



Proximal composition and fatty acid profile of *Hemigrapsus crenulatus* (H. Milne Edwards, 1837) as one of the main foods of “patagonian blenny” *Eleginops maclovinus* (Cuvier, 1830)

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Abstract

The Patagonian blenny (*Eleginops maclovinus*) is species endemic to South America with physiological characteristics that would facilitate its incorporation into Chilean aquaculture. However, there is currently no specific artificial food that can be used to raise *E. maclovinus*. In light of this problem, this study describes the proximal composition and fatty acid profile of the crab *Hemigrapsus crenulatus*, one of the main foods of *E. maclovinus*. The purpose of the study is to serve as basic information for the development of a specific artificial diet for juveniles of this fish species. The proximal analysis of the complete body of *H. crenulatus* indicates that it is mainly composed of ash (35.9%), proteins (32.2%), glucides (19.8%) and minor lipids (3.6%). The fatty acid profile is 40.7% PUFAs, 29.7% MUFAs and 29.5% SAFAs, and the most abundant acids are Eicosapentaenoic (18.8%), Oleic (6.8%) and Palmitic (16.6%), respectively. *H. crenulatus* has highest level of proteins, lipids and PUFAs among the species of the Brachyura infraorder.

Keywords: *Eleginops maclovinus*, *Hemigrapsus crenulatus*, proximal analysis, fatty acid profile.

Composição proximal e perfil de ácidos graxos de *Hemigrapsus crenulatus* (H. Milne Edwards, 1837) como um dos principais alimentos da “blenny patagônica” *Eleginops maclovinus* (Cuvier, 1830)

Resumo

O “blenny da patagônia” (*Eleginops maclovinus*) é uma espécie endêmica da América do Sul, com características fisiológicas que facilitariam sua incorporação na aquicultura chilena. No entanto, atualmente não há alimento artificial específico que possa ser usado para criar *E. maclovinus*. Diante desse problema, este estudo descreve a composição proximal e o perfil de ácidos graxos do caranguejo *Hemigrapsus crenulatus*, um dos principais alimentos de *E. maclovinus*. O objetivo do estudo é servir como informação básica para o desenvolvimento de uma dieta artificial específica para espécies juvenis desse peixe. A análise proximal do corpo completo de *H. crenulatus* indica que ele é composto, principalmente, de cinzas (35,9%), proteínas (32,2%), glicídios (19,8%) e lipídios menores (3,6%). O perfil

de ácidos graxos é 40,7% PUFA, 29,7% MUFA e 29,5% SAFA, e os ácidos mais abundantes são eicosapentaenoico (18,8%), oleico (6,8%) e palmítico (16,6%), respectivamente. *H. crenulatus* possui o mais alto nível de proteínas, lipídios e PUFA entre as espécies da infraordem de Brachyura.

Palavras-chave: *Eleginops maclovinus*, *Hemigrapsus crenulatus*, análise proximal, perfil de ácidos graxos.

1. Introduction

Chile is undergoing an aquaculture diversification process that has led to increased public and government interest in promoting the development of aquaculture of native species with the potential for cultivation (Sa et al., 2014) such as *Eleginops maclovinus* (Cuvier, 1830). *E. maclovinus* is a monotypic species from the Eleginopsidae family that is endemic to the southern part of South America (Vargas-Chacoff et al., 2014; Ceballos et al., 2016). Its geographic distribution ranges are from the mouth of the Plata River to the extreme south of South America on the Atlantic Coast, including the Falkland Islands, and from there to Valparaíso on the Pacific Coast (Gacitúa et al., 2008). It can be found in environments with different levels of salinity, including the open sea, coastal waters, estuaries and freshwater rivers (Pequeño, 1979; Vargas-Chacoff et al., 2016). In regard to its ecology, this species, which presents bento-demersal habits, is an important component of many trophic chains in the areas that it inhabits as both predator and prey. As a predator, it is an omnivore with a generalist, opportunistic-type diet, feeding mainly on crustaceans, polychaetes, insects and marine algae (Guzmán and Campodónico, 1973; Pavés et al., 2005; Licandeo et al., 2006; Martin and Bastida, 2008; Pequeño et al., 2010; Figueroa-Muñoz and De los Ríos, 2018; De los Ríos et al., 2019). Its stomach contents have been found to include a wide variety of food items such as the intertidal crab *Hemigrapsus crenulatus* (H. Milne Edwards, 1837), which has been described as one of its most frequent and abundant preys in terms of biomass (Licandeo et al., 2006). It has also been described as the exclusive prey of the fish (Figueroa-Muñoz and De Los Ríos, 2018).

H. crenulatus is an epibenthic species from estuary habitats in the South Pacific Ocean. It is found in Chile between Cavanha Beach in Iquique to the north and the Strait of Magellan and in New Zealand (Retamal, 1969; Retamal and Moyano, 2010; Urbina et al., 2010; McLay et al., 2011). It is a euryhaline estuary marine species of tropical origin from temperate environments that tolerates broad temperature fluctuations (6 to 24 °C) (Cumillaf et al., 2016) and salinity. Most of the adults are excellent osmoregulators that can grow in a wide range of salinities between 5 to 33‰ (Urbina et al., 2010; Urzúa and Urbina, 2017).

The advantages of developing the breeding of *E. maclovinus* in Chile include the fact that it is an endemic white meat species, presents a high rate of growth in the natural environment, ranges from 10.2-11 cm year⁻¹ for cohorts in the Atlantic Ocean (Gosztonyi, 1974; Brickle et al., 2005) and 6.4 cm year⁻¹ for a cohort from the Pacific Ocean (Licandeo et al., 2006), has a high

tolerance for captivity (Vargas-Chacoff et al., 2014) with limited antagonistic behavior (Sa et al., 2014), presents a high rate of fertilization and high fecundity as well as low mortality rates for larvae and juveniles in captivity (Sa et al., 2014; Valdebenito Isler et al., 2016, 2018), has omnivorous feeding habits (Pequeño et al., 2010), tolerates variations in temperatures and salinity (Vargas-Chacoff et al., 2016; Oyarzún et al., 2018) and accepts pelletized feed in a feral manner (Fortt et al., 2007; Buschmann et al., 2009), facilitating one of the main challenges to be resolved at the beginning of the breeding of native fish (Deguara, 1997). However, a priority challenge is the development of specific artificial diets for the different stages of its ontogenetic development. There is no information on many of its nutritional requirements, as only the protein requirements of juveniles have been determined. According to Sa et al. (2014), this corresponds to 10% to satisfy its metabolic needs and 35% to optimize growth. Additionally, for juveniles of *E. maclovinus* a proximal composition has been reported, with a percentage of protein levels in the range of 54.29-60.66, lipids of 28.17-36.51, ash of 8.79-9.46, and energy of 25.93-27.83 (Oyarzún et al., 2019). This information can be used as a reference range for diet-specific design for *E. maclovinus*. However, currently the information for the design of diets for this species is still very limited.

Given these circumstances, there is a need to obtain basic information on the nutritional composition of *H. crenulatus* the main prey of *E. maclovinus* in the wild, particularly fatty acids, as it has been determined that these molecules are the main energy source that the fish use for their growth and reproduction. They also fulfill a structural function, forming part of the phosphoglycerides of cellular membranes (Sargent et al., 2002). Furthermore, long chain omega 3 such as docosahexaenoic acid (DHA 22:6n-3) and eicosapentaenoic acid (EPA 20:5n-3) in marine fish are considered to be essential to survival and normal growth and development (Tocher, 2010).

The aim of this study is to describe the proximal composition and fatty acid profile of the crab *H. crenulatus* in order to contribute to research on its nutrition and potentially to develop of artificial diet to *E. maclovinus* diet.

2. Material and Methods

2.1. Capture of *H. crenulatus* specimens

The capture was carried out in the intertidal area of Puerto Cisnes bay (44°44S 72°41W) during the winter of 2017 (Vega-Aguayo et al., 2018). The *H. crenulatus* specimens were gathered manually at random during low tide under rocks until at least 700 g (N = 406) of wet weight sample had been collected. The specimens were then frozen

at -20 °C and sent to the Universidad Católica de Temuco Fish Physiology and Nutrition Laboratory for analysis.

2.2. Determining the proximal composition of *H. crenulatus*

The analysis was conducted at the Universidad Católica de Temuco Fish Physiology and Nutrition Laboratory in duplicate following AOAC methods (AOAC, 1995). The sample was first lyophilized at -48 °C at a pressure of 3 mbar. The researchers then determined the dry material by gravimetric at 104 °C for 24 h, the crude protein using the Kjeldahl technique (N x 6.25), the total lipid content (etheral extract) using the gravimetric method of extracting fats with a Soxhlet device using petroleum ether (40-60°), the ash content using burning of the sample at 550 °C for three hours in order to obtain inorganic content, the crude fiber by acid hydrolysis of the defatted samples with sulfuric acid (H₂SO₄), followed by alkaline hydrolysis with potassium hydroxide (KOH) in a digestion system and using a Fibertec device (AOAC, 1993), the carbon glucides or hydrates (non-nitrogenized extract) by difference, phosphorus using Mission Reaction AOAC method 965.17 and gross energy using mathematical calculation following Maynard et al. (1979).

2.3. Determination of the fatty acid profile of *H. crenulatus*

The analysis was conducted in the Universidad Católica de Temuco Fish Physiology and Nutrition Laboratory using the methodology described by Dantagnan et al. (2012). The samples were lyophilized and the total lipids were extracted using a blend of methanol chloroform (2:1) (Folch et al., 1957). The fatty acids were methylated using the model proposed by Morrison and Smith (1964) and separated using a Hewlett Packard 5890 Series II Plus gas chromatograph (Wilmington NC, USA), with a capillary column measuring 30 m * 0.25 mm * 0.20 µm (SPTM 2380, SUPELCO, Bellefonte, PA, USA). Helium gas was used as the transporter gas. The fatty acids were identified through comparison with a standard Supelco 37 fatty acid (Sigma Aldrich, St. Louis, MO, USA). The fatty acids were expressed on a dry basis as a percentage of the total of fatty acids identified.

3. Results

3.1. Proximal composition of *H. crenulatus*

The results obtained show that *H. crenulatus* is mainly composed of ash (35.88%) and proteins (32.18%), and to a lesser extent by glucides (non-nitrogenized extract, 19.84%), fiber (8.5%) and lipids (etheral extract, 3.6%); with gross energy of 10.25 MJ kg⁻¹ (Table 1).

3.2. Fatty acid profile of *H. crenulatus*

The fatty acid profile of the full set of specimens of *H. crenulatus* is composed of polyunsaturated fatty acids (PUFAs), 40.7%, the most abundant of which is eicosapentaenoic acid (EPA) at 18.8%; 29.7% monounsaturated

fatty acids (MUFAs), the most abundant of which is oleic acid, 16.8%, and 29.5% saturated fatty acids (SAFAs), the most abundant of which is palmitic acid, at 16.6%. In regard to the PUFAs from the omega-3 series, these constituted 28.3% and the EPA/DHA ratio was 3.4, which indicates that there is more abundance of EPA than DHA (Table 2).

4. Discussion

4.1. *H. crenulatus* as one of the main foods of *E. maclovinus*

H. crenulatus has been described as prey of *Eleginops maclovinus* (Cuvier, 1830) in studies conducted in Chile in the estuary of the Valdivia River (Table 3). For example, Pavés et al. (2005) state that in specimens ranging from 18 to 79 cm in length captured during March 2002, this food item presented a frequency of occurrence (%F) of 4.9 and an abundance based on the number of prey (%N) of 0.008. Pequeño et al. (2010) include data from Pavés et al. (2005) and state that in specimens captured in the same area in August 2003, this food item presented a %F of 9.1 and a %N of 0.038. Licandeo et al. (2006) state that in fish with a total length of between 19 and 57 cm, this food item presented a %F of 35.4 and a %N of 2.55 between November 2002 and December 2003.

The abundance of prey in the stomach depends on their abundance in the environment. Pavés et al. (2005) and Pequeño et al. (2010) showed a low %F and %N for *H. crenulatus* because the most abundant prey species in the area studied by these authors was the amphipod *Paracorophium hartmannorum* (Andres, 1975), which represented over 90% of individual prey in both seasons. In the area studied in this article, the most abundant species is *H. crenulatus*, which presents an ecological density of 11.50 ± 10.62 individuals m⁻² (Vega-Aguayo et al., 2018). The results of %F 35.4 and %N 2.55 obtained by Licandeo et al. (2006) are the closest to our results (%F 78.7 and %N 96.3), however this prey is so abundant in Aysén that it represents an even greater %F and %N.

4.2. Proximal composition of *H. crenulatus*

The high quantity of ashes (35.88%) obtained in the proximal composition (Table 1) is due to the fact that the

Table 1. Proximal composition (percentage in dry basis) of specimens of *H. crenulatus* captured at Puerto Cisnes.

Total dry matter (%)	96.89
Crude protein (%)	32.18
Total lipids (%)	3.60
Crude fiber (%)	8.50
Total ash (%)	35.88
Glucides (%)	19.84
Phosphorous (%)	0.72
Gross energy (MJ kg ⁻¹)	10.25

Table 2. Fatty acid profile (percentage of dry basis of the total fatty acids identified) in *H. crenulatus* specimens captured at Puerto Cisnes.

Saturated Fatty Acids (SAFAs)		%
C12:0	Lauric acid	0.19
C13:0	Tridecanoic acid	0.04
C14:0	Myristic acid	2.60
C15:0	Pentadecanoic acid	0.56
C16:0	Palmitic acid	16.59
C17:0	Heptadecanoic acid	2.05
C18:0	Stearic acid	4.63
C20:0	Arachidic acid	0.22
C21:0	Heneicosanoic acid	1.24
C22:0	Behenic acid	0.26
C23:0	Tricosanoic acid	0.66
C24:0	Lignoceric acid	0.49
Total SAFAs		29.54
Monounsaturated fatty acids (MUFAs)		
C14:1	Myristoleic acid	0.53
C16:1	Palmitoleic acid	9.83
C17:1	cis-10-Heptadecenoic acid	1.18
C18:1 <i>n-9t</i>	Elaidic acid	0.20
C18:1 <i>n-9c</i>	Oleic acid	16.84
C20:1 <i>n-9</i>	cis-11-Eicosenoic acid	0.76
C22:1 <i>n-9</i>	Erucic acid	0.09
C24:1 <i>n-9</i>	Nervonic acid	0.27
Total MUFAs		29.74
Polyunsaturated fatty acids (PUFAs)		
C18:2 <i>n-6c</i>	Linoleic acid	8.52
C18:3 <i>n-3</i>	Linolenic acid	3.89
C18:3 <i>n-6</i>	g-Linolenic acid	0.35
C20:2	cis-11,14-Eicosadienoic acid	1.05
C20:3 <i>n-3</i>	cis-11, 14, 17-Eicosatrienoic acid	0.13
C20:3 <i>n-6</i>	cis-8,11,14-Eicosatrienoic acid	0.40
C20:4 <i>n-6</i>	Arachidonic acid	2.10
C20:5 <i>n-3</i>	cis-5,8,11,14,17-Eicosapentaenoic acid	18.77
C22:6 <i>n-3</i>	cis-4,7,10,13,16,19-Docosahexaenoic acid	5.51
Total <i>n-3</i> PUFAs		28.31
Total PUFAs		40.72
EPA/DHA		3.4
EPA + DHA		24.28

specimen possess a broad cephalothorax that covers their entire body, which is typical of the Brachyura family. It is comprised of a large proportion of minerals (ashes) such as calcium, iron, zinc, potassium and phosphorus (Sifa et al., 2000; Adeyeye, 2002). This value is similar to the one described by García Alonso and Oviedo Vega (1990) in another species from the same family, the Cuban blue crab, *Callinectes sapidus* (Rathbun, 1896) (31%) (Table 4). The high percentage of proteins (32.18%) and lipids (3.6%) in the body compared to those described for some structures of other species from the Brachyura family is noteworthy. This amount would be much higher than many of those species, as its ranges run from 7 to

22.6% proteins and 0.2 to 1.21% lipids. The percentage of lipids (3.6%) would be similar to those described for *Carcinus maenas* (Linnaeus, 1758) (3.8%). This species presents the highest percentage of proteins, which is 80.9% (Table 4). The percentages of proteins and lipids of the organs are generally higher than those of the musculature of the body, with ranges of 12.5 to 62.2% of proteins and 7.8 to 59.9% for lipids.

The high percentages of high quality lipids (40.7% PUFAs) found are interesting given that *H. crenulatus* could be a potential ingredient for future formulations of diets of *E. maclovinus*, although more analyses are need to determine the amino acid profile and apply treatments

Table 3. Length of the predator fish *Eleginops maclovinus* and percentage of frequency of *Hemigrapsus crenulatus* as prey for different months in the Valdivia River.

Date	L (cm)	% F	% N	Reference
March 2002	18-42	4.9	0.008	Pavés et al. (2005)
August 2003	18-42	9.1	0.038	Pequeño et al. (2010)
Nov 2002-Dec. 2003	19-79	35.4	2.550	Licandeo et al. (2006)

L = Length; F= Frecuency; N= Number.

Table 4. Proximal composition of the flesh of the structures of the body and organs of species in the Brachyura family (average ± standard deviation).

Species and Origin	Organ or Structure	Crude protein (%)	Crude lipids (%)	Ash	Reference
				(%)	
<i>C. pagurus</i> (♀)*	M	16.4 ± 4.2	0.3 ± 0.1	2.1 ± 0.2	Barrento et al. (2010)
Scotland	H	12.2 ± 1.6	10.2 ± 3.6	3.0 ± 0.4	
	G	25.5 ± 0.0	3.1 ± 0.5	1.6 ± 0.0	
<i>C. pagurus</i> (♂)*	M	20.5 ± 1.7	0.2 ± 0.1	1.9 ± 0.1	
Scotland	H	13.3 ± 1.9	12.2 ± 3.4	5.0 ± 1.2	
	G	13.1 ± 0.0	0.9 ± 0.0	2.7 ± 0.0	
<i>E. sinensis</i> # (♂)	Flesh Ch, P and A	18.9 ± 0.5	0.9 ± 0.1	1.39 ± 0.01	Chen et al. (2007)
China	Ve (H and G)	12.5 ± 0.4	20.2 ± 0.1	1.90 ± 0.08	
<i>M. brachydactyla</i> ⁺	M	15.7 ± 3.0	0.32 ± 0.06	2.55 ± 0.05	Marques et al. (2010)
(♀) Scotland	H	13.7 ± 1.4	7.08 ± 0.75	3.14 ± 0.27	
	G	24.1 ± 1.7	1.36 ± 0.28	1.62 ± 0.05	
<i>C. maenas</i> ^o	Flesh Ch and the body	80.9 ± 0.5	3.8 ± 0.1	-	Naczka et al. (2004)
Canada	E	7.06 ± 0.38	0.38 ± 0.03	-	
<i>E. sinensis</i> ^o	H	22.7 ± 1.7	59.9 ± 7.9	-	Chang et al. (2017)
(♀ normal) China	O	60.5 ± 1.0	31.6 ± 1.0	-	
<i>E. sinensis</i> ^o	H	39.8 ± 3.13	36.5 ± 3.3	-	
(♀ precocious) China	O	62.2 ± 0.7	30.3 ± 0.7	-	
<i>C. mediterraneus</i> ^o	H	13.0 ± 0.6m	21.9 ± 0.5	-	Cherif et al. (2008)
Tunisia	Flesh Ch	17.8 ± 0.9	0.85 ± 0.05	-	
<i>C. sapidus</i> Cuba	C	19.0 ± 3.0	-	31.0 ± 1.0	García Alonso and Oviedo Vega (1990)
<i>C. sapidus</i>	Flesh Ch	15.0 ± 0.03	0.64 ± 0.01	1.39 ± 0.02	
Turkey	Flesh body	14.7 ± 0.01	0.8 ± 0.02	1.89 ± 0.08	Yerlikaya (2003)
<i>P. pelagicus</i>	Flesh Ch	21.5 ± 0.3	0.81 ± 0.1	2.5 ± 0.01	
Turkey	Flesh body	22.6 ± 1.0	1.21 ± 0.02	2.24 ± 0.02	

*g per 100 g sample in dry weight; ^opercentage based on dry weight; [#]percentage based on wet weight; ⁺g per 100 g sample in wet weight; A = abdomen; C = cephalothorax; E = exoskeleton; G = gonads; H = hepatopancreas; M = muscle; O = ovary; P = pereopods; Ch = chelipods; Ve = edible viscera; *C. pagurus* = *Cancer pagurus*; *E. sinensis* = *Eriocheir sinensis*; *M. brachydactyla* = *Maja brachydactyla*; *C. maenas* = *Carcinus maenas*; *C. mediterraneus* = *Carcinus mediterraneus*; *C. sapidus* = *Callinectes sapidus*; *P. pelagicus* = *Portunus pelagicus*.

that allow the nutrients that it contains to become more bio accessible and bioavailable for the fish.

Given that *H. crenulatus* turned out to be one of the main prey of *E. maclovinus* in Puerto Cisnes, it would seem to obtain the main nutrients required to meet its needs based on consumption of this species. These nutrients include the high amount of ash found, which would provide a high contribution of minerals. However, the bioavailability of those minerals would be low because the exoskeleton, which is where they are mainly found, is not digested a great deal in the intestine of the fish. Based on the proximal

analysis, the results obtained in this study could serve as a point of departure for estimating the needs of the species in their juvenile stage. This statement would be more robust based on Sa et al. (2014), who determined that the protein requirement of juveniles of the species would be 10% to meet metabolic needs and 35% to optimize growth. This would fall within the range of protein found in *H. crenulatus* (32%). Additionally, Oyarzún et al. (2019) has suggested reducing the percentage of lipids in the diet of *E. maclovinus* due to the presence of fatty liver in juveniles of this species fed with a commercial diet with

a lipid percentage of 20%. The presence of fatty liver can have a negative effect on the physiology of *E. maclovinus*, so it would be appropriate to reduce lipid levels taking into account the lipid values obtained in the present study for *H. crenulatus*. Based on this information, it is reasonable that *E. maclovinus* juveniles would require a low level of lipids, but they would have to be good quality. These are mainly comprised of PUFAs, which have been described as having a series of benefits for fish such as improving growth and larval survival, decreasing the incidence of malformations, improving reproductive performance and increasing immune response (Roo et al., 2009; Chen et al., 2016; Norberg et al., 2017).

4.3. Fatty acid profile of *H. crenulatus*

In regard to the fatty acid profile determined for the full body of specimens of *H. crenulatus* captured during the summer of 2018 in Puerto Cisnes, the results obtained are: SAFAs: 29.5%, MUFAs: 29.7%, PUFAs: 40.7%. When compared to those described for structures or organs of other species from the Brachyura infraorder (Table 5), there is a large amount of variation (SAFAs: 16.7-45.7%, MUFAs: 22.7-50.1%, PUFAs: 6.5-52.2%) given that the composition of fatty acids would vary based on the feeding habits, age and sex of each individual as well as the season, salinity and temperature in which each species

lives (Barrento et al., 2010). This would suggest that the fatty acid profile described for summer could change over the course of the year.

Regardless of the variability found in the results obtained and those described in the literature, the high percentage of polyunsaturated fatty acids found suggests that *H. crenulatus* has a higher level of lipids than other Brachyura, that are of very good quality, particularly given that the PUFAs include a good proportion of EPA (18.8%) and DHA (5.5%) fatty acids, which are known to play important biological roles (precursor to bioactive compounds, structural maintenance and functional integrity of cellular membranes in fish, important for the normal development of neural function and others) (Bell et al., 1995; Sargent et al., 2002). There are two potential explanations for the high concentration of PUFAs. The first is that *H. crenulatus* obtains them from its diet (detritus, fellow members of its species, fish, dead crustaceans, and the macroalgae *Ulva* sp.) (Retamal, 1969). The second is that they can biosynthesize, which would be possible in function of that which was described by Monroig et al. (2013), who state that the species *Eriocheir sinensis*, which belongs to the same Brachyura family, has a desaturase that would allow for biosynthesis of PUFAs. However, studies must be conducted to corroborate biosynthesis of PUFAs in *H. crenulatus*.

Table 5. Composition of saturated fatty acids (SAFAs), monounsaturated fatty acids (MUFAs), polyunsaturated fatty acids (PUFAs), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) of some organs and structures of Brachyura species (average ± standard deviation).

Species and origin	Organ or Structure	SAFAs (%)	MUFAs (%)	PUFAs (%)	EPA (%)	DHA (%)	Reference
<i>C. pagurus</i> (♀) ^o Scotland	M.	17.4 ± 0.9	30.8 ± 1.7	48.4 ± 2.7	21.3 ± 2.5	10.9 ± 1.5	Barrento et al. (2010)
	H.	21.8 ± 2.6	46.3 ± 5.3	24.2 ± 4.2	5.5 ± 1.5	6.5 ± 2.1	
	G.	17.6 ± 1.8	34.3 ± 0.7	43.2 ± 2.4	13.9 ± 0.4	14.2 ± 1.6	
<i>C. pagurus</i> (♂) ^o Scotland	M.	16.7 ± 1.0	30.9 ± 1.5	48.9 ± 1.8	19.5 ± 2.3	11.5 ± 1.3	
	H.	20.5 ± 1.8	38.8 ± 4.5	32.8 ± 2.4	7.4 ± 1.7	10.4 ± 1.3	
	G.	16.6 ± 0.9	32.2 ± 2.1	48.6 ± 3.6	19.7 ± 0.9	15.5 ± 0.9	
<i>E. sinensis</i> (♂) ^o China	E.s.	24.91	49.81	23.87	2.17 ± 0.1	2.85 ± 0.1	Chen et al. (2007)
<i>M. brachydactyla</i> ^o (♀) Scotland	M.	20.8 ± 0.7	22.7 ± 0.7	52.2 ± 0.7	22.1 ± 1.2	12.5 ± 0.4	Marques et al. (2010)
	H.	45.7 ± 2.8	38.6 ± 2.6	6.5 ± 0.9	0.36 ± 0.2	0.63 ± 0.2	
	G.	23.0 ± 0.7	28.0 ± 0.3	42.9 ± 1.0	15.1 ± 0.5	12.2 ± 0.5	
<i>C. maenas</i> ^o Canada	Ch. flesh and body	19.0	25.7	48.4	25.1	11.9	Naczka et al. (2004)
<i>C. mediterraneus</i> ^o Tunisia	Ch. flesh	23.1 ± 0.5	24.0 ± 0.7	36.1 ± 0.9	8.9 ± 0.4	10.5 ± 0.9	Cherif et al. (2008)
	H.	26.2 ± 0.5	24.1 ± 0.7	42.9 ± 0.9	11.0 ± 0.4	11.4 ± 0.9	
	G.	22.3	46.1	31.6	15.4	12.7	
<i>M. magister</i> (♀)* United States	E.	23.2	47.3	29.5	16.8	8.8	Allen (1971)
	H.	22.1	50.1	27.8	12.3	10.1	
	V.	21.8	45.8	32.4	20.2	8.7	
	M.	20.6	28.1	51.3	34.2	13.9	

^oTotal percentage of fatty acids identified; *g of fatty acids per 100 g of total fatty acids; E = exoskeleton; E.s. = edible structures; G = gonads; H = hepatopancreas; M = muscle; Ch = chelipeds; V = viscera; *C. pagurus* = *Cancer pagurus*; *E. sinensis* = *Eriocheir sinensis*; *M. brachydactyla* = *Maja brachydactyla*; *C. maenas* = *Carcinus maenas*; *C. mediterraneus* = *Carcinus mediterraneus*; *M. magister* = *Metacarcinus magister*.

As conclusion, the fully body of specimens of *H. crenulatus* collected during the summer in Puerto Cisnes are mainly composed of ash (35.9%) and proteins (32.2%), and to a lesser extent by carbohydrates (19.8%), crude fiber (8.5%) and lipids (3.6%). Its fatty acid composition is 40.7% PUFAs, 29.7% MUFAs and 29.5% SAFAs. *H. crenulatus* has highest level of proteins, lipids and PUFAs among the species of the Brachyura infraorder.

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