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A REVIEW OF THE NUTRITIONAL VALUE OF CRUSTACEANS

Carla Pires e Irineu Batista

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A review of the nutritional value of crustaceans

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ABSTRACT

Crustaceans are among the most appreciated and valued fishery products. The extraordinary development of aquaculture production of crustaceans, particularly shrimp, surpassed, in 2014, the volume of catches. The wide availability of crustaceans on the world market has led to an increase in consumption representing 11 % (2.2 kg) of world *per capita* fish consumption, which reached 20.5 kg in 2019. This work presents a bibliographic review of the most relevant works, published in the 2010s, on the nutritional value of crustaceans. The muscle fraction of crustaceans has protein contents between 10.8 and 23.5 % and fat between 0.3 and 4.4 %. In some crab species, the hepatopancreas and roe are highly prized and have protein contents in the ranges of 7.6-20.1 % and 11.8-28.7 %, respectively. These tissues generally have fat contents in the range of 3.1-36.7 % in the hepatopancreas and 0.6-24.9 % in the roe. In general, the n-3/n-6 ratio in salt and brackish water crustaceans is greater than one. Crustaceans are also good or excellent sources of several elements, especially Cu, Zn and Se.

Keywords: proximate composition, fatty acids, elemental profile, amino acids

Título: Uma revisão bibliográfica sobre o valor nutricional dos crustáceos

RESUMO

Os crustáceos encontram-se entre os produtos da pesca mais apreciados e valorizados. O extraordinário desenvolvimento da produção aquícola de crustáceos, particularmente de camarões, ultrapassou, em 2014, o volume das capturas. A grande disponibilidade de crustáceos no mercado mundial levou a um aumento do consumo que, em 2019, representou 11 % (2,2 kg) do consumo mundial de pescado *per capita* o qual atingiu 20,5 kg. Este trabalho apresenta uma revisão bibliográfica dos trabalhos mais relevantes, publicados na década de 2010, sobre o valor nutricional dos crustáceos. A fração muscular dos crustáceos apresenta teores de proteína entre 10,8 e 23,5 % e de gordura entre 0,3 e 4,4 %. Nalgumas espécies de caranguejos, o hepatopâncreas e as ovas são muito apreciados e apresentam teores de proteína nas gamas de 7,6-20,1 % e 11,8-28,7 %, respetivamente. Estes tecidos apresentam, em geral, teores de gordura na gama de 3,1-36,7 % no hepatopâncreas e 0,6-24,9 % nas ovas. Em geral, a razão n-3/n-6 nos crustáceos de água salgada ou salobra são superiores a um. Os crustáceos são também boas ou excelentes fontes de vários elementos, destacando-se o Cu, Zn e Se.

Palavras chave: composição química, ácidos gordos, composição mineral, aminoácidos

REFERÊNCIA BIBLIOGRÁFICA: Pires, C.; Batista, I. 2023. A review of the nutritional value of crustaceans. **Relatórios Científicos e Técnicos do IPMA (http://ipma.pt), nº 44, 55 pp.**

Worldwide productions and values of crustaceans

Shrimps and lobsters are among the most highly valuable groups of aquatic food products traded worldwide. In 2019, the aquatic food consumption per capita was estimated in 20.5 kg and the contribution of crustaceans represented 11 %. The total international trade of aquatic products, except algae, attained 59.8 million tones live weight, with a value of USD 151 billion in 2020 and crustaceans accounted for 22.8 % of the global value of exported aquatic products (FAO, 2022). The evolution of total crustaceans catches, capture fishery and aquaculture produced, is shown in Figure 1 where it is evidenced the significant increase of aquaculture contribution. On the beginning of this decade, crustaceans from the capture fishery accounted for 51.7 % of total catches but in 2019 they represented 35.8 %.

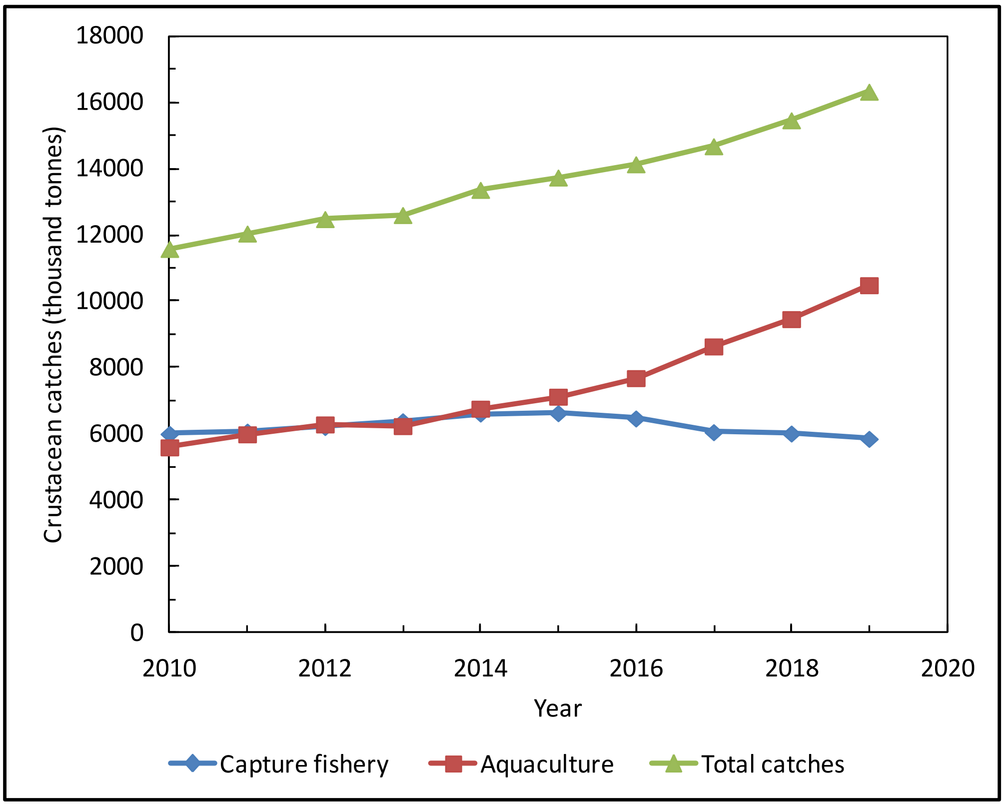
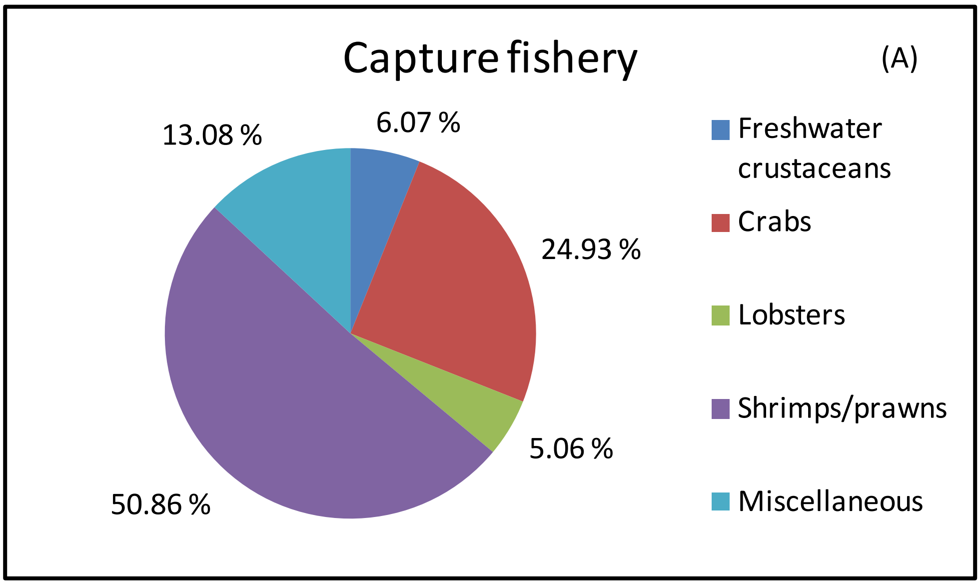


Figure 1 – Evolution of total catches, capture fishery and aquaculture crustaceans between 2010 and 2019 (FAO, 2018, 2021).

Figura 1 – Evolução das capturas totais, pesca e aquacultura de crustáceos entre 2010 e 2019 (FAO, 2018, 2021).

The different species of crustaceans were distributed into five groups (freshwater crustaceans, crabs, king crabs, lobsters, and shrimps) according to the fisheries and aquaculture statistic published published by FAO and the FAO database (2016) on the nutritional value of fishery products. This distribution was based on the capture and aquaculture productions, volume of international exports and prices of the different groups of species. The relative percentages of each crustacean group in relation to the total capture by fisheries and aquaculture production in 2019 (FAO, 2021) are shown in Figure 2. Shrimp and prawns are the major groups both, in fishery captures and aquaculture production. However, freshwater crustaceans were the second most important in the aquaculture production whereas crabs from capture fishery were the second most important within capture fishery crustaceans.



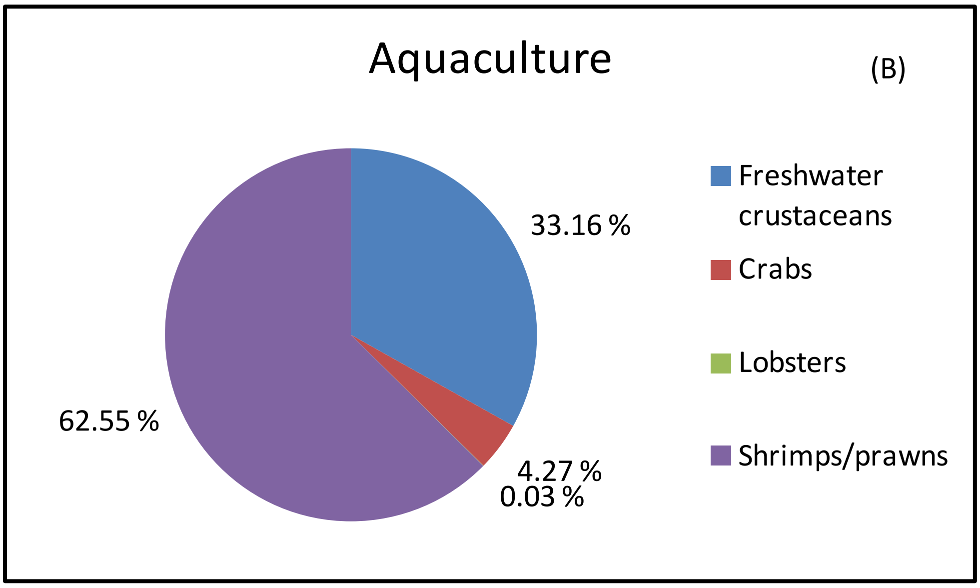


Figure 2 – Percentages of total catches of each crustacean group from fishery captures (A) and aquaculture production (B).

Figura 2 – Percentagens das capturas totais de cada grupo de crustáceos da pesca (A) e da aquacultura (B).

Table 1 presents the average prices of the four main crustaceans groups in 2019 as reported in FAO (2021). As shown, aquaculture crustaceans had higher prices than their counterparts from fisheries captures and it is also remarkable the very high price of aquaculture lobsters.

Table 1 – Average prices (US$/kg) of the four crustacean groups from capture fishery and aquaculture in 2019 (FAO, 2021).
Tabela 1 – Preços médios (US$/kg) dos quatro grupos de crustáceos capturados na pesca e de aquacultura em 2019 (FAO, 2021).

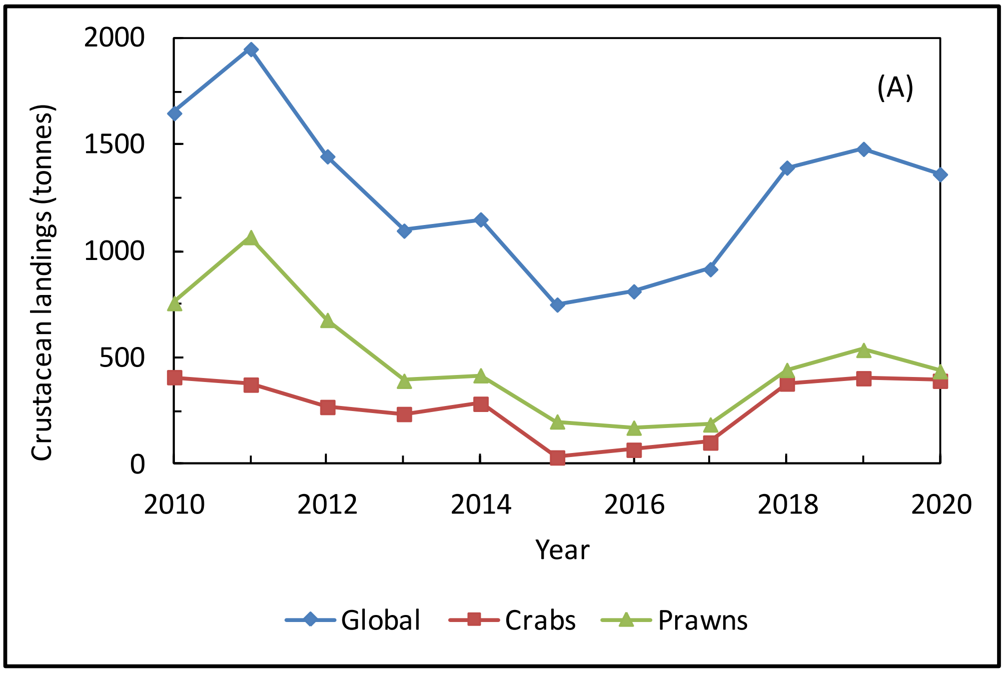
	Capture fishery	Aquaculture
Freshwater crustaceans	3.00	9.42
Crabs	4.30	6.27
Lobsters	12.70	27.92
Shrimp/prawns	4.45	6.21

Landings and values of crustaceans in Portugal

Crustaceans landed in the Portuguese auctions may be included in the following groups of species: crabs – brown crab (*Cancer pagurus*) and spider crab (*Maja squinado*); lobsters – Norway lobster (*Nephrops norvegicus*), several species of the gender *Palinurus* and European lobster (*Homarus gammarus*); shrimps/prawns – common prawn (*Palaemon serratus*), blue and red shrimp (*Aristeus antennatus*) and deep-water rose shrimp (*Parapenaeus longirostris*); and miscellaneous which includes barnacles, several shrimp species, Mediterranean slipper lobster, among others.

The evolution of crustacean catches in Portugal during 2010-2020 is shown in Figure 3 (INE, 2010-2021). As shown in Figure 3A, the maximum of global catches (1950 t) was reached in 2011 as a result of the contributions of prawns (1067 t) and miscellaneous crustacean (242 t) catches. On the other hand, the minimum global catches (750 t) occurred in 2015.

The evolution of global catches was similar to that recorded for prawns which are the crustacean species with the highest amounts of catches. Crab catches varied between 409 t in 2010 and 392 t in 2020 with a very sharp minimum of 32 t in 2015. In this period, the Norway lobster catches were 122 t and 131 t in 2010 and 2020, respectively with a maximum of catches (217 t) occurring in 2012 (Fig. 3B). The levels of shrimp catches accounted for 122 t in 2010 and 87 t in 2020 and a maximum catch of 140 t took place in 2017. Catches of spider crabs and lobsters were the most modest during this decade. In the catches of the former species there was a decrease from 37 t in 2010 to 23 t in 2012, but in 2013 they increased to 44 t. After this initial period, there was a general increase in crab catches reaching 62 t in 2020. Lobsters catches were 17 t and 24 t in 2010 and 2020, respectively with a maximum of 44 t in 2017.



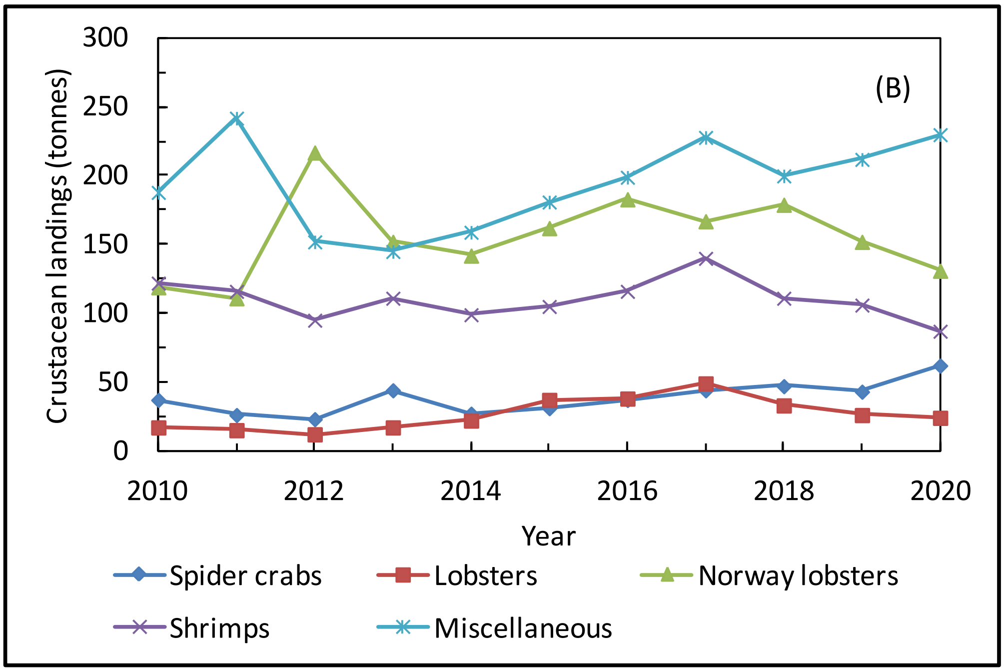


Figure 3 – Evolution of global, crabs, and prawns landings (A) and spider crabs, lobsters, Norway lobsters, shrimps and miscellaneous crustacean species landings (B) in Portuguese fisheries.

Figura 3 – Evolução das capturas globais, gambas e caranguejos (A) e santolas, lagostas, lagostins, camarões e diversas espécies de crustáceos (B) nas pescas portuguesas.

The evolution of crustacean values during the 2010s (INE, 2010-2021) is shown in figures 4 A and B. As shown in the former figure, the highest global value of crustaceans ($16867x10^3$ €) was recorded in 2010. A general decline of values occurred until 2014 when a minimum value of $11365x10^3$ € was attained. After 2014, there was a progressive increase until 2019 when the value reached $16867x10^3$ €, but in 2020 there was a decrease as a result of COVID.

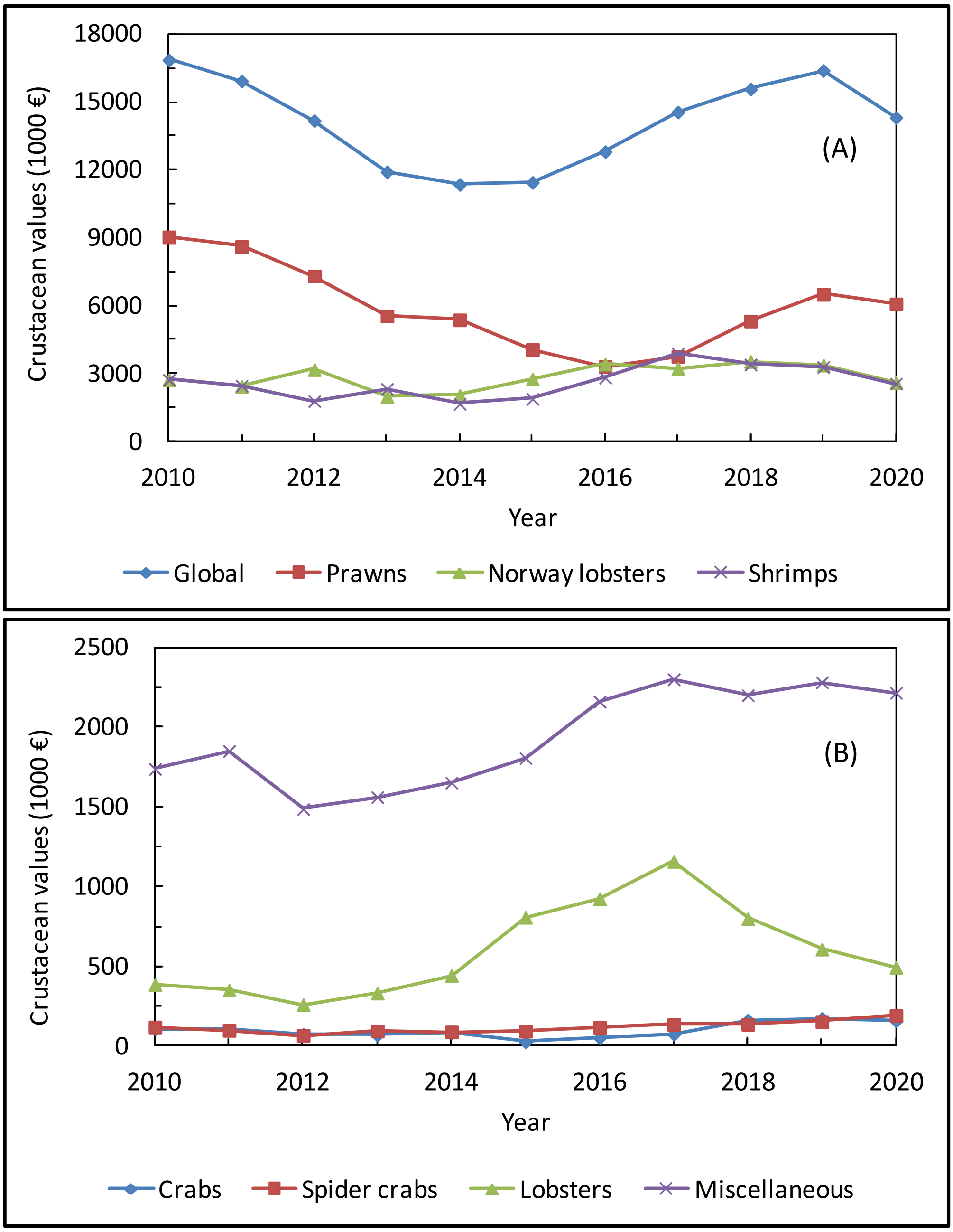


Figure 4 – Evolution of global, prawns, Norway lobsters, and shrimps values (A) and crabs, spider crabs, lobsters, and miscellaneous crustacean species values (B) in Portuguese fisheries.

Figura 4 – Evolução dos valores dos desembarques globais, gambas, lagostins e camarões (A) e valores de caranguejos santolas, lagostas e diversas espécies de crustáceos (B) nas pescas portuguesas.

Prawn values varied between 9040x10^3 € and 6086x10^3 € in 2010 and 2020, respectively with a minimum value of 3312x10^3 € in 2016 (Fig. 4A). The evolution of Norway lobsters and shrimps in this decade were similar, where the former species had a maximum value of 3542x10^3 € in 2018 and the second species a maximum of 3892x10^3 € in 2017 (Fig. 4A).

Spider crabs values ranged from 120x10^3 € to 94x10^3 € in 2010 and 2015, respectively but a significant increase took place afterwards until the end of the decade when it reached 192x10^3 € in 2020 (Fig. 4B). A decrease of crab values was also recorded between 2010 and 2015 – 108x10^3 € and 25x10^3 €, respectively – but afterwards attained 175x10^3 € in 2019 (Fig. 4B). Concerning the lobster values, the maximum of 1160x10^3 € reached in 2017 should be noted (Fig. 4B).

The evolution of prices (€/kg) of these species is shown in figure 5 A and B. As shown in figure 5A, shrimp prices tended to decrease between 2010 and 2015, but from that date onwards there was a rapid increase in prices that reached a maximum of €31.05/kg in 2019. Lobster prices varied between €23.68/kg and €21.22/kg in 2010 and 2020, respectively, with a maximum of €25.10/kg in 2018. With regard to Norway lobsters, there was, as in shrimps, a decrease in prices until 2013, but they gradually recovered, not having, however, reached the value of the beginning of the decade, which was 23.01 €/kg. Regarding prawns, there was an irregular evolution of prices that varied from €11.95/kg in 2010 to €12.87/kg in 2014. However, between 2015 and 2017, the average price was around €20/kg, but from 2018 onwards, prices were once again close to those recorded at the beginning of the decade. The average price of miscellaneous crustaceans was 10.05 €/kg in this decade. Prices were relatively stable with a low of €7.71/kg in 2011 (Fig. 5B). The relatively high price of this crustacean group was mainly due to the barnacle price. Spider crab prices had slight fluctuations during the decade, varying between €3.24/kg and €3.11/kg in 2010 and 2020, respectively (Fig. 5B). In the evolution of crab prices during this decade, three periods can be considered: the first until 2014, when prices were between 0.26 and 0.30 €/kg; the second between 2015 and 2017 with an average price of €3.20/kg; and the third until 2020 in which the average price was 3.17 €/kg (Fig. 5B).

Nutritional value

The proximate composition (g 100 g^{-1}) of the above mentioned groups is shown in Table 2. The percentage and content (mg 100 g^{-1}) of total saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs), polyunsaturated fatty acids (PUFAs), eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and n-3/n-6 ratio are presented in Table 3. The elemental profile (mg 100 g^{-1}) of these species is shown in Table 4.

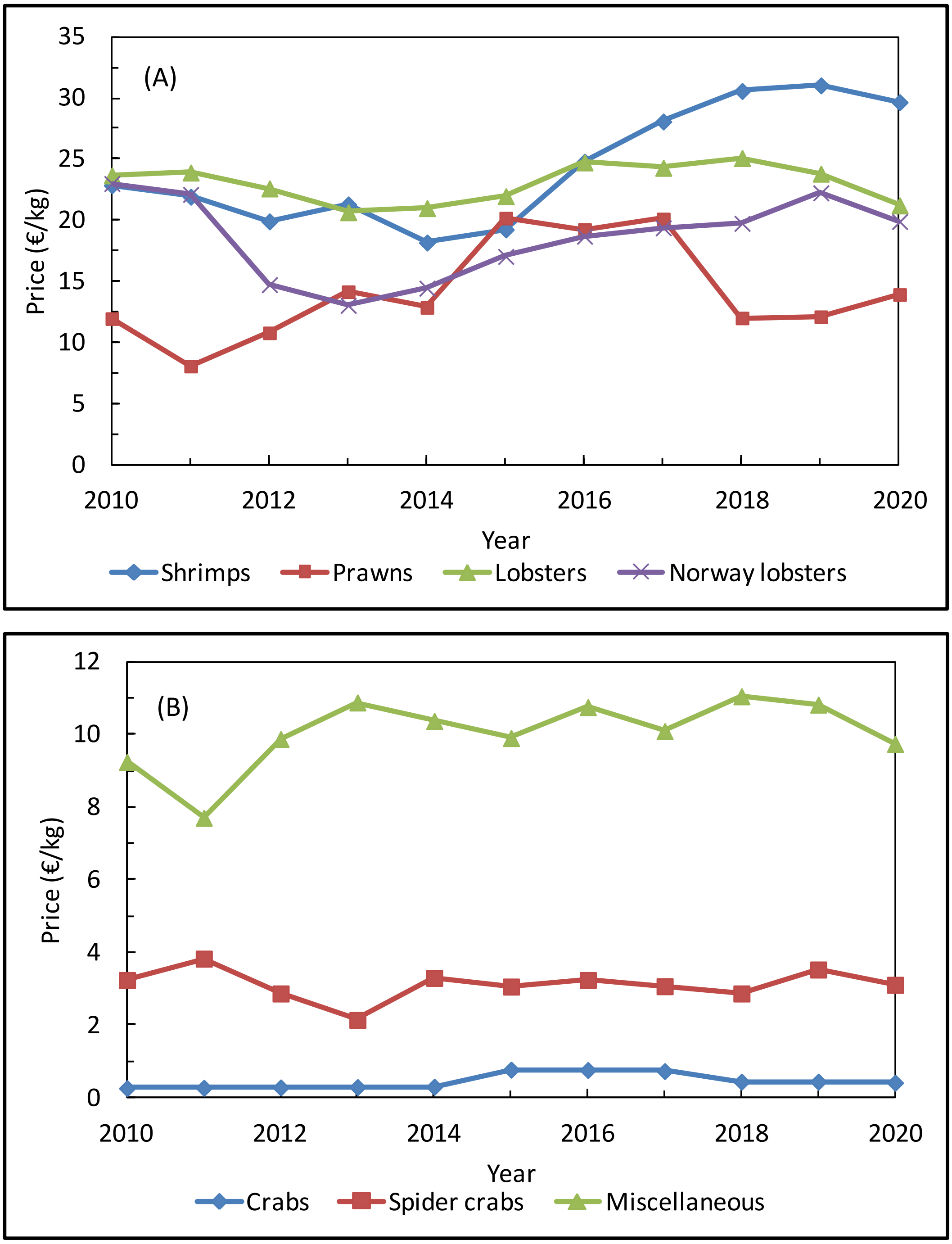


Figure 5 – Evolution of prices (€/kg) of shrimps, prawns, lobsters, and Norway lobsters (A) and crabs, spider crabs, and miscellaneous crustaceans (B) in Portuguese auctions.

Figura 5 – Evolução dos preços (€/kg) de camarões, gambas, lagostas e lagostins (A) e caranguejos, santolas e diversas espécies de crustáceos (B) nas lotas portuguesas.

Freshwater crustaceans

The fat quality of Oriental river prawns (*Macrobrachium nipponense*) collected in rain-fed rice fields in Sisaket Province (Thailand) was assessed in the study by Karapanagiotidis *et al.* (2010). These prawns had 1.13 % fat content and arachidonic acid (20: 4 n-6, ARA) (11.05 %) was the main PUFA, followed by linoleic acid (18:2 n-6) (8.69 %), EPA and DHA. The lipid content and fatty acid composition of this river prawn from the Zhejiang province (China) were evaluated by Li *et al.* (2011). These authors reported a fat content of 1.33 % for this river prawn where palmitic acid (16:0) was predominant with 26.4 %, followed by oleic acid (18:1 n-9) with a level of 17.3 %, and linoleic acid with a percentage of 8.7.

The high world production of the giant freshwater prawn (*Macrobrachium rosenbergii*), market demand and attractive prices have led to the development of several studies on the nutritional value of this food product. Thus, Chedoloh *et al.* (2011) determined the fat content and fatty acid profile of giant freshwater prawn from the southern Thailand. The fat content reported for this species was 1.66 %and palmitic and oleic acids accounted for 30.1 % and 16.5 %, respectively, while DHA was the main PUFA. It is also to be mentioned the relatively high n-3/n-6 ratio.

Li *et al.* (2011) also evaluated the fat content and fatty acid composition of giant freshwater prawn from the Zhejiang province (China). The fat content was 1.86 % and part of its lipid profile is shown in Table 3. The main SFA was palmitic acid and its level represented 18.4 %, oleic acid was the predominant MUFA with a level of 13.1 %, and linoleic acid the main PUFA with a percentage of 16.4.

The proximate composition, fatty acid and amino acid profiles of Amazon river (*Macrobrachium amazonicum*) and giant freshwater prawns were analyzed by Portella *et al.* (2013) after four months farming. Amazon river prawn had higher protein and fat content than giant freshwater prawn and the percentages of SFAs, MUFAs, PUFAs, and EPA were similar in both species, but Amazon river prawn had higher DHA content and a somewhat higher n-3/n-6 ratio than giant freshwater prawn. These authors reported total essential amino acids (TEAA) for Amazon river prawn of 396 mg g^{-1} protein and lysine had the highest amino acid score[1]. Sriket *et al.* (2013) also determined the proximate composition of farmed giant freshwater prawn from the Phatthalun province, Thailand. The proximate composition of this freshwater prawn obtained by these authors (Table 2) was similar to that reported by Portella *et al.* (2013). These authors reported a TEAA (Arg, His, Ile, Leu, Lys, Met, Phe, Thr, and Val) of 15.633 g 100 g^{-1} for this prawn and an essential amino acids/non-essential amino acids (EAA/NEAA)ratio of 0.92.

[1] sample amino acid x100/reference amino acid

In order to fully utilize the potential of different fish species for human nutrition, Mohanty *et al.* (2016a) analyzed the proximate composition and fatty acid profile of 39 food fishes caught in India which included giant freshwater prawn. As shown in Table 2, protein content of this prawn is lower than that reported by other authors for this species and its fat content is much higher. As shown in Table 3, the same percentage of SFAs and PUFAs was recorded in this prawn and DHA was not detected. Oleic acid was the main fatty acid (19.1 %), followed by palmitic acid (14.2 %) and stearic acid (18:0) (11.5 %). Linoleic acid accounted for 10.8 % and was the main PUFA.

The comprehensive study by Bogard *et al.* (2015) on the nutritional value of many fish species consumed in Bangladesh includes the monsoon river prawn (*Machrobrachium malcolmsonii*). This prawn was collected in the district of Mymensingh (Bangladesh) and its proximate composition and mineral profile were determined. As shown in Table 2, monsoon river prawn has high protein content (because it is between 15 and 20 %) but it is the lowest among the prawn species of the *Macrobrachium* genus. This prawn is good source of Mg and excellent source of P, Ca, Fe, Cu, Zn, and Se (Table 4). Moreover, as mentioned by the authors, a standard portion (50 g/ day for pregnant and lactating women and 25 g/ day for infants) of this species would contribute to 30 % and 33 %, respectively for the recommended nutrient intake of iodine. The molar Na:K ratio of this species (0.64) was relatively low taking into account the molar Na:K ratio intake between 1.0 and 2.0 recommended by Swanepoel *et al.* (2016) and Vasara *et al.* (2017) for presumably lowering cardiovascular disease risk in adults.

Stanek *et al.* (2010) compared the fat content and fatty acid profile in the meat of the abdomen section of spiny-cheek crayfish (*Orconectes limosus*) caught in Brda River and Lake Gopło (Poland). The fat content of crayfish meat (around 0.44 %) from both places did not differ significantly. However, significant differences in the fatty acid profile were observed. The total SFA content of crayfish from Brda River was higher than that caught off in the lake which was much rich in PUFA, EPA, and DHA. However, the n-3/n-6 ratio was similar in samples caught in the two places, i. e., 0.72 in crayfish from Brda River and 0.70 in crayfish from Lake Gopło. In a second study, Stanek *et al.* (2011) studied the fatty acid profile, cholesterol and fat content in the meat of the abdominal section of this crayfish species (aged 3+ and 4+) caught in Lake Gopło in spring and summer. The lowest fat content (0.92 % in aged 3+ specimens and 1.05 % in older crayfish) was recorded in crayfish caught in summer, while fat content of crayfish caught in spring was 1.09 % in aged 3+ individuals and 1.1 % in older crayfish. In Table 3, the percentage of each fatty acid group is the mean percentage obtained in individuals aged 3+ and 4+. No significant differences between the percentage of each fatty acid group in individuals caught in the spring or summer were recorded. PUFAs were the predominant group followed by MUFAs and SFAs. EPA was the main PUFA followed by ARA with a mean level of 12.5 %. The main MUFA was oleic acid with a mean value 19.8 % and palmitic acid (16:0) (mean value 13.8 %) was predominant within SFAs. Total cholesterol content in crayfish caught in summer (71.98 mg 100 g^{-1}) was significantly higher than in specimens caught in spring (65.32 mg 100 g^{-1}).

Manhas *et al.* (2013) studied the seasonal variation of lipid and moisture content of body and claw meat of the freshwater crab (*Paratelphusa masoniana*) females collected in Jammu region (India). The annual average moisture content of body meat was 80.98 % with a minimum value of 78.13 % in March and a maximum of 84.23 % in July. In the case of claw meat, the average moisture content was 79.66 % with a minimum of 77.73 % and a maximum of 83.58 % also in March and July, respectively. Body meat was fattier than claw meat and their annual average fat content was 4.83 % and 3.38 %, respectively. Fat content of body meat varied between 3.99 % in July and 5.85 % in September, whereas in claw meat it changed from 2.82 % in December and 4.01 % in April. An inverse relationship between these two components was obtained and the highest lipid content was generally observed during the non-spawning season.

The Chinese mitten crab (*Eriocheir sinensis*) has deserved a great attention in recent years due to its sensory characteristics, nutritional quality and economic relevance. In the context of the studies carried out on the nutritional value of this crab, Shao *et al.* (2014) tested the effect of two diets (natural, ND and formulated, FD) on the meat quality of crabs with 75-85 g for females and 105-115 g for males fed for 42 days. The proximate composition of Chinese mitten crab fed with the two diets shown in Table 2 is the average composition of males and females fed with the same diet. No significant differences in the proximate composition of crabs fed with natural and formulated diets were found. The order of abundance of the three fatty acid groups was PUFAs > MUFAs > SFAs in crabs fed with both diets (Table 3). The main SFA was palmitic acid with average values of males and females of 18.76 % and 20.20 % for crabs fed ND and FD, respectively. Oleic acid was the predominant fatty acid and its percentage was 20.68 % and 20.42 % in crabs fed ND and FD, respectively. Crabs fed ND had significantly lower contents of 20:5n-3 as well as higher ARA/EPA value compared with those of same sex crabs fed FD. The total free amino acid (TFAA) content of crab meat varied between 1399 and 1648 mg 100 g^{-1}. Ala content was the highest (360-427 mg 100 g^{-1}), followed by Gly (285-414 mg 100 g^{-1}), Pro (227-289 mg 100 g^{-1}), and Arg (163-229 mg 100 g^{-1}). The authors concluded that diets had no significant effects on FAA content of the meat, while gender significantly affected the contents of some amino acids, such as Tau and Gly. Concerning sensory evaluation there were no significant dietary effects on a range of sensory traits evaluated by panellists, neither in female nor in male crabs.

Shao *et al.* (2013) also evaluated the hepatopancreas and gonad quality of male and female Chinese mitten crabs fattened with of ND or FD. The diets had no significant effect on the proximate composition of hepatopancreas and gonads of this crab regardless of gender. The proximate composition presented in Table 2 is the average of males and females fed with different diets. As shown, female hepatopancreas was fattier than that of male and female gonads had higher protein and fat content than that of males. Hepatopancreas had lower protein level but higher fat content than gonads. MUFAs were the main group in both hepatopancreas and gonads and males presented higher level of PUFA than females (Table 3). Palmitic acid was the main SFA (hepatopancreas – 18.96 % in females and 19.07 % in males; gonads - 16.72 % in females and 13.89 % in males) and oleic acid the main MUFA (hepatopancreas – 23.36 % in females and 25.27 % in males; gonads - 29.60 % in females and 20.89 % in males). Concerning PUFAs, linoleic acid (13.08 % in females and 8.12 % in males) was the main PUFA in the hepatopancreas but in male gonads DHA was predominant, followed by ARA (8.51 %) and EPA. Total FAA of hepatopancreas was 1470 mg 100 g^{-1} and the main amino acids were Ala (199-212 mg 100 g^{-1}), followed by Tau, Gly, Glu, and Arg. The TFAA contents of female and male gonads were 965 mg 100 g^{-1} and 741 mg 100 g^{-1}, respectively. Cys and Trp were found in trace both in hepatopancreas and gonads.

The fatty acids and amino acids of the edible parts of Chinese mitten crab collected from a cultivation farm at Taihu Lake, China, were analyzed by Jiang *et al.* (2014). Palmitic acid was the main SFA in all parts and its level ranged from 14.53 % in male muscle and 21.65 % in male hepatopancreas. Oleic acid was the predominant MUFA in all parts and its lowest level (20.37 %) was recorded in female muscle and the highest level (31.13 %) in the male hepatopancreas. EPA was predominant in the muscle, while linoleic acid was the main PUFA in the hepatopancreas and female gonads. Muscle had the highest total amino acids (TAA) content (in g 100 g^{-1} dry weight) (75.3), followed by female gonads (57.1) and hepatopancreas (29.5). The TAA content of muscle and hepatopancreas is the average content of males and females. The EAA/TAA ratio in muscle and hepatopancreas was similar (0.36), but it was 0.41 in the female gonads. Total FAA content (in g 100 g^{-1} dry weight) was 36.3, 23.0, and 12.5 in muscle, female gonads, and hepatopancreas, respectively.

Chinese mitten crab (*E. sinensis*) (U.S. Fish & Wildlife Service).
Caranguejo-peludo-chinês (*E. sinensis*) (U.S. Fish & Wildlife Service).

Guo *et al.* (2014) determined the proximate composition, fatty acid and amino acid profiles of steamed Chinese mitten crab from the Yangcheng Lake in the Jiangsu Province, China. The crabs were divided into three grades mainly based in weight: special (G_s, 200/150 g); first (G_1, 150/125 g); and second (G_2, 125/100 g). The meat parts (body, claw and leg) and gonads of males and females from the three grades were analyzed separately. In Table 2 are shown the average composition of meat crab and male and female gonads. The variation ranges of the four constituents of crab meat were: 73.07-76.34 % moisture; 19.74-22.15 % protein; 0.44-1.29 % fat; and 1.51-1.74 % ash. In gonads, the variation ranges of these constituents in male gonads were: 59.03-59.92 % moisture; 10.01-10.93 % protein; 26.26-26.30 % fat; and 1.77-1.86 % ash. In female gonads, the variation ranges were: 59.15-60.63 % moisture; 12.87-12.95 % protein; 23.53-23.56 % fat; and 1.59-1.88 % ash. The lipid compositions shown in Table 3 are the average percentages fatty acids groups of meat parts and gonads. MUFAs were the main fatty acid group both in meat and gonads and their variation ranges were 34.04-44.60 % and 43.11-48.86 %, respectively. However, meat muscle was richer in PUFAs than gonads and their PUFAs ranges were 23.74-37.92 % and 23.02-29.29 %, respectively. On the other hand, oleic, palmitic, and linoleic acids were dominant with approximately 30, 20, and 10 % of overall fatty acids, respectively. The main amino acids in all four parts were Glu, Asp and Arg. The TAA and EAA levels depended on the gender, type of edible part and grade and their variation ranges were: 15.06-16.62 and 5.99-6.72 g 100 g^{-1} in claw meat; 13.01-14.95 and 5.32-6.09 g 100 g^{-1} in body meat; 11.76-14.29 and 4.90-5.87 g 100 g^{-1} in leg meat; 15,50-16,62 and 6,28-6,79 g 100 g^{-1} in female gonads; and 15.06-15.92 and 5.99-6.47 g 100 g^{-1} in male gonads. The ratio of EAA/TAA in the meat from body, claws or legs varied between 0.40 and 0.42 and in the gonads it was in the range 0.42-0.45 and the levels of almost every amino acid (except Cys) decreased from special grade to first grade and second grade.

Wang *et al.* (2018) studied the proximate composition, fatty acid and amino acid profile of edible parts of adult male Chinese mitten crab from four grades (Grade I: 200-249 g; Grade II: 175-199 g; Grade III: 150-174; Grade IV: ≤ 150 g). Crabs were collected in Chongming, Shanghai (China) and the edible parts included hepatopancreas and gonads tissues and meat from claws and legs. As shown in Table 2, the highest moisture of crab muscle was recorded in grade IV crabs but grade III crabs presented the highest fat content. The different sizes of this crab had not significant effect on the protein content, while the carbohydrate content significantly reduced with the decreasing of the average weight of male. The moisture content of hepatopancreas was the smallest in the grade II crabs, which had the highest fat content. No significant differences on the protein and carbohydrates levels with the crab sizes were recorded. Concerning gonads, the lowest fat content was found in grade II crabs, while moisture, protein and carbohydrate contents did not show significant differences for all crab sizes. Muscle and gonads were richer in PUFAs, whereas SFAs and MUFAs were dominant in the hepatopancreas. Palmitic acid and oleic acids were the dominant SFA and MUFA respectively in all edible parts. Among PUFAs, EPA, linoleic acid and ARA predominated in the muscle, hepatopancreas and gonads, respectively. It is also noticeable that the n-3/n-6 ratio was above one in the muscle of the all crab grades whereas in the hepatopancreas was below one. Regarding amino acids, the average EAA content in the crab muscle was in the range 6.08 and 7.05 g 100 g^{-1} where the lowest value was recorded in grade IV crabs and the highest in grade III crabs. TAA varied from 15.26 g 100 g^{-1} in grade I crabs and 17.23 g 100 g^{-1} in grade III crabs. The EAA/TAA ratio varied between 0.40 and 0.41. The limiting amino acid was tryptophan with a score of 85 %. In male gonads, the average EAA content was between 6.00 in grade II crabs and 6.41 g 100 g^{-1} in grade I crabs. The lowest TAA content (15.24 g 100 g^{-1}) was found in grade II crabs and the highest total AA (16.31 g 100 g^{-1}) was determined in grade III crabs. The variation range of the EAA/TAA ratio was between 0.39 and 0.40. The limiting amino acids were Leu (90 %), Lys (72 %), Trp (81 %), and Val (97 %).

The nutritional quality of wild-caught and rice-field male Chinese mitten crab was studied by Wu *et al.* (2020). The comparison of the proximate composition (Table 2) of both types of crabs showed that only the protein content of rice-field hepatopancreas crab was significantly higher than that of its counterpart of wild-caught crab. PUFAs were the main group of fatty acids in the edible parts of both types of crab, except in the hepatopancreas of rice-field crab where SFAs were predominant (Table 3). Arachidic acid (20:0) was the main SFA in the muscle (around 7.55 %) and male gonads (7.75 % in wild-caught crabs and 11.24 % in rice-field crabs). The main MUFA in the muscle (10.68 %) and gonads (12.32 %) of wild-caught crabs was the unusual heptadecenoic acid (17:1 n-9) whereas erucic acid (22:1 n-9) was the main MUFA in the muscle (16.45 %) and gonads (8.05 %) of rice-field crabs. This latter fatty acid was also dominant (around 3.1 %) in the hepatopancreas of both crab types. Linolenic acid (18:3 n-3) was the main PUFA in all edible parts of both crab types with percentages ranging from 21.36 % in the muscle of rice-field crabs to 37.57 % in the gonads of wild-field crabs. With respect to amino acids, TAA content in the muscle of wild-caught and rice-field crabs was 14.28 and 13.11 g 100 g^{-1}, respectively. The levels of TAA were much lower in the hepatopancreas which accounted for 5.64 and 8.68 g 100 g^{-1}, respectively, while male gonads were the richest edible fraction in TAA and their contents were 18.33 g 100 g^{-1} in wild-caught crabs and 17.79 g 100 g^{-1} in rice-field crabs. Glu was the most abundant amino acid in the three edible parts with 2.19 and 2.00 g 100 g^{-1} in the muscle, 0.74 and 1.24 g 100 g^{-1} in the hepatopancreas and 2.58 and 2.56 g 100 g^{-1} in the gonads of wild-caught and rice-field crabs, respectively. The EAA/TAA values were 0.35 and 0.33 in the muscle and gonads of both types of crabs. In hepatopancreas this ratio was 0.37 and 0.36 in wild-caught and rice-field crabs, respectively. The levels of Arg, Glu and Gly in the muscle of wild-caught crab were higher than those in the rice-field crab muscle. Glycine is responsible for the sweet flavour and Glu has a strong umami taste. So, the higher content of these amino acids enhance the taste of the wild-caught muscle crabs. Regarding the Na:K molar ratio, it is worth mentioning the very high value of this ratio in the rice-field crab muscle (14.0), while in the wild-caught crab muscle the value was 2.6. It is also worth mentioning the high value of this ratio in the wild-caught hepatopancreas (7.1) compared to its counterpart in the rice-field crab (1.3). As shown in Table 4, all edible fractions were excellent sources of Fe and Cu and also excellent or good sources of P and Zn with the exception of P in the muscle of rice-field mitten crab.

The pleasant aroma of water boiled or steamed cooked Chinese mitten crab was studied by Chen *et al.* (2010), Gu *et al*. (2013), and Wu *et al.* (2014). The odorants were extracted by headspace solid phase microextraction (SPME) and analyzed by Gas Chromatography-Mass Spectrometry (GC/MS) coupled with Gas Chromatography-Olfactometry (CG/O).

In turn, Kong *et al.* (2012) evaluated the non-volatile compounds and sensory characteristics of Chinese mitten crabs produced in net pens located in Yangchen Lake and ponds containing water originating from this Lake. The results obtained by these authors showed that the TFAA content, umami 5′-nucleotide compounds (adenosine monophosphate (AMP), inosine monophosphate (IMP) and guanosine monophosphate (GMP)) and PUFAs in the hepatopancreas and muscle of crab produced in ponds were lower than those reared in the net pens.

Wang *et al.* (2016) also compared the flavour qualities of steamed edible parts of Chinese mitten crab collected in three different areas (wild and pond-reared). The flavour profiles, evaluated by electronic-tongue and electronic-nose, showed differences in the tastes and odours among the crab samples from the three origins. Female gonads had the highest equivalent umami concentration (EUC) – 69.21 g MSG 100 g^{-1} – and wild crabs had higher EUC values in all edible parts than pond-reared ones. The EUC is calculated from the content of the umami free amino acids (Glu and Asp) and 5’-nucleotide concentrations and is expressed in grams of monosodium glutamate (MSG) per 100 g of tissue. Wild crabs had the highest level of the nine key volatile compounds in gonads and hepatopancreas, but the lowest in the muscle.

Jiang *et al.* (2014) also analyzed the fatty acid and amino acid profiles of the muscle, hepatopancreas and female gonads of green mud crab (*Scylla paramamosain*) and swimming crab (*Portunus trituberculatus*） cultured in Chongming Island and Zhujiajian Island (China), respectively. In both species, palmitic acid was the main SFA ranging from 14.88 % to 26.47 % in green mud crab and 18.40 to 24.15 % in swimming crab (Table 3). Similarly, oleic acid was the main MUFA in both species varying between 12.73 % and 19.85 % in the former species and between 14.63 % and 23.73 % in the latter species. EPA and DHA were the predominant PUFAs in the muscle and hepatopancreas of green mud crab, but in the female gonads the main PUFAs were linoleic acid (7.56 %) and linolenic acid (7.08

%) followed by EPA and DHA. In the case of swimming crab the predominant PUFAs were EPA and DHA in the three tissues. TAA content (g 100 g^{-1} dry weight) of green mud crab varied from 30.8 in the female hepatopancreas and 82.9 in the male muscle. The lowest EAA/TAA ratio (0.34) was recorded in the male muscle, while female gonads had the highest value (0.42). The FAA content (g 100 g^{-1} dry weight) was in the range of 12.5 in the female hepatopancreas and 41.4 in the male muscle. In the case of swimming crab the lowest TAA content (31.2 g 100 g^{-1} dry weight) was also recorded in female hepatopancreas but the highest content (72.5 g 100 g^{-1} dry weight) was obtained in the female muscle. Such as in the green mud crab, the lowest EAA/TAA ratio (0.34) was recorded in male muscle and the female gonads had the highest value (0.42). Regarding the FAA content (g 100 g^{-1} dry weight), it was in the range of 12.7 in the female hepatopancreas and 35.3 in the male muscle.

He *et al.* (2017) also evaluated the nutritional value of wild-caught swimming crab from the north of Zhejiang Province and pond-reared collected in an aquaculture farm in Zhejiang (China). It is noteworthy highlighting the very high protein content of female gonads and conversely the very low content of this constituent in the hepatopancreas (Table 2). The very high fat content of hepatopancreas is also to be highlighted. The fatty acid composition (Table 3) shows that in both type of crabs, the order of abundance is PUFAs > MUFAs > SFAs in the muscle, MUFAs > SFAs> PUFAs in the hepatopancreas and MUFAs > PUFAs > SFAs in the female gonads. It is also noticeable that in both types of crabs, muscle was the richest tissue in n-3 PUFAs, followed by female gonads and hepatopancreas. However, female gonads from both types of crabs showed the highest n-3/n-6 ratio. Palmitic and oleic acid were the predominant SFA and MUFA in the hepatopancreas and female gonads in both crabs. However, DHA was the main PUFA in the hepatopancreas and female gonads, while EPA predominated in the muscle. The TAA and EAA contents in the muscle of pond-reared crabs were 16.12 and 6.19 g 100 g^{-1}, respectively and in the female gonads these levels were 29.10 and 13.72 g 100 g^{-1}, respectively. Wild-caught crabs had lower AA contents than pond-reared crabs and their TAA and EAA contents in the muscle were 13.00 and 5.22 g 100 g^{-1}, respectively, while in the female gonads the levels were 27.76 and 13.16 g 100 g^{-1}, respectively. As shown in Table 4, the three edible tissues are excellent sources of Cu, Zn, and Se, with the exception of pond-reared crab hepatopancreas that is good source of Zn. The Na:K molar ratio recorded in muscle and female gonads of both types of crabs is in the recommended range of 1.67 and 1.98. In the hepatopancreas, this ratio was 2.33 in wild-caught crabs and 2.56 in pond-reared crabs.

Crabs

Wu *et al.* (2010) evaluated the nutritional value of various edible parts of blue swimmer crab (*Portunus pelagicus*) caught in the coast of Hainan Island (China). As shown in Table 2, the hepatopancreas had the lowest protein content, particularly in males, while gonads were the richest in protein. PUFAs were the major group in meat (Table 3) but in hepatopancreas and gonads the main fatty acids were SFAs. The three most significant PUFAs in all tissues were ARA (average values: 8.87 % meat; 5.99 % hepatopancreas; 5.42 % gonads), EPA, and DHA where females had higher levels of EPA than males which in turn were richer in DHA. The cholesterol content (mg 100 g^{-1}) in the edible parts of females and males were respectively: 108 and 79 in meat; 142 and 211 in hepatopancreas; and 284 and 61 in gonads. The level of EAAs in the muscle of this crab males and females was 5.79 and 7.21 g 100 g^{-1}, respectively and the content of NEAAs in males and females muscle was 9.72 and 10.11 g 100 g^{-1}, respectively. In gonads, the levels of EAAs (g 100 g^{-1}) were 9.17 and 11.41 in males and females, respectively, while the levels of NEAAs (g 100 g^{-1}) in males and females were 12.13 and 13.49, respectively. Essential amino acids scores (EAAS)[2] of all EAAs was higher than 100, with the exception of Trp in crab meat and Met and Cys in male gonads. However, in crab female gonads the EAAS of all EAAs were higher than 100.

Barrento *et al.* (2010) analyzed the muscle, gonads and hepatopancreas of brown crab (*Cancer pagurus*) females and males caught in Scottish coast and English Channel. In Table 2 is shown the proximate composition of these parts and each proximate composition is the average of crabs from both fishing grounds. The authors concluded that the fishing ground had no influence on the chemical composition but significant differences between tissues and sexes were found. The highest protein content was measured in female gonads followed by meat and hepatopancreas but in males meat was richest in protein followed by hepatopancreas and male gonads. The average cholesterol content in muscle and hepatopancreas was 38.9 and 117.8 mg 100 g^{-1}, respectively. In the gonads, the average cholesterol content was 170.1 and 85.3 mg 100 g^{-1} in female and male gonads , respectively. Its noticeable the low levels of cholesterol in the muscle and the significant difference of its level in gonads of females and males. The abundance of the three fatty acids groups (Table 3) followed the order PUFAs > MUFAs > SFAs in muscle and gonads but in hepatopancreas MUFAs were dominant followed by PUFAs and SFAs. It is also worth highlighting the high EPA percentage in the muscle. Regarding the amino acids, the average TAA (g 100 g^{-1}) were: 16.7 in muscle, 11.0 in hepatopancreas, 26.6 in female gonads, and 12.8 in male gonads. The average EAA/NEAA ratio varied between 0.80 in muscle and 0.88 in hepatopancreas. All tissues had EAAS above 100 %, except for Met.

[2] EAA content of the sample x 100/FAO reference for EAA content

Maulvault *et al.* (2012) also evaluated the proximate composition of raw, steamed and boiled muscle and brown meat (mainly gonads and hepatopancreas) of brown crab from Scotland coast caught in spring and summer (Table 2). The composition of raw muscle crab from both seasons was not different, with the exception of spring crab which was carbohydrates richer than summer crab. However, raw brown meat from spring crab was richer in carbohydrates and ash than summer crab. On the other hand, the protein and fat contents of summer crab were higher than in its counterpart of spring crab. The culinary treatments (boiling and steaming) induced weight losses which were more pronounced in summer crabs. Moreover, higher weight losses were registered in boiled tissues than in steamed ones. These losses were mainly due to water released during the cooking processes which generally led to decreasing moisture content and increasing ash, protein (in muscle) and carbohydrate contents. The percentages of the three fatty acids groups in muscle and brown meat did not present significant differences between the two seasons (Table 3). Palmitic and oleic acids were the main SFA and MUFA, respectively both in the muscle and brown meat. EPA was the dominant PUFA in muscle in both seasons, but in the brown meat DHA was dominant in spring and EPA in summer. Culinary treatments caused changes in the fatty acid profile which were more accentuated in boiled products. A decrease of most fatty acids occurred in both boiled tissues regardless of season. In contrast, smaller changes took place in steamed tissues. The content of some fatty acids decreased, but was lower than that observed in boiled tissues and an increase of the content of some fatty was also recorded. The decrease of long chain fatty acids content may result from their oxidation during the culinary procedures. In addition to the elements presented in Table 4, the contents of S, Cl, Br and Sr and toxic elements (Hg, Cd, Pb, and As) were also determined in this study. The elemental profile of both tissues was season dependent and a common pattern for the retention of elements in cooked crabs was not observed. As shown in Table 4, muscle and brown meat raw or cooked were generally excellent sources of Cu, Zn, and Se and brown meat was excellent source of Ca and good source of Fe.

Brown crab (*Cancer pagurus*) (anoukkadijk/iNaturalist).
Sapateira (*Cancer pagurus*) (anoukkadijk/iNaturalist).

The proximate composition, fatty acids, amino acids and elemental profiles of the muscle, hepatopancreas and gonads of female spider crab (*Maja brachydactyla*) were analyzed by Marques *et al*. (2010). As shown in Table 2, gonads had the highest protein content followed by muscle and hepatopancreas. The latter tissue was the fattiest and had also the highest ash content. The fatty acid profile of muscle, hepatopancreas, and female gonads presented in Table 3 shows some similarity whereas the low PUFA content of hepatopancreas is remarkable. The latter tissue had also the lowest n-3/n-6 ratio. However, the level of PUFAs (in mg 100 g^{-1}) in the hepatopancreas was of the same order of magnitude as the value recorded the gonads due to its high fat content. The cholesterol content of muscle was relatively low (37.13 mg 100 g^{-1}) whereas it attained 133.1 mg 100 g^{-1} in the gonads. The TAA (g 100 g^{-1}) were 14.86 in muscle, 8.91 in hepatopancreas and 17.54 in gonads and the EAA/NEAA ratio were 0.86, 0.77, and 0.84, respectively. Essential amino acids score based on amino acid pattern requirement for adults generally were above 100, in the three tissues, except Ile (muscle) and Met (gonads). The elemental profile of the three tissues presented in Table 4 shows that they are excellent sources of Cu, Zn, and Se. Hepatopancreas was also excellent source of Fe. The Na:K ratio was 2.97 in the muscle and hepatopancreas and 1.33 in gonads which are close to the variation range of this ratio (1.0-2.0) recommended by Swanepoel *et al.* (2016) and Vasara *et al.* (2017).

Özden and Erkan (2011) evaluated the proximate composition (Table 2), amino acid and elemental profiles of warty crab (*Eriphin verrucosa*) and shamefaced crab (*Calappa granulata*). The most relevant characteristics of the proximate composition of these two species were the differences between their moisture and protein contents. Total amino acids of warty and shamefaced crabs were

17.51 and 12.50 g 100 g^{-1}, respectively and the EAA/TAA ratio was 0.42 and 0.38, respectively. As shown in Table 4, both crab species are excellent sources of P and Se and good sources of Mg. Moreover, shamefaced crab is excellent source of Ca and Fe and warty crab good source of Fe. It is also to be mentioned the Na:K molar ratio for shamefaced crab (0.79) and the most favourable value of 1.62 for warty crab.

The proximate composition (Table 2) and elemental profile (Table 4) of claw muscle tissue of blue crab and warty crab captured in the Acquatina Lagoon (Italy) and brown crab from Weymouth Bay (UK) were determined by Zotti *et al.* (2016). As shown in Table 2, warty crab had protein content close to that reported by Özden and Erkan (2011) for this crab species. In the case of brown crab, its protein content was only similar to the value obtained by Barrento *et al.* (2010) for the muscle of female brown crab. Regarding the mineral profile, it should be noted that these three species were excellent sources of Cu and Zn, as well as the warty crab an excellent source of Ca. Brown crab had the lowest Na:K (0.93), but the value of this ratio – 1.06 for blue crab and 1.98 for warty crab – fell in the recommend range of 1.0 to 2.0.

Mandume *et al.* (2019) determined the proximate composition, amino and fatty acid profiles, cholesterol and mineral content of edible tissues (muscle, female gonads and hepatopancreas) of female boiled Western African geryon (*Chaceon maritae*) caught off Namibe coast (Angola). The samples analyzed were caught in two distinct seasons – March and October. Seasonal significant differences were only recorded in the moisture and fat contents of female gonads and hepatopancreas and in the ash content of hepatopancreas. The highest protein was measured in the female gonads and the lowest in the hepatopancreas which was the fattiest tissue. In both seasons, PUFAs in muscle and female gonads were the main group, followed by MUFAs and SFAs. In the hepatopancreas of crabs from March the decreasing order of their percentages was: MUFAs > PUFAs > SFAs, but in the hepatopancreas of crabs caught in October the order was MUFAs > SFAs > PUFAs (Table 3). Muscle was generally richer in EPA and DHA, while female gonads were richer than hepatopancreas in these two fatty acids. Palmitic acid was the main SFA in the three tissues and its level ranged from 10.95 % in the muscle of March crab and 13.61 % in the hepatopancreas of October crab. Oleic acid was also the major MUFA in the three tissues analyzed and its level was in the range of 2.77 % in the muscle of March crab and 16.8 % in the hepatopancreas of October crab. EPA and DHA were the predominant PUFA in these tissues. The level of cholesterol in the muscle of March and October crab was 62.8 and 79.2 mg 100 g^{-1}, respectively. No significant differences between the amino acids profile of muscle protein of crab caught in the two seasons were observed. Total amino acids of this tissue of crab caught in March and October were 15.54 and 14.96 g 100 g^{-1}, respectively and the EAA/NEAA ratio was 0.55 and 0.57 for March and October crab proteins, respectively. As shown in Table 4, the crab muscle is a good source of P, Mg, and Fe (March) and excellent source of Cu, Zn, and Se. Female gonads and hepatopancreas are also excellent sources of Cu and Zn. The high Na:K ratio (around 5.3) may be due the addition of salt during the cooking process.

King crabs

The nutritional value of southern king crab (*Lithodes santolla*) caught in San Jorge Gulf, Argentina, was evaluated by Risso and Carelli (2012). Differences in the proximate composition between raw and cooked crabs (Table 2) are due to the loss of water during the cooking process. As shown in Table 3, an increase of the levels (mg 100 g^{-1}) of the three fatty acids groups was registered in cooked king crab. Palmitic acid was the main SFA (15.8 and 15.3 % in raw and cooked king crab, respectively). Oleic acid was the predominant MUFA (21.8 and 22.1 % in raw and cooked king crab, respectively). Cholesterol content increased from 37.3 mg 100 g^{-1} in raw meat to 51.0 mg 100 g^{-1} in cooked meat. Total tocopherol[3] content (mg 100 g^{-1}) was 37.3 and 1.14 in raw and cooked meat, respectively. It was constituted by α-tocopherol (raw: 96.4 %, cooked: 98.06 %) and γ-tocopherol. No significant differences were found between the amino acid content of raw and cooked meat expressed as g/100 g protein. The EAAs content was around 6.20 g 100 g^{-1} raw meat. All amino acid scores were over 100, indicating that proteins of southern king crab were well-balanced in the EAAs composition. The elemental profile (Table 4) of raw and cooked meat did not present significant differences and both raw and cooked meat are good sources of P and Zn and cooked meat is good source of Ca and Fe. The Na:K ratio was relatively high (around 4.9).

Red king crab (*Paralithodes camtschaticus*) (Mags49/iNaturalist United Kingdom)
Caranguejo-real (*Paralithodes camtschaticus*) (Mags49/iNaturalist United Kingdom)

[3] Tocopherol is a component of vitamin E that has powerful antioxidant effects.

Lobsters

Tsape *et al.* (2010) compared the fatty acid profile of the muscle and hepatopancreas of Norway lobster (*Nephrops norvegicus*) and common spiny lobster (*Palinurus elephas*). PUFAs (Table 3) were dominant in both edible tissues of these crustacean species. Palmitic acid (22.50 %) and oleic acid (21.02 %) were the main fatty acids in the muscle of Norway lobster, while ARA (22.76 %) and oleic acid (13.91 %) were dominant in the muscle of European spiny lobster muscle. In hepatopancreas, oleic acid (21.55 %) and palmitic acid (19.29 %) predominated in Norway lobster whereas EPA and palmitic acid (11.51 %) were predominant in European spiny lobster. The levels of cholesterol in the muscle and hepatopancreas of Norway lobster were 74.97 and 103.56 mg 100 g^{-1}, respectively. In European spiny lobster, the levels of this sterol were 98.58 mg 100 g^{-1} in the muscle and 97.36 mg 100 g^{-1} in the hepatopancreas.

Özden and Erkan (2011) evaluated the proximate composition, amino acid and elemental profiles of shovelnose lobster (*Scyllarides latus*), common spiny lobster and Norway lobster. It is worth mentioning the high protein content of these lobster species shown in Table 2. The TAA content of shovelnose lobster, common spiny lobster and Norway lobster was 15.4, 21.7, and 22.48 g 100 g^{-1}, respectively which is in line with their increasing protein content. Elemental composition of these lobster species (Table 4) shows they are excellent sources of P, Fe (except European spiny lobster), and Se and good sources of Mg. The Na:K ratio varied between 0.65 in shovelnose lobster and 1.64 in Norway lobster.

Norway lobster (*Nephrops norvegicus*) (Karim Haddad/iNaturalist).
Lagostim (*Nephrops norvegicus*) (Karim Haddad/iNaturalist).

Shrimps/prawns

Caramote prawn (*Penaeus kerathurus*) is a crustacean widely consumed in the Mediterranean area and presents the fatty acid composition shown in Table 3 (Tsape *et al.*, 2010). EPA was the main fatty acid in the muscle of caramote prawn followed by palmitic acid (13.25 %). The latter fatty acid

(17.20 %) predominated in the hepatopancreas of this prawn followed by EPA. Cholesterol level in the muscle was 144.29 mg kg^{-1}, while in the hepatopacreas attained 521.44 mg kg^{-1}.

The proximate composition of jinga shrimps (*Metapenaeus affinis*) collected in landing areas located along the West Coast of Peninsular Malaysia was evaluated by Nurnadia *et al.* (2011) and it is shown in Table 2. The high protein content of this shrimp is to be stressed. Nurnadia *et al.* (2013) also determined the mineral composition of this shrimp shown in Table 4. This shrimp is excellent source of Cu and Mg, but the content of this mineral seems extremely high. The Na:K molar ratio was 5.80 mainly due to the low K content reported by these authors.

The fatty acid profile of male and female jinga shrimps collected in three stations of the Persian Gulf (Iran) was analyzed (Eskandari *et al.*, 2014). The average fatty acid composition of males and females collected in the three stations is shown in Table 3. Males of all stations had higher PUFA content than females and the maximum recorded was 49.75 %. On the contrary, females were richer in MUFA and the highest percentage registered was 21.08. The variation ranges of SFA, EPA, and DHA in the total of males and females were 31.13-36.72 %, 12.73-16.80 %, and 11.19-13-12 %, respectively. Females from all stations presented higher n-3/n-6 ratio and the maximum was 2.96.

Jinga shrimp is also highly popular in Izmir (Turkey) and the proximate composition, fatty acid profile and elemental composition of males and females were determined by Dinçer and Aydin (2014). The levels of moisture, protein, and fat in males and females were not significantly different. It is also worth mentioning the similarity between these values and those reported by Nurnadia *et al.* (2011). The order of abundance of the three fatty acid groups (SFAs > PUFAs > MUFAs) was the same in males and females (Table 3). Palmitic acid was the main SFA both in males (23.24 %) and females (23.70 %). Similarly, oleic acid was the main MUFA in males (7.53 %) and females (9.78 %). The mineral profile of jinga shrimps shows (Table 4) that jinga shrimps are excellent sources of Cu and the Na:K molar ratio was 0.65.

Özden and Erkan (2011) evaluated the proximate composition (Table 2), amino acid and elemental profiles of pink shrimp (*Parapenaeus longirostris*). Total amino acids were 15.3 g 100 g^{-1} and Phe was the main essential amino acid accounting for 2.17 g 100 g^{-1}. As shown in Table 4, pink shrimp is excellent source of P, Fe and Se and good source of Mg and its Na:K molar ratio (1.32) is in the recommended range of 1.0-2.0 previously mentioned. The study by Olmedo *et al.* (2013) on the determination of several essential elements and toxic metals in seafoods consumed in Andalusia (Spain) includes fresh pink shrimp (caught in the Atlantic coast), frozen pink shrimp (imported from Tunisia) and frozen whiteleg shrimp (*Penaeus vannamei*) imported from Panama. The median of values presented in Table 4 show that shrimps from both species are excellent sources of Cu and frozen pink a good source of Se. It is to stress the very low level of Se in whiteleg shrimp reported by these authors.

Li *et al.* (2011) analyzed the fatty acid profile and their fat content (in brackets) of the following marine shrimps or prawns: ridgetail white prawn, *Exopalaemon carinicauda* (0.46 %); Cipango prawn, *E. annandalei* (1.78 %); mantis shrimp, *Oratosquilla oratoria* (1.42 %); fleshy prawn, *Penaeus chinensis* (1.18 %); and whiteleg shrimp (1.32 %) from the Zhejiang province (China). PUFA was the major group in all species generally following the order PUFAs > SFAs > MUFAs. Palmitic acid was the main SFA in all species varying from 14.4 % in mantis shrimp and 20.0 % in whiteleg shrimp and oleic acid was the predominant MUFA and its content varied between 10.7 % in fleshy prawn and 15.8 % in whiteleg shrimp.

The study by Chedoloh *et al.* (2011) on the fatty acid composition of aquatic animals consumed in Thailand included the following marine crustacean species: banana shrimp (*Penaeus merguiensis*), whiteleg shrimp and giant tiger prawn (*P. monodon*). Their fat content was in the range of 1.38 % in giant tiger prawn and 1.62 % in whiteleg shrimp whereas banana shrimp had an intermediate value of 1.48 %. The order of abundance of the three fatty acid groups was SFAs > PUFAs > MUFAs in these three species, but banana shrimp and giant tiger prawn were richer in n-3 fatty acids than whiteleg

Pink shrimp (*Parapenaeus longirostris*) (Katerina/iNaturalist).
Gamba (*Parapenaeus longirostris*) (Katerina/iNaturalist).

shrimp. In these crustaceans, palmitic acid was the main SFA and its content ranged between 15.3 % in whiteleg shrimp and 26.4 % in banana shrimp, while the content of oleic acid, the main MUFA, ranged from 11.2 % in banana shrimp to 15.0 % in whiteleg shrimp. The proximate composition of giant tiger prawn reported by Mohanty *et al.* (2016a, 2019) is shown in Table 2 and the percentages of their three fatty acid groups are presented in Table 3. The decreasing order of abundance (SFAs > PUFAs > MUFAs) of the three fatty acid groups was the same obtained by Chedoloh *et al.*, but the percentages of SFAs and PUFAs were closer in the studies reported by Mohanty *et al*. (2016a). The mineral profile of this species reported by Mohanty *et al.* (2016b, 2019) is presented in Table 4. According to the results of these authors, giant tiger prawn is excellent source of K, P, Mg, Ca, Fe, Cu, Zn, and Se and the Na:K molar ratio was 1.14.

Wild and farmed whiteleg shrimps from Sinaloa and Nayarit states, Mexico, were analyzed by Puga-López *et al.* (2013). The average proximate composition of wild and farmed shrimps is presented in Table 2. No significant differences in the proximate composition between wild and farmed shrimps nor between wild and farmed shrimps from the two states were found.

Mehta and Nayak (2017) also analyzed the proximate composition of whiteleg shrimp from a culture pond in Raighart district of Maharashtra (India). As shown in Table 2, the proximate composition of this shrimp is similar to that reported by Puga-López *et al.* (2013). The fatty acid composition reported by Mehta and Nayak for this shrimp is shown in Table 3 and the palmitic acid (50.15 %) was the main SFA and oleic acid (23.80 %) the predominant MUFA. It is to stress the rather high percentage of SFAs together with that of PUFAs as compared with the results obtained by Li *et al.* (2011) and Chedoloh *et al.* (2011).

The proximate composition, fatty acid profile and cholesterol content of common shrimp (*Crangon crangon*) harvested from Black Sea, Turkey, were determined Turan *et al.* (2011). The proximate and fatty acids composition are shown in Tables 2 and 3, respectively. As shown in Table 3, SFA was the main fatty acid group and palmitic acid was predominant (20.69 %). Among MUFAs, the predominant was oleic acid accounting for 14.25 %. This shrimp species presents a cholesterol content of 173.56 mg 100 g^{-1}.

The fat content (1.35 %) and fatty acid profile of common shrimp from the Bulgarian Black Sea coast was determined by Merdzhanova *et al.* (2014). As shown in Table 3, the decreasing order of abundance of the three fatty acids groups was PUFAs > SFAs > MUFAs. Palmitic acid (27.38 %) was the main SFA and the percentage of palmitoleic acid (16: 1 n-7), the predominant MUFA, accounted for 16.10. For these authors, the low MUFA content may result from an increase of phytoplankton mass in Black Sea as a result of eutrophication. Common shrimp had high levels of vitamin A (537.0 µg 100 g^{-1}), vitamin D_3 (12.99 µg 100 g^{-1}) and particularly vitamin E (7730.9 µg 100 g^{-1}).

Ouraji *et al.* (2011) compared the fatty acid profile of wild and farmed Indian white shrimps (*Penaeus indicus*) caught in the Persian Gulf (Iran). Farmed and wild shrimps had similar SFA percentages, but wild shrimps were richer of MUFA and PUFA than farmed shrimps. In both shrimps, palmitic acid was the main SFA (19.18 % and 21.27 % in wild and farmed shrimps, respectively) as well as oleic acid among MUFAs (13.64 % and 17.12 % in wild and farmed shrimps, respectively). EPA was the main PUFA followed by DHA and linoleic acid (7.25 %) in wild shrimps (7.25 %), while linoleic acid (13.04 %) predominated in farmed shrimps. The mineral profile of Indian white shrimp determined by Mohanty *et al.* (2016b, 2019) and shown in Table 4 indicated that this species is an excellent source of K, P, Mg, Ca, Fe, Cu, Zn, and Se and the Na:K molar ratio was 1.32.

Yanar *et al.* (2011) also compared the proximate composition, fatty acid, amino acid, and elemental profiles of farmed and wild green tiger shrimps (*Penaeus semisulcatus*) from Turkey. The high protein of these shrimps shown in Table 2 is to be stressed. Fatty acid profile of wild and farmed shrimps presented significant differences. In wild shrimps the decreasing order of the three fatty acid groups was PUFAs > SFAs > MUFAs, while in farmed shrimps this order was SFAs > PUFAs > MUFAs (Table 3). Wild shrimps also had higher n-3/n-6 ratio than farmed shrimps. In both wild and farmed shrimp, palmitic and oleic acids were the main SFA and MUFA, respectively. The levels of the former fatty acid were 18.44 % in wild shrimps and 16.01 % in farmed shrimps, while the percentages of oleic acid were 8.96 and 12.42 in wild and farmed shrimps, respectively. Concerning the amino acid profile, non significant differences in the content of EAA and NEAA of shrimps from both origins were obtained. The content of total EAA was 11.07 and 10.04 g 100 g^{-1} in wild and farmed shrimps, respectively and NEAA contents were 12.32 g 100 g^{-1} in wild and 11.68 g 100 g^{-1} in farmed shrimps. As shown in Table 4, green tiger shrimps of both origins are excellent source of P and good source of Mg, Fe, and Zn. It is also to stress that farmed shrimps are good source of K. The Na:K molar ratio was 1.51 and 1.06 in wild and farmed shrimps, respectively.

Fatima *et al*. (2012) studied the muscle fatty composition of banana shrimp and redtail prawn (*P. penicillatus*) caught in Pakistan. The average fat content of banana shrimp muscle was 0.96 % (varied between 0.87 and 0.98 %) and that of the redtail prawn muscle was 0.93 % (varied from 0.92 and 1.0 %). The levels of total SFAs, MUFAs, and PUFAs as well as those of EPA and DHA were similar in these two crustacean species (Table 3). In both species, palmitic acid was the most abundant SFA and represented 16.90 % in banana shrimp and 17.31 % in redtail prawn. Similarly, oleic acid was the main MUFA in these two species and its percentage accounted for 9.61 % in banana shrimp and 10.35 % in redtail prawn.

The fat content and fatty acid profile of males and females of giant red shrimp (*Aristaemorpha foliacea*) from the Mediterranean Sea (Turkey) were reported by Olgunoglu *et al.* (2015). The lipid content was 0.51 % in males and 0.72 % in females. In both males and females, the decreasing order of the three fatty acid groups was SFAs > PUFAs > MUFAs (Table 3), the main SFA was palmitic acid (27.29 % in males and 27.59 % in females) and oleic acid was the main MUFA (15.68 % in males and 21.68 % in females).

Speckled shrimp (*Metapenaeus monoceros*) collected in Khulna district (Bangladesh) was analyzed by Bogard *et al.* (2015). The proximate composition is shown in Table 2 and the mineral profile in Table 4. As shown in this Table, speckled shrimp is good source of Mg and Fe and excellent source of P, Ca, Cu, and Se. The molar Na:K ratio of this species (0.69) was relatively low taking into account the recommended range (1.0-2.0) of this ratio previously mentioned. The vitamin content of speckled shrimp was: 1.4 µg 100 g^{-1} vitamin B12; 0.055 µg 100 g^{-1} vitamin D3; and 1.6 mg 100 g^{-1} vitamin E. As reported by the authors, a standard portion (50 g/ day for pregnant and lactating women and 25 g/ day for infants) of this species would contribute to 26 % and 44 %, respectively for the recommended nutrient intake of vitamin B12.

Ozogul *et al.* (2015) evaluated the effect of different cooking method on the cholesterol content of Red Sea mantis shrimp (*Erugosquilla massavensis*) caught in Mediterranean Sea. The levels of cholesterol (mg 100 g^{-1}) in raw and cooked shrimps were: 37.38 raw; 30.18 oven cooked; 26.22 microwave cooked; and 18.76 fried. Either cooking method led to a decrease in cholesterol content which was most pronounced in fried shrimp.

In summary

- In general, crustacean muscle may be considered high protein content food (protein content in the range 15-20 %) with the exception of southern king crab and shamefaced crab which had protein content below 15 %. Moreover, Norway lobster and wild green tiger shrimp are very high protein content foods (protein content above 20 %). The muscle of crustaceans is very lean with fat content between 0.3 and 1.8 %, with only one reference to a fat content of 4.4 % in giant freshwater prawn. Ash content of crustacean muscle falls in the range of 1.10 and 3.10 %, except for giant freshwater prawn where 4.9 % has been reported.
- The proximate composition of hepatopancreas and gonads of freshwater crabs (FWC) and marine crabs (MC) was quite different from muscle crab. Hepatopancreas from FWC had low protein content (below 15 %) but MC hepatopancreas had wider protein content range (between 8 and 20 %). This edible part had generally high fat content which attained more than 30 % in Chinese mitten crab. Regarding female gonads, they had very high protein content (over 20 %) and low to medium fat content. Male gonads had relatively lower protein and fat contents than female gonads.

- PUFAs were the major group in the muscle in the majority of crustaceans whereas MUFAs predominated in hepatopancreas and gonads of FWC as well as in the hepatopancreas of MC.
- The TAA content in the muscle varied between 11.76 and 23.39 g 100 g^{-1}, with the highest levels recorded in prawns. The hepatopancreas had the lowest levels of TAA and the highest level was recorded in female gonads (23.39 g 100 g^{-1}). It should also be noted that the highest values of the EAA/NEAA ratio were found in the gonads (over 0.70).
- Chinese mitten crab was excellent source of Fe and Cu and good or excellent source of P, Ca and Zn depending on the habitat. MC were excellent sources of Cu, Zn, and Se. Lobsters were excellent sources of P and Se. Shrimps were generally excellent sources of Cu and Se and good or excellent sources of P, Mg, and Fe.

Factor used to converting the percentage of fatty acid to fatty acid in mg 100 g^{-1} edible portion

In order to converting the percentage of fatty acid to fatty acid in mg 100 g^{-1} edible portion (EP) the following equation was used:

Total fatty acid (mg 100 g^{-1} EP) = % fatty acid x XFA x F x 10

where XFA is the conversion factor and F the total lipid content (g 100 g^{-1} EP).

XFA was calculated using the formula by Weihrauch *et al.* (1977) for crustaceans:

XFA (g g^{-1}) = 0.956 - 0.273/total lipid content.

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Table 2 - Proximate chemical composition (g 100 g^{-1}) of several crustacean species.
Tabela 2 – Composição química aproximada (g 100 g^{-1}) de várias espécies de crustáceos.

Common name	Scientific name	Moisture	Protein	Fat	Carbohydrate	Ash	Source
Freshwater crustaceans							
Amazon river prawn	*Machrobrachium amazonicum*	76.5	21.5	1.5	-	1.3	Portella *et al.* (2013)
Giant freshwater prawn	*M. rosenbergii*	78.4	18.5	1.2	-	1.3	Portella *et al.* (2013)
Giant freshwater prawn	*M. rosenbergii*	77.5	18.7	1.7	-	1.1	Sriket *et al.* (2013)
Monsoon river prawn	*M. malcolmsonii*	77.9	15.7	2.2	-	3.3	Bogard *et al.* (2015)
Giant freshwater prawn	*M. rosenbergii*	73.5	16.9	4.4	-	4.9	Mohanty *et al.* (2016a, 2019)
Swimming crab (wild-caught)	*Portunus trituberculatus*						He *et al.* (2017)
Muscle		82.72	15.35	1.16	0.84	-	
Hepatopancreas		76.41	7.58	25.61	0.78	-	
Female gonads		57.70	23.42	15.36	0.68		
Swimming crab (pond-reared)	*P. trituberculatus*						He *et al.* (2017)
Muscle		78.26	15.73	1.20	0.67	-	
Hepatopancreas		72.61	9.76	22.53	1.04	-	
Female gonads		53.09	27.81	12.93	0.45	-	
Chinese mitten crab	*Eriocheir sinensis*						Shao *et al.* (2013)
Female hepatopancreas		44.55	8.39	36.68	-	0.88	
Male hepatopancreas		50.35	9.46	30.21	-	1.06	
Female gonads		50.75	28.73	13.37	-	1.93	
Male gonads		72.65	17.50	0.63	-	2.23	
Chinese mitten crab	*E. sinensis*						Shao *et al.* (2014)
Natural diet		77.29	18.60	0.98	-	1.78	
Formulated diet		77.37	18.60	0.92	-	1.74	

Table 2 (Cont.)

Common name	Scientific name	Moisture	Protein	Fat	Carbohydrate	Ash	Source
Chinese mitten crab (Male muscle)	*E. sinensis*						Wang *et al.* (2018)
Grade I		79.23	18.20	0.81	0.97	-	
Grade II		77.27	18.13	0.74	0.67	-	
Grade III		77.89	18.14	0.94	0.27	-	
Grade IV		80.30	17.78	0.78	0.15	-	
Chinese mitten crab (Male hepatopancreas)	*E. sinensis*						Wang *et al.* (2018)
Grade I		66.17	10.70	20.01	1.31	-	
Grade II		60.44	10.59	24.16	1.32	-	
Grade III		67.87	9.35	21.00	1.54	-	
Grade IV		70.38	8.30	16.33	2.37	-	
Chinese mitten crab (Male gonads)	*E. sinensis*						Wang *et al.* (2018)
Grade I		74.06	17.37	1.14	0.77	-	
Grade II		75.70	16.89	0.87	1.12	-	
Grade III		73.78	17.25	0.93	1.01	-	
Grade IV		73.88	17.06	1.22	0.88	-	
Chinese mitten crab (Male) (wild-caught)	*E. sinensis*						Wu *et al.* (2020)
Muscle		79.09	17.65	0.68	-	1.79	
Hepatopancreas		57.15	8.68	31.77	-	1.56	
Gonads		70.15	13.23	0.96	-	2.48	
Chinese mitten crab (Male) (rice-field)	*E. sinensis*						Wu *et al.* (2020)
Muscle		76.85	16.90	0.78	-	1.78	
Hepatopancreas		55.86	10.04	33.61	-	1.75	
Gonads		68.79	12.82	1.19	-	2.71	

Table 2 (Cont.)

Common name	Scientific name	Moisture	Protein	Fat	Carbohydrate	Ash	Source
Chinese mitten crab	*E. sinensis*						Guo *et al.* (2014)
Steamed meat		74.54	20.73	0.86	-	1.63	
Steamed male gonads		59.58	10.61	26.28	-	1.81	
Steamed female gonads		59.90	12.90	23.54	-	1.69	
Crabs							
Blue swimmer crab	*Portunus pelagicus*						Wu *et al.* (2010)
Female meat		78.2	18.4	1.08	0.20	-	
Male meat		79.5	16.9	0.75	0.14	-	
Female hepatopancreas		77.3	8.4	3.09	0.62	-	
Male hepatopancreas		76.6	10.8	6.70	0.53	-	
Female gonads		61.0	25.5	9.60	0.78	-	
Male gonads		73.0	22.9	2.00	n.d.	-	
Brown crab							Barrento *et al.* (2010)
Female meat	*Cancer pagurus*	77.6	17.6	0.4	-	2.2	
Male meat		75.9	19.2	0.3	-	2.1	
Female hepatopancreas		68.7	10.8	10.1	-	3.1	
Male hepatopancreas		61.5	13.8	11.5	-	5.8	
Female gonads		57.5	25.3	3.3	-	1.6	
Male gonads		79.1	13.5	1.0	-	2.7	
Brown crab	*C. pagurus*						Maulvault *et al.* (2012)
Raw muscle (spring)		76.3	19.1	0.6	0.9	2.2	
Steamed muscle(spring)		72.3	22.8	0.6	1.3	2.9	
Boiled muscle(spring)		70.5	24.3	0.5	1.4	2.8	
Raw muscle(summer)		77.7	16.7	0.7	0.2	2.3	
Steamed muscle (summer)		73.9	19.4	1.1	0.7	2.4	
Boiled muscle (summer)		73.8	16.5	0.7	1.0	2.6	

Table 2 (Cont.)

Common name	Scientific name	Moisture	Protein	Fat	Carbohydrate	Ash	Source
Raw brown meat (spring)	*C. pagurus*	63.8	16.3	9.6	1.2	5.8	
Steamed brown meat (spring)		67.9	15.8	8.5	1.5	4.3	
Boiled brown meat (spring)		64.8	17.3	9.5	1.3	4.7	
Raw brown meat (summer)		70.3	20.1	13.5	0.6	3.8	
Steamed brown meat (summer)		64.3	16.3	13.8	1.2	4.6	
Boiled brown meat (summer)		61.7	17.9	13.9	0.9	4.3	
Spider crab							Marques *et al*. (2010)
Muscle	*Maja brachydactyla*	79.2	15.7	0.32	-	2.55	
Hepatopancreas	*M. brachydactyla*	70.0	13.7	7.08	-	3.14	
Female gonads	*M. brachydactyla*	68.1	24.1	1.36	-	1.62	
Warty crab	*Eriphin verrucosa*	77.37	18.73	0.67	0.97	2.26	Özden and Erkan (2011)
Shamefaced crab	*Calappa granulata*	85.84	10.78	0.64	0.73	2.01	Özden and Erkan (2011)
Blue crab	*Callinectes sapidus*	80.12	15.13	-	-	1.63	Zotti *et al.* (2016)
Brown crab	*C. pagurus*	77.96	17.02	-	-	2.25	Zotti *et al.* (2016)
Warty crab	*E. verrucosa*	78.03	18.13	-	-	1.81	Zotti *et al.* (2016)
West African geryon	*Chaeceon maritae*						Mandume *et al.* (2019)
Boiled muscle (March)		76.6	17.7	1.0	-	3.2	
Boiled muscle (October)		75.8	17.1	1.0	-	3.0	
Boiled hepatopancreas (March)		67.3	11.5	16.8	-	2.6	
Boiled hepatopancreas (October)		64.4	12.2	20.0	-	2.4	

Table 2 (Cont.)

Common name	Scientific name	Moisture	Protein	Fat	Carbohydrate	Ash	Source
Boiled female gonads (March)	*C. maritae*	60.2	21.4	11.8	-	2.1	
Boiled female gonads (October)		60.0	21.9	12.7	-	2.0	
King crabs							
Southern king crab (raw)	*Lithodes santolla*	80.9	14.6	0.70	-	2.03	Risso and Carelli (2012)
Southern king crab (cooked)	*L. santolla*	78.6	16.3	0.76	-	2.10	
Lobsters							
Shovelnose lobster	*Scyllarides latus*	79.14	18.41	0.91	0.03	1.51	Özden and Erkan (2011)
Common spiny lobster	*Palinurus elephas*	77.13	19.95	0.63	0.15	2.14	Özden and Erkan (2011)
Norway lobster	*Nephrops norvegicus*	76.68	20.31	1.07	0.31	1.63	Özden and Erkan (2011)
Shrimps/prawns							
Jinga shrimp	*Metapenaeus affinis*	79.47	19.12	1.06	0.0	1.35	Nurnadia *et al.* (2011)
Jinga shrimp (male)	*M. affinis*	78.43	19.10	1.07	0.30	1.10	Dinçer and Aydin (2014)
Jinga shrimp (female)	*M. affinis*	77.47	18.40	1.30	0.96	1.86	
Pink shrimp	*Parapenaeus longirostris*	75.82	19.73	0.95	1.83	1.67	Özden and Erkan (2011)
Common shrimp	*Crangon crangon*	79.21	18.47	0.95	-	1.39	Turan *et al.* (2011)
Green tiger shrimp (wild)	*Penaeus semisulcatus*	75.18	23.53	0.76	-	1.62	Yanar *et al.* (2011)
Green tiger shrimp (farmed)	*P. semisulcatus*	75.10	22.76	1.44	-	1.36	
Whiteleg shrimp (wild)	*Penaeus vannamei*	73.77	20.07	1.30	-	2.18	Puga-López *et al.* (2013)
Whiteleg shrimp (farmed)	*P. vannamei*	73.52	19.96	1.33	-	2.24	
Whiteleg shrimp (farmed)	*P. vannamei*	73.50	20.00	1.80	-	1.60	Mehta and Nayak (2017)
Speckled shrimp	*M. monoceros*	79.5	17.6	1.0	-	2.2	Bogard *et al.* (2015)
Indian white shrimp	*Penaeus indicus*	82.2	16.4	0.7	-	1.4	Mohanty *et al.* (2016a, 2019)
Giant tiger prawn	*P. monodon*	76.3	19.4	0.7	-	3.1	Mohanty *et al.* (2016a, 2019)

Grade I: 200-249 g; Grade II: 175-199 g; Grade III: 150-174; Grade IV: ≤ 150 g

Table 3 – Total SFAs, MUFAs, PUFAs, EPA and DHA as % of total fatty acids and in mg 100 g^{-1} (in brackets) in several crustacean species.
Tabela 3 - Teores de SFA, MUFA, PUFA, EPA e DHA expressos em percentagem do total de ácidos gordos e em mg 100 g^{-1} (entre parêntesis) de várias espécies de crustáceos.

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Freshwater crustaceans							
Oriental river prawn (*Macrobrachium. nipponense*)	33.06 (266.9)	21.49 (173.5)	40.57 (327.5)	6.64 (53.6)	5.38 (43.4)	0.74	Karapanagiotidis *et al.* (2010)
Spiny-cheek crayfish (*Orconectes limosus*)							
From Brda River	32.89 (48.6)	34.35 (50.7)	32.76 (48.4)	13.22 (19.5)	0.48 (0.7)	0.72	Stanek *et al.* (2010)
From Lake Gopło	24.76 (36.6)	36.02 (53.2)	39.18 (57.8)	15.41 (22.8)	0.78 (1.2)	0.70	
Spiny-cheek crayfish (Lake Gopło, spring)	21.62 (145.6)	29.70 (200.0)	48.68 (327.8)	19.76 (133.1)	3.33 (22.4)	1.01	Stanek *et al.* (2011)
Spiny-cheek crayfish (Lake Gopło, summer)	22.18 (172.7)	28.63 (222.9)	49.19 (383.0)	20.16 (157.0)	3.90 (30.4)	1.04	
Giant freshwater prawn	44.4 (583.4)	21.7 (285.1)	33.9 (445.4)	2.0 (26.3)	16.7 (219.4)	3.25	Chedoloh *et al*. (2011)
Giant freshwater prawn	28.9 (435.0)	25.5 (383.8)	41.4 (623.1)	11.6 (174.6)	4.9 (73.8)	0.8	Li *et al.* (2011)
Oriental river prawn	38.4 (383.4)	25.5 (254.6)	32.8 (327.5)	8.1 (80.9)	6.8 (67.9)	1.1	Li *et al.* (2011)
Amazon river prawn	34.69 (402.8)	25.88 (300.5)	39.48 (458.4)	11.71 (136.0)	6.11 (70.9)	1.11	Portella *et al.* (2013)
Giant freshwater prawn	34.35 (300.3)	24.51 (214.3)	40.83 (356.9)	11.69 (102.2)	4.33 (37.9)	0.85	Portella *et al.* (2013)
Giant freshwater prawn	35.2 (1384.6)	29.6 (1164.3)	35.2 (1384.6)	7.4 (291.1)	- (-)	0.4	Mohanty *et al.* (2016a)
Chinese mitten crab							Shao *et al.* (2013)
Female hepatopancreas	26.83 (152.5)	47.49 (269.9)	24.28 (138.0)	2.47 (14.0)	4.40 (25.0)	0.50	

Table 3 (Cont.)

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Male hepatopancreas	25.07 (185.6)	45.64 (337.9)	25.41 (188.1)	2.73 (20.2)	7.09 (52.5)	1.12	
Female gonads	23.66 (372.0)	49.64 (780.4)	21.07 (331.2)	3.83 (60.2)	5.45 (85.7)	1.19	
Male gonads	21.17 (393.5)	39.02 (725.3)	35.48 (659.5)	7.31 (135.9)	11.37 (211.4)	1.24	
Chinese mitten crab (Natural Diet)	20.28 (134.6)	32.85 (218.1)	44.11 (292.8)	15.38 (102.1)	13.89 (92.2)	2.64	Shao *et al.* (2014)
Chinese mitten crab (Formulated Diet)	20.20 (122.5)	32.17 (195.1)	44.98 (272.8)	16.67 (101.1)	14.17 (85.9)	2.78	
Chinese mitten crab							Jiang *et al.* (2014)
Male muscle	26.23	25.83	47.95	13.99	10.18	1.44	
Female muscle	34.21	29.95	35.83	9.56	7.17	1.49	
Male hepatopancreas	25.81	38.46	35.74	1.59	2.27	0.57	
Female hepatopancreas	27.39	37.80	34.82	2.64	2.16	0.74	
Female gonads	20.53	48.80	30.65	4.58	3.87	1.11	
Chinese mitten crab (meat)	29.73	38.68	30.97	10.95	7.79	1.35	Guo *et al.* (2014)
Chinese mitten crab (gonads)	27.97	46.01	25.94	5.98	5.87	0.89	
Chinese mitten crab (muscle)							Wang *et al.* (2018)
Grade I	17.52	24.75	50.60	14.93	13.38	1.53	
Grade II	16.84	23.85	51.92	15.81	14.83	1.73	
Grade III	17.27	24.56	50.99	15.95	14.38	1.77	
Grade IV	17.55	24.32	50.78	15.76	13.84	1.66	
Chinese mitten crab (hep)							
Grade I	20.36	36.67	31.18	2.10	4.81	0.44	
Grade II	20.52	35.18	34.04	2.66	5.97	0.51	
Grade III	20.14	39.86	21.89	1.60	3.48	0.61	
Grade IV	18.26	33.03	31.57	4.30	4.42	0.50	

Table 3 (Cont.)

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Chinese mitten crab (gon)							
Grade I	17.33	27.26	48.01	7.97	11.64	0.80	
Grade II	17.38	24.94	49.87	9.63	14.57	1.06	
Grade III	16.03	27.14	48.93	8.75	15.12	1.07	
Grade IV	18.76	32.48	37.70	5.74	9.59	0.86	
Chinese mitten crab (wild-caught)							Wu *et al.* (2020)
Muscle	14.59 (209.8)	14.86 (213.7)	70.55 (1014.7)	18.44 (265.2)	11.13 (160.1)	4.45	
Hepatopancreas	42.53 (518.2)	8.25 (100.5)	44.56 (542.9)	3.00 (36.6)	2.98 (36.3)	8.13	
Gonads	15.31 (321.2)	26.70 (560.1)	58.98 (1237.3)	14.11 (296.0)	-	7.08	
Chinese mitten crab (rice-field)							
Muscle	14.08 (201.2)	32.93 (470.5)	49.38 (705.5)	7.03 (100.4)	11.93 (170.4)	4.45	
Hepatopancreas	45.38 (635.3)	6.59 (92.3)	42.80 (599.2)	1.97 (27.6)	2.35 (32.9)	7.09	
Gonads	41.88 (970.7)	9.50 (220.2)	46.32 (1073.6)	9.71 (225.1)	- (-)	6.82	
Chinese mitten crab (Pond group)							Kong *et al.* (2012)
Muscle	28.44	28.18	36.05	10.95	10.32	-	
Hepatopancreas	34.35	39.87	19.49	4.63	3.70	-	
Chinese mitten crab (Lake group)							
Muscle	25.92	30.43	40.16	10.90	12.43	-	
Hepatopancreas	28.79	40.56	26.87	4.37	10.28	-	

Table 3 (Cont.)

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Green mud crab (*Scylla paramamosain*)							Jiang *et al.* (2014)
Male muscle	34.61	23.64	41.75	14.18	14.76	6.35	
Female muscle	30.54	16.45	52.99	14.63	15.69	6.07	
Male hepatopancreas	41.56	27.42	31.04	7.15	12.86	2.90	
Female hepatopancreas	39.61	31.97	28.42	7.36	11.65	3.11	
Female gonads	39.17	25.86	34.98	5.23	4.81	1.18	
Swimming crab (*Portunus trituberculatus*)							Jiang *et al.* (2014)
Male muscle	36.21	27.30	36.49	11.16	13.76	2.65	
Female muscle	33.22	20.74	46.05	13.81	19.17	2.52	
Male hepatopancreas	41.95	28.68	29.36	5.38	11.13	1.69	
Female hepatopancreas	41.10	29.85	29.04	5.03	14.07	2.14	
Female gonads	32.69	36.95	30.35	7.05	18.54	6.34	
Swimming crab (wild-caught)							He *et al.* (2017)
Muscle	26.27 (219.6)	31.18 (260.7)	41.57 (347.5)	15.74 (131.6)	15.63 (130.7)	3.30	
Hepatopancreas	27.15 (6573.1)	44.93 (10877.5)	25.40 (6149.4)	5.62 (1360.6)	13.53 (3275.6)	3.81	
Female gonads	26.17 (3771.4)	37.87 (557.5)	34.50 (4971.9)	8.41 (1212.0)	20.00 (2882.2)	5.12	
Swimming crab (pond-reared)							
Muscle	21.79 (190.5)	34.41 (300.8)	43.49 (380.2)	19.86 (173.6)	16.52 (144.4)	5.62	
Hepatopancreas	23.86 (5074.0)	52.82 (11232.5)	21.81 (4638.0)	4.43 (942.1)	12.41 (2639.1)	4.67	
Female gonads	23.39 (2827.4)	38.32 (4632.2)	36.94 (4465.3)	9.86 (1191.9)	22.88 (2765.8)	8.10	

Table 3 (Cont.)

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Crabs							
Blue swimming crab							Wu *et al.* (2010)
Female meat	26.2 (199.0)	26.4 (200.5)	39.4 (299.2)	15.4 (117.0)	11.3 (85.8)	2.64	
Male meat	25.4 (112.8)	23.4 (103.9)	42.1 (186.9)	13.8 (61.3)	14.0 (62.2)	2.55	
Female hepatopancreas	35.7 (957.1)	30.9 (828.4)	19.2 (514.8)	3.97 (106.4)	4.72 (126.5)	1.27	
Male hepatopancreas	36.1 (2213.7)	25.5 (1563.7)	22.9 (1404.3)	3.75 (230.0)	6.69 (410.2)	1.28	
Female gonads	35.4 (152.2)	32.4 (2885.1)	19.1 (1700.8)	3.74 (333.0)	7.16 (637.6)	1.96	
Male gonads	36.3 (595.0)	23.9 (391.7)	27.8 (455.6)	6.45 (105.7)	9.35 (153.2)	2.08	
Brown crab							Barrento *et al.* (2010)
Female muscle	16.6 (303.8)	30.3 (554.6)	49.5 (905.9)	22.6 (413.6)	10.8 (197.7)	3.7	
Male muscle	17.2 (298.4)	29.9 (518.6)	49.7 (862.1)	20.5 (355.6)	11.9 (206.4)	3.8	
Female hepatopancreas	21.2 (570.4)	45.5 (1224.2)	26.1 (702.2)	6.3 (169.5)	7.2 (193.7)	2.7	
Male hepatopancreas	21.3 (1122.9)	37.3 (1966.4)	33.9 (1787.1)	8.9 (469.2)	9.9 (521.9)	3.7	
Female gonads	17.2 (216.1)	34.7 (436.0)	42.9 (539.1)	14.4 (181.0)	14.0 (175.9)	4.2	
Male gonads, male)	18.0 (415.5)	31.1 (717.9)	45.9 (1059.5)	19.0 (438.6)	13.4 (309.3)	3.5	
Brown crab							Maulvault *et al.* (2011)
Raw muscle (spring)	(481)	(577)	(596)	(237)	(102)	3.5	
Steamed muscle (spring)	(455)	(607)	(568)	(240)	(96)	4.9	

Table 3 (Cont.)

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Boiled muscle (spring)	(218)	(110)	(194)	(44)	(17)	20.0	
Raw muscle, (summer)	(342)	(362)	(454)	(141)	(82)	4.1	
Steamed muscle (summer)	(286)	(277)	(313)	(111)	(45)	11.0	
Boiled muscle (summer)	(123)	(17)	(86)	(3.9)	(4.8)	29.0	
Raw brown meat (spring)	(1836)	(3034)	(1932)	(517)	(555)	4.4	
Steamed brown meat (spring)	(2008)	(3089)	(1611)	(455)	(399)	4.2	
Boiled brown meat (spring)	(1403)	(2091)	(1479)	(441)	(382)	4.7	
Raw brown meat (summer)	(1893)	(2762)	(1946)	(576)	(465)	3.2	
Steamed brown meat (summer)	(1986)	(2357)	(1912)	(566)	(482)	4.7	
Boiled brown meat (summer)	(1517)	(1863)	(1753)	(573)	(417)	4.0	
Spider crab							Marques *et al*. (2010)
Muscle	20.76 (42)	22.66 (47)	52.18 (105)	22.10	12.53	5.24	
Hepatopancreas	45.67 (2928)	38.61 (2524)	6.45 (356)	0.36	0.63	2.50	
Gonads	23.03 (237)	28.04 (293)	42.94 (434)	15.05	12.15	4.92	
West African geryon							Mandume *et al.* (2019)
Boiled muscle (March)	21.07 (143.9)	28.68 (195.9)	46.90 (320.3)	17.29 (177.6)	17.33 (178.0)	5.70	
Boiled muscle (October)	22.78 (155.6)	31.86 (217.6)	42.27 (288.7)	15.91 (163.4)	14.98 (153.9)	5.63	
Boiled female gonads (March)	24.65 (2695)	33.90 (3714)	36.04 (3957)	11.54 (118.5)	11.50 (118.1)	4.78	
Boiled female gonads (October)	20.90 (2480)	36.38 (4318)	38.34 (4550)	11.92 (122.4)	12.72 (130.7)	4.88	
Boiled hepatopancreas (March)	24.87 (3927)	37.56 (5928)	31.95 (5045)	8.21 (84.3)	11.14 (114.4)	3.76	

Table 3 (Cont.)

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Boiled hepatopancreas (October)	27.48 (5178)	42.95 (8094)	23.56 (4440)	5.75 (59.1)	6.68 (68.6)	3.04	
King crabs							
Southern king crab (raw)	23.7 (93.9)	29.1 (115.3)	38.8 (153.7)	17.1 (67.8)	11.0 (43.6)	3.26	Risso and Carelli (2012)
Southern king crab (cooked)	21.9 (99.3)	26.8 (121.6)	45.7 (207.3)	21.8 (98.9)	13.5 (61.2)	3.60	
Lobsters							
Norway lobster (muscle)	31.34	27.11	41.54	15.30	18.45	4.74	Tsape *et al.* (2010)
Norway lobster (hepatopancreas)	30.37	29.77	39.86	13.70	18.40	4.36	
Common spiny lobster (muscle)	26.86	24.05	50.56	11.17	10.79	0.83	Tsape *et al.* (2010)
Common spiny lobster (hepatopancreas)	27.47	28.02	37.18	13.90	7.88	1.46	
Shrimps/prawns							
Caramote prawn (*Penaeus kerathurus*)							Tsape *et al.* (2010)
Muscle	29.95	23.53	45.36	17.28	10.70	2.34	
Hepatopancreas	41.51	21.83	35.37	13.05	10.38	1.79	
Ridgetail white prawn (*Exopalaemon carinicauda*)	25.5 (42.5)	29.3 (48.9)	39.1 (65.2)	17.2 (28.7)	11.4 (19.0)	4.2	Li *et al.* (2011)
Cipango prawn (*E. annandalei)*	29.7 (424.3)	25.4 (362.9)	39.5 (564.3)	13.8 (197.2)	15.2 (217.2)	3.2	Li *et al.* (2011)
Mantis shrimp (*Oratosquilla oratoria*)	25.6 (277.6)	25.9 (280.6)	41.3 (447.9)	13.2 (143.2)	16.0 (173.5)	3.5	Li *et al.* (2011)
Fleshy prawn (*Penaeus chinensis*)	28.0 (239.4)	19.4 (165.9)	47.5 (406.2)	15.2 (130.0)	14.9 (127.4)	2.0	Li *et al.* (2011)
Whiteleg shrimp	34.0 (336.2)	22.3 (220.5)	38.8 (383.7)	12.3 (121.6)	9.1 (90.0)	1.6	Li *et al.* (2011)

Table 3 (Cont.)

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Whiteleg shrimp	40.0 (510.3)	28.1 (358.5)	32.0 (408.2)	2.4 (30.6)	6.2 (79.1)	0.65	Chedoloh *et al.* (2011)
Whiteleg shrimp	60.68 (878.5)	24.78 (358.8)	14.55 (210.7)	9.96 (144.2)	3.06 (44.3)	8.51	Mehta and Nayak (2017)
Common shrimp	33.04 (209.9)	22.17 (140.8)	29.00 (184.2)	11.79 (74.9)	9.38 (59.6)	3.31	Turan *et al.* (2011)
Common shrimp	36.49 (371.3)	26.30 (267.6)	37.21 (378.6)	5.95 (60.5)	14.75 (150.1)	1.72	Merdzhanova *et al.* (2014)
Indian white shrimp (wild)	31.88	24.43	36.47	12.40	8.80	1.94	Ouraji *et al.* (2011)
Indian white shrimp (farmed)	33.79	20.80	30.68	7.71	5.90	1.17	
Green tiger shrimp (wild)	29.97 (135.9)	17.43 (79.1)	38.65 (175.3)	13.76 (62.4)	17.48 (79.3)	4.37	Yanar *et al.* (2011)
Green tiger shrimp (farmed)	31.83 (351.3)	22.13 (244.2)	28.95 (319.5)	8.47 (93.5)	11.39 (125.7)	2.33	
Banana shrimp	37.9 (432.8)	20.1 (229.5)	42.1 (480.7)	3.8 (43.4)	13.8 (157.6)	1.24	Chedoloh *et al.* (2011)
Giant tiger prawn	43.8 (458.3)	17.3 (181.0)	39.0 (408.0)	4.1 (42.9)	11.0 (115.1)	1.10	Chedoloh *et al.* (2011)
Giant tiger prawn	39.1 (154.9)	22.7 (89.9)	38.4 (152.1)	12.8 (50.7)	6.4 (25.4)	1.3	Mohanty *et al.* (2016a)
Banana shrimp	30.54 (196.9)	23.21 (149.6)	40.82 (263.2)	14.57 (93.9)	12.90 (83.2)	2.89	Fatima *et al.* (2012)
Redtail prawn	30.41 (187.3)	24.27 (149.5)	40.01 (246.5)	13.95 (85.9)	12.79 (78.8)	2.78	Fatima *et al.* (2012)
Jinga shrimp (male)	33.73	16.69	47.71	15.47	12.84	2.46	Eskandari *et al.* (2014)
Jinga shrimp (female)	32.98	20.74	43.35	14.52	11.59	2.83	
Jinga shrimp (male)	60.31 (452.3)	15.47 (116.0)	24.21 (181.6)	12.71 (95.3)	8.73 (65.5)	13.24	Dinçer and Aydin (2014)
Jinga shrimp (female)	53.64 (520.2)	19.90 (193.0)	25.48 (247.1)	14.38 (139.5)	7.84 (76.0)	10.53	

Table 3 (Cont.)

Common name	SFA	MUFA	PUFA	EPA	DHA	n-3/n-6	Source
Indian white shrimp	35.4	16.5	35.6	10.6	10.0	1.6	Mohanty *et al.* (2016a)
Giant red shrimp (male)	47.15 (101.2)	17.34 (37.2)	25.41 (54.5)	11.47 (24.6)	9.53 (20.4)	4.76	Olgunoglu *et al.* (2015)
Giant red shrimp (female)	43.69 (181.5)	24.30 (100.9)	29.33 (121.8)	13.36 (55.5)	9.60 (39.9)	3.69	

Table 4 – Elemental profile of crustaceans (mg 100 g^{-1}).
Tabela 4 - Perfil mineral de várias espécies de crustáceos (mg 100 g^{-1}).

Common name	Na	K	P	Mg	Ca	Fe	Cu	Zn	Mn	I	Se	Source
Freshwater crustaceans												
Monsoon river prawn	75	200	**320**	*52*	**1200**	**13**	**1.2**	**3.3**	2.8	0.120	**0.034**	Bogard *et al.* (2015)
Chinese mitten crab (wild-caught)												Wu *et al.* (2020)
Muscle	372.27	242.85	**336.26**	36.82	*255.53*	**5.77**	**3.20**	**10.79**	0.80	-	-	
Hepatopancreas	464.74	110.42	*177.87*	*57.86*	**282.76**	**4.19**	**1.09**	*2.43*	0.67	-	-	
Gonads	203.43	290.85	**291.39**	37.50	91.12	**3.76**	**2.25**	**8.99**	0.39	-	-	
Chinese mitten crab (rice-field)												
Muscle	344.75	41.72	108.48	22.40	91.94	**4.24**	**0.44**	*2.11*	0.31	-	-	
Hepatopancreas	118.65	159.70	*190.71*	17.04	51.63	**9.81**	**3.32**	*2.50*	0.20	-	-	
Gonads	190.76	131.77	*137.24*	17.87	25.63	**23.28**	**1.51**	*1.90*	0.49	-	-	
Crabs												
Warty crab	381.1	400.0	**326.8**	*54.7*	91.8	*3.37*	-	-	-	0.02	**0.07**	Özden and Erkan (2011)
Shamefaced crab	197.6	426.8	**581.1**	*54.1*	**375.9**	**15.63**	-	-	-	0.14	**0.06**	Özden and Erkan (2011)
Brown crab												Maulvault *et al.* (2011)
Raw muscle (spring)	-	310.5	-	-	*193.8*	0.44	**0.85**	**6.1**	0.09	-	**0.08**	
Steamed muscle (spring)	-	279.0	-	-	119.7	0.36	**1.8**	**8.8**	0.09	-	**0.10**	
Boiled muscle (spring)	-	244.4	-	-	81.0	0.29	**1.7**	**8.3**	0.09	-	**0.11**	
Raw muscle (summer)	-	292.6	-	-	92.9	0.74	**1.1**	**7.6**	0.09	-	**0.17**	
Steamed muscle (summer)	-	253.9	-	-	62.2	0.36	**1.5**	**8.8**	0.07	-	**0.12**	
Boiled muscle (summer)	-	239.0	-	-	53.4	0.44	**1.4**	**9.9**	0.08	-	**0.14**	

Table 4 (Cont.)

Common name	Na	K	P	Mg	Ca	Fe	Cu	Zn	Mn	I	Se	Source
Raw brown meat (spring)	-	240.8	-	-	**1054.5**	*3.1*	**1.5**	*2.2*	0.42	-	**0.17**	
Steamed brown meat (spring)	-	213.9	-	-	**728.5**	*2.3*	**3.5**	**3.0**	0.30	-	**0.09**	
Boiled brown meat (spring)	-	192.9	-	-	**844.4**	*2.1*	**3.9**	**3.1**	0.28		**0.09**	
Raw brown meat (summer)	-	263.5	-	-	**499.3**	*3.1*	**1.5**	*2.2*	0.33		**0.09**	
Steamed brown meat (summer)	-	248.1	-	-	**738.3**	*2.8*	**2.1**	*2.8*	0.42		**0.07**	
Boiled brown meat (summer)	-	275.5	-	-	**669.3**	**3.6**	**2.8**	**3.1**	0.36		**0.11**	
Spider crab												Marques *et al.* (2010)
Muscle	396	226	-	61.2	78.7	1.07	**1.19**	**6.28**	0.06	-	**0.09**	
Hepatopancreas	361	206	-	59.2	*390*	**17.1**	**4.52**	**5.77**	0.16	-	**0.17**	
Gonads	195	249	-	23.0	24.0	*2.97*	**1.13**	**5.15**	0.23	-	**0.33**	
Blue crab	188.3	302.1	-	35.9	119.7	0.30	**0.90**	**4.76**	0.03	-	-	Zotti *et al.* (2016)
Warty crab	325.9	278.4	-	*66.4*	**456.8**	0.46	**1.33**	**9.40**	0.10	-	-	Zotti *et al.* (2016)
Brown crab	212.1	388.2	-	*42.0*	128.6	0.57	**0.71**	**7.45**	0.03	-	-	Zotti *et al.* (2016)
Swimming crab (wild-caught)												He *et al.* (2017)
Muscle	293.0	292.5	*196.7*	39.99	90.75	0.89	**0.72**	**4.20**	0.18	-	**0.15**	
Hepatopancreas	317.7	231.4	*197.2*	32.5	42.20	1.45	**2.01**	**3.11**	0.19	-	**0.17**	
Female gonads	269.4	230.9	**547.7**	24.1	37.40	*5.91*	**0.60**	**7.16**	0.87	-	**0.35**	
Swimming crab (pond-reared)												
Muscle	273.6	278.2	*209.3*	*42.1*	80.34	0.87	**0.53**	**4.38**	0.22	-	**0.03**	
Hepatopancreas	322.8	213.7	*179.6*	29.3	29.25	1.22	**0.58**	*1.98*	0.17	-	**0.06**	
Female gonads	230.7	221.6	**537.7**	20.2	25.63	2.92	**0.32**	**8.56**	0.48	-	**0.02**	

Table 4 (Cont.)

Common name	Na	K	P	Mg	Ca	Fe	Cu	Zn	Mn	I	Se	Source
West African geryon												Mandume *et al.* (2019)
Boiled muscle (March)	690.63	214.51	*152.00*	*76.08*	-	*1.85*	**1.49**	**4.04**	0.03	0.15	**0.17**	
Boiled muscle (October)	653.24	219.42	*155.19*	*79.03*	-	1.20	**1.51**	**4.17**	0.02	0.19	**0.12**	
Boiled female gonads (March)	-	-	-	-	-	-	**2.43**	**22.05**	0.14	-	-	
Boiled female gonads (October)	-	-	-	-	-	-	**2.62**	**19.27**	0.13	-	-	
Boiled hepatopancreas (October)	-	n.a	-	-	-	-	**2.62**	**5.48**	0.15	-	-	
King crabs												
Southern king crab (raw)	509	179	*126*	34.3	114	1.26	-	*1.88*	-	-	-	Risso and Carelli (2012)
Southern king crab (cooked)	594	203	*143*	41.3	*197*	*1.86*	-	*2.64*	-	-	-	
Lobsters												
Shovelnose lobster	183.7	*476.7*	**370.3**	*42.8*	44.2	**14.13**	-	-	-	0.01	**0.03**	Özden and Erkan (2011)
European spiny lobster	414.4	427.9	**332.0**	*58.4*	55.2	0.93	-	-	-	0.01	**0.08**	Özden and Erkan (2011)
Norway lobster	271.1	363.8	**300.1**	*63.0*	71.7	**5.21**	-	-	-	0.26	**0.05**	Özden and Erkan (2011)
Shrimps/prawns												
Pink shrimp	285.6	366.9	**305.8**	*48.2*	82.2	**8.26**	-	-	-	0.24	**0.07**	Özden and Erkan (2011)
Pink shrimp (fresh)	-	-	-	-	-	-	**0.47**	0.63	0.04	-	0.002	Olmedo *et al.* (2013)
Pink shrimp (frozen)	-	-	-	-	-	-	**0.38**	0.36	0.05	-	*0.009*	
Whiteleg shrimp (frozen)	-	-	-	-	-	-	**0.69**	0.41	0.04	-	10^{-4}	Olmedo *et al.* (2013)
Green tiger shrimp (wild)	324.6	365.6	**244.5**	*69.1*	10.7	*2.02*	-	*2.3*	0.13	-	-	Yanar *et al.* (2011)
Green tiger shrimp (farmed)	294.7	*472.5*	**290.2**	*57.9*	8.9	*1.98*	-	*2.5*	0.11	-	-	

Table 4 (Cont.)

Common name	Na	K	P	Mg	Ca	Fe	Cu	Zn	Mn	I	Se	Source
Jinga shrimp	59.2	17.3	**-**	**1220.6**	36.3	0.98	**0.29**	0.57	0.03	-	**-**	Nurnadia *et al.* (2013)
Jinga shrimp (male)	125.4	303.1	**-**	37.2	24.5	0.09	**0.41**	0.97	0.01	-	n.d.	Dinçer and Aydin (2014)
Jinga shrimp (female)	125.3	355.9	**-**	41.4	23.7	0.14	**0.42**	0.97	0.02	-	n.d.	
Speckled shrimp	85	210	**290**	*45*	**550**	*2.7*	**0.49**	1.3	0.57	0.026	**0.042**	Bogard *et al.* (2015)
Giant tiger prawn	831	**1233.7**	**1970.3**	**281.7**	**419.3**	**16.41**	**4.18**	**7.34**	0.31	-	**0.13**	Mohanty *et al.* (2016b)
Indian white shrimp	809	**1041.7**	**1248**	**252.0**	**49.7**	**10.81**	**4.36**	**6.09**	0.21	-	**0.11**	Mohanty *et al.* (2016b)
DV	-	4700	1250	420	1300	18	0.9	15	-	-	**55**	

n.d. – not detected. DV – daily value. Daily value in mg 100 g^{-1} except Se (μg 100 g^{-1}).Daily values are based on the Available Dietary Guidelines from the USDA National Nutritional Database as reported by Wright *et al.* (2018).Values in italics are "good sources" and values in bold are "excellent sources" based on daily value.

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