crabs is presented in Table 1and 2.

Table1. *Protein, carbohydrate, lipid, moisture and ash of freshwater crab species.*

Species	Organ	Sex	Season	Protein	Lipid	Carbohydrate	Ash	Fibre	References
Spiralothelphusa hydrodroma	Cephalothorax(%dry)	-	-	13.48	0.57	0.85	0.72	-	Varadharajan and Soundarapandian 2014
	Walking legs(%dry)	-	-	3.15	0.19	0.34	0.31	-	
Sudanonautes africanus	Cheliped (muscle only) (%dry weight)	M	Summer	85.34	8.88	2.97	2.45	0.47	Adeyeye, 2002
		F	Summer	87.57	6.11	2.88	3.15	0.49	
Potamon potamios	Meat (%)	M	Spring	13.96	0.67	-	0.99	-	Bilgin and Fidanbaş, 2011
			Summer	18.35	1.05	-	1.06	-	
			Autumn	17.26	0.48	-	1.03	-	
			Winter	16.34	0.56	-	1.05	-	
		F	Spring	13.94	0.67	-	1.05	-	
			Summer	15.84	0.98	-	1.04	-	
			Autumn	15.10	1.08	-	1.08	-	
			Winter	17.25	1.06	-	1.71	-	
Maydelliathelphusa Masoniana	Body meat(%dry weight)	M	Annual Average	59.42	5.15	-	8.58	-	Bandral et al. 2015
		F	Annual Average	54.47	4.76	-	8.39	-	
Sartoriana spinigera	Meat (%)	F	Spring	30-59	7-11	-	38-40	-	Pati et al., 2012

Table2. *Mineral composition of freshwater crab species.*

Species	Organ	Sex	Season	Ca	Mg	Zn	Ni	Fe	Cu	Na	K	References
S. africanus	Cheliped (muscle only) (ppm)	M	Summer	50.14	1.76	-	1836	54.75	109105	44	22	Adeyeye, 2002
		F	Summer	539.62	1.43	-	231	148	47830	53	21	
S. hydrodro	Cephalothorax (%	-	-	9.7	0.81	0.15	-	0.014	0.02	7.51	5	Varadharajan and

ma	dry)											Soundarapandian 2014
	Walking legs (% dry)	-	-	4.3	0.36	0.8	-	0.08	0.01	4.35	3.4	
Potamon potamios	Meat (mg/g)	M	Spring	13.53	2.08	0.21	-	0.02	0.06	11.59	11	Bilgin and Fidanbaş, 2011
			Summer	8.97	1.66	0.20	-	0.03	0.07	9.53	11	
			Autumn	11.77	1.86	0.21	-	0.03	0.05	9.50	11.48	
			Winter	11.91	1.67	0.20	-	0.05	0.06	11.45	10.76	
		F	Spring	13.07	1.74	0.20	-	0.031	0.06	11.58	8.93	
			Summer	14.27	1.86	0.19	-	0.05	0.05	11.88	9.66	
			Autumn	9.92	1.71	0.23	-	0.04	0.06	9.76	10.44	
			Winter	17.87	1.82	0.18	-	0.06	0.05	11.54	9.17	
Sudanonautes africanus	Flesh (mg/100 g))	M	Summer	24.4	30.1	8.14	6.06	11.4	-	29.6	34.5	Adeyeye et al. 2010
		F	Summer	30.9	30.0	7.90	7.46	15.0	-	34.3	36.5	

Economic And Medical Uses

Freshwater crabs are an important source of protein and are eaten in many parts of the world. Ng (1988) stated that the great amount of potamids and parathelphusids in Thailand are rarely consumed by the locals. In addition, Yeo & Ng (1998) reported that potamids are important in the diet of rural and hill tribes of northern Vietnam. Dai (1999) also reported that freshwater crabs are eaten for purported medicinal and tonic properties, containing treatment of stomach ailments and physical injuries In South America, indigenous groups use freshwater crabs eating, especially the great pseudothelphusids (Finkers 1986).

Medically, freshwater crabs are important because they are the intermediate hosts of parasitic lung fluke, It is known that Paragonimus (Platyhelminthes) which gives rise to paragonimiasis. This dangerous disease affects people when eating infected crabs (Ng, 1988; Dai, 1999; Cambridge, 1999). Rodriguez and Magalhães (2005) declared the pseudothelphusid species known as hosts for Paragonimus and discussed its presence in the neotropics. Although appropriate cooking kills parasites, most rural communities prefer to eat freshwater crabs half-raw (Ng, 1988; Dai, 1999). According to Ng (1988) although proper cooking kills parasites, most rural communities prefer to consume their freshwater crabs as semi-raw. In addition, it is used as food additive and fertilizer; especially crab processing residues are used as feed additive (Bilgin and Fidanbaş 2011).

Furthermore, fresh water crabs are important for chitin and chitosan production (Bolat et al. 2010). Bolat et al. 2010 investigated chitin-chitosan amount of freshwater crab *Potamon potamios* shell. The chitosan amount of crab shell was found to be 4.65% from grinded crab shell after demineralization (amount is 34.32%), deproteinization (amount is 7.25%), decoloration (amount is 6.83%) and deacetylation processes.

Freshwater crabs are sometimes sold in the aquarium trade. These are usually the more colorful Indochinese potamids e.g. *Demanietta khirikhan*, *Pudaengon arnamicai*, *Terrapotamon abbotti*, but less gaudy parathelphusids such as *Heterothelphusa fatum* are also sold. On the other hand, the trichodactylid crab, Dilocarcinus pagei, is hunted for bait in game fishing of large catfishes in the Pantanal Matogrossense, a swampy area in the Paraguay River basin (Magalhães, 2000). The negative effect of these actions on the freshwater crab fauna, however, is relatively little as request is minor and collection is irregular.

Important Species As A Food Commodity

The most important economically consumed freshwater crab species are Eriocheir sinensis, Somanniathelphusa dangi, Varuna litterata, Barytelphusa cunicularis, Sudanonautes aubryi, Sudanonautes africanus, Sudanonautes kagoroensis, Potamonautes niloticus, Liberonautes nanoides, Fredius fittkaui, Fredius reflexifrons, Sylviocarcinus pictus and Valdivia serrata.

Table3. *Economically important freshwater crab species and their consumption region*

Species	Consumption region	Source	References
Eriocheir sinensis	China, South Korea, Hong Kong, Japan	Fisheries and aquaculture	Sui et al., 2009; Sui et al., 2011; Wang, 2013a,b
Somanniathelphusa dangi	Rural markets in northern Vietnam	Fisheries	Yeo et al., 2008
Varuna litterata	India	Fisheries	Das et al., 2015
Barytelphusa cunicularis	India	Fisheries	Padghane et al. 2016
Sudanonautes aubryi	Ivory Coast	Fisheries	Bertrand 1979
S. africanus and *S. kagoroensis*	Nigeria	Fisheries	Okafor 1988; Cumberlidge 1991
Potamonautes niloticus	Victoria Lake (Kenya, Uganda, Tanzania)	Fisheries	Dobson, M., 2010
Liberonautes nanoides	Liberia	Fisheries	Sachs & Cumberlidge 1991
Fredius fittkaui, Fredius reflexifrons, Sylviocarcinus pictus, Valdivia serrata	Northern Brazil and southern Venezuela	Fisheries	Magalhães et al. 2006

The Chinese mitten crab, *E. sinensis,* is one of the most important consumed freshwater crab species. It has a crucial commercial value in the markets of the East Asian countries (Sui et al., 2009). There has been a rapid increase in the farming of *E. sinensis* in China. The culture of *E. sinensis* has been carried out in ponds, reservoirs, and lakes throughout China since the 1990s (Sui et al., 2011). Various production systems are currently used for the grow-out of *E. sinensis*. Net-pens installed in shallow lakes, earthen ponds, paddy fields, and small lakes and reservoirs are the most common systems employed for grow-out, while earthen ponds and paddy fields are commonly used for seed rearing of the crab. In China, the first reported production of the cultured Chinese river crab was 3.305 tons in 1989. In addition, rapid expansion, reaching 368,000 tons in 2003, reached approximately 416,000 tons in 2004 (FAO, 2017).

However, the production of freshwater crab in the Republic of Korea is small and variable; it was first announced in 1994 as 3 tons and it has never yet exceeded its peak of 31 tons in 1997. As a result, the global aquaculture yields of freshwater crab have gradually increased to approximately 796,621 tons in 2014 from 17,641 tons in 1993 (FAO, 2017). Almost all commercial production of Chinese river crabs are obtained in China itself. Although the product is consumed locally and processed Products appear, they are usually marketed live. On the other hand, The Chinese river crabs were a very high commodity, but in recent years they have become more affordable than ordinary consumers.

Chinese river crabs are marketed at a very wide price range (5-25 US $ / kg) according to the size and environment of the crab. In 2004, China exported about 800 tons of live Chinese river crab, and was worth about $ 6 million according to national statistical data. The exports of freshwater crab raised by more than 70% compared to 2003. Infect, actual exports may be even higher, because China also report exports of some 7 000 tons of unspecified crab products. Hong Kong SAR of China, Japan and the Republic of Korea are the major export markets (FAO, 2017).

In the culture of *E. sinensis,* generally, ponds are stocked with two seed stock sources, captive pond-reared juveniles (coin-sized seed, PR) or wild-caught seed stock of *E. sinensis* (WC) (Wang, 2013a,b). According to Zhou et al. (2003) WC stocks are chosen as they are considered to perform better in culture compared with PR stocks. However, the availability and low cost of PR seed stock has become a dominant seed for production, despite the lack of selective breeding programs. It was also declared that there is a need for genetic improvement breeding programs that focused on the creation of captive stocks in order to achieve the desired traits, such as larger harvest size,

low FCR, and postponement of the maturity in *E. sinensis* (He et al., 2014). Additionally, there is little published information explaining the growth and gonadal development of wild megalopae and juvenile *E. sinensis* under commercial farming conditions (Zhang and Li, 2001; He, 2005).

CONCLUSION

In conclusion, freshwater crabs have remarkable importance in many aspects such as ecological economical and medical uses. In addition, they are a good source of protein, carbohydrates and various minerals. However, the bulk of consumed freshwater crabs are obtained from wild catch and the crabs hunted from the natural environment are not at a level that meets the required amount of this valuable product. Therefore, further studies are required in order to develop freshwater crab aquaculture and their applications in industry and medicine.

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