Nutritional value of crustaceans from Lagoone-Estuary Complex Mundaú/Manguaba-Alagoas

Valor nutritivo de crustáceos do Complexo Estuarino-Lagunar Mundaú/Manguaba-Alagoas

RIALA6/1137

Giselda M. LIRA[1]*, Elizabeth A.F.S. TORRES[2], Rosana A.M. SOARES[2], Simone MENDONÇA[2], Mirella F COSTA[3], Kelly WB SILVA[3], Sarah J.G.B. SIMON[3], Katherine M.A. VERAS[3]

*Endereço para correspondência: [1]Faculdade de Nutrição, Universidade Federal de Alagoas, BR 101, Km 14 , Maceió, AL/Brasil, CEP 57072-900. Fone: (082) 3214-1158, fax: (082) 3214-1160. E-mail: gmlira@superig.com.br
[2] Departamento de Nutrição, Faculdade de Saúde Pública, Universidade de São Paulo, São Paulo, SP/Brasil.
[3] Bolsistas de Iniciação Científica – PIBIC/CNPq/UFAL e FAPEAL, Curso de Nutrição, Universidade Federal de Alagoas.
Recebido: 04/07/2007 – Aceito para publicação: 09/11/2007.

ABSTRACT
In order to evaluate the nutritional value of Pilar soft crab (*Callinectes bocourt A.*) and uçá crab (*Ucides cordatus L.*)**,** 20 samples of both crustaceans were collected from lagoone-estuary complex Mundaú/Manguaba, located in the state of Alagoas, Brazil. Results from this analysis showed a high levels of moisture (soft crab – 79.82%; crab 78.85%), proteins (soft crab – 17.71%; crab – 17.99%) and ash (soft crab – 2.18%; crab – 2.06%)**,** and reduced values of lipids (soft crab – 2.78%; crab – 2.57%). Caloric values reached to 96.0 kcal in soft crab and 95.0 kcal in crab. Cholesterol levels were very low, being 34.65 mg/100g in Pilar soft crab and 35.37 mg/100g in crab-uçá. As for fatty acids contents, the Pilar soft crab presented 37.9% of saturated, 23.2% of monounsaturated and 29.9% of polyunsaturated; while uçá-crab presented 30.0% of saturated, 31.4% of monounsaturated and 34.9% of polyunsaturated. In view of these results, both species should be considered a healthy food**,** and their consumption should be stimulated.
Key words. crustaceans, proximate composition, caloric value, cholesterol, fatty acid.

RESUMO
Com o objetivo de avaliar o valor nutritivo de siri-do-Pilar e caranguejo-uçá foram analisadas 20 amostras de cada crustáceo, adquiridas no complexo estuarino-lagunar Mundaú/Manguaba, localizado no estado de Alagoas, Brasil. Foram detectados elevados teores de umidade (siri – 79,82% e caranguejo 78,85%), proteínas (siri – 17,71% e caranguejo – 17,99%) e cinzas (siri – 2,18% e caranguejo – 2,06%)**,** porém reduzidos valores de lipídios (siri – 2.78% e caranguejo – 2,57%). O valor calórico correspondeu a 96,0 kcal no siri e 95,0 kcal no caranguejo. Os teores de colesterol foram muito baixos, sendo 34,65 mg/100g em siri-do-Pilar e 35,37 mg/100g em caranguejo–uçá. Quanto ao teor de ácidos graxos, para o siri-do-Pilar foram verificados os seguintes valores: 37,9% de saturados, 23,2% de monoinsaturados e 29,9% de poliinsaturados**;** em caranguejo-uçá foram detectados 30.0% de saturados, 31,4% de monoinsaturados e 34,9% de poliinsaturados. Em vista dos resultados obtidos, as duas espécies de crustáceos podem ser consideradas como alimentos benéficos a saúde, cujo consumo deve ser estimulado.
Palavras-chave. crustáceos, composição centesimal, valor calórico, colesterol, ácidos graxos.

INTRODUCTION

Information on the composition of foods consumed in Brazil is essential for the design of a database adjusted to national reality. The lagoone-estuary complex Mundaú/Manguaba, located in the state of Alagoas, is the habitat of a large variety of fish and crustaceans. Amongst the crustaceans, grujaú soft crab or Pilar soft crab (*Callinectes bocourt* A. Milne-Edwards, 1879) and the uçá-crab (*Ucides cordatus* L. Linnaeu*s,* 1376) are a major feeding source, highly appreciated by both local population and tourists[1].

Pilar soft crab is a species found in shallow water and in mangroves substratum. Inhabits shallow waters of estuaries and mouths of river, supporting little saline and even polluted waters; lodging itself deep in the sand, mud, shells or rocks, from between-tides up to 20 meters of depth. Presents black and brown carapace and legs and chelipeds of light brown color[1].

Uçá-crab is a species found in burrows with over 1 meter of deep in the mangrove substratum. These crabs feed on seaweed and debris produced in the mangrove. Presents yellow and grey carapace and dark brown legs and chelipeds [1].

Uçá crabs are important in the region, both as fishing resources and as a source of income for the thousand of fishermen in the Brazilian coast living around mangroves, and their nutritional quality, includes these crustaceous as an important protein source for human consumption[2].

According to reviews by Skonberg and Perkins[3] although the nutritional composition of several commercially harvested species of crab has been partially characterized, shellfish vary widely in their nutrient content. Researchers have also reported differences in concentrations of moisture, fat, ash, protein and various volatile compounds in meats provenient from different body parts of the blue crab (*Callinectes sapidus*) and in the south east Asian crab (*Charybdis feriatus*).

Connor and Ling[4] described crustaceans as good sources of polyunsaturated fatty acids, especially serious omega 3 (ω-3), presenting low levels of fatty saturated acids.

Linoleic and ∝-linolenic fatty acids, representatives of the ω-6 and ω-3 series, are absolutely essential in human diet. Moreover, polyunsaturated fatty acids contribute for the prevention of coronary and rheumatic illnesses, diabetes and cancer[5]. Docosahexaenoic (DHA), a fatty acid of the omega 3 series, is the greater constituent of the phospholipidic portion of the receiving cells, present in the retina, the organ that posseses the highest amount of DHA, which is also indispensable for adequate brain functions[6].

Since there is no information on the main chemical constituent of crustaceans in the lagoone-estuary complex Mundaú/Manguaba (Alagoas), this study aims to evaluate the proximate composition, caloric values, cholesterol and cholesterol oxides and fatty acids profile of Pilar soft crab and uçá-crab of the lagoone-estuary complex Mundaú/Manguaba.

MATERIALS AND METHODS

Sample collection and preparation

Twenty samples of grujaú soft crab or Pilar soft crab (*Callinectes bocourti* A.) and twenty samples of uçá-crab (*Ucides cordatus* L.) collected in the lagoone-estuary complex Mundaú/Manguaba in Alagoas were analyzed. The samples of soft crab were acquired in lots, containing about 200g, and the uçá-crabs were acquired living, since edible parts are not sold in the amount needed to compose a lot. Both were collected during the period September 2005 to April 2006.

Soon after the acquisition, the samples of soft crab were conditioned in sterilized plastic bags and kept under refrigeration, while the crabs remained alive. Samples of the crustaceans were led to the Laboratory of Bromatology of the Nutrition College of the Federal University of Alagoas, where the analyses were performed.

Crabs were washed in a container with water and placed in boiling water during 5 to 10 minutes. After cooling, legs were scraped and laundered once more. Meat of both big and small legs and cephalothoraxes was collected.

Analytical determinations

After homogenization, the following determination was performed in three replicates.

Proximate composition

Moisture: determined gravimetrically in greenhouse 105°C (AOAC)[7].

Ash: obtained by incineration of a known amount of the sample, in muffle 550°C (AOAC)[7].

Proteins: determined by the Kjedahl method, to convert results into nitrogen for crude protein were used factor 6,25 (AOAC)[7].

Total lipids: obtained by cold extraction employed the method of Folch et al.[8], with aliquots taken for gravimetrical determination.

Carbohydrates: quantified by difference.

Total Caloric Value: calculated by the corresponding caloric coefficients for proteins, carbohydrates and lipids, respectively, 4,4 and 9 kcal/g (Brasil)[9].

Cholesterol and cholesterol oxides (7β-OH, 7α-OH, 7-K and 25-OH) free: extracted by the method of Csallany and Ayaz [10], adapted from Folch et al.[8] , that consisting of adding chloroform: methanol (2:1), washing samples with distilled water, combining laundering waters and extracting with chloroform: methanol (2:1), to combine the not watery phases and to filtered with Na_2SO_4, dried under a nitrogen flow, samples were then ressuspended in 3mL of mobile phase (hexane: isopropanol- 97:3) and injected in liquid high efficiency chromatograph.

The stage of injection in liquid chromatograph was carried through in the Laboratory of Bromatology of the Department of Nutrition - Public Health College, USP, São Paulo.

Identification and quantification of cholesterol and oxides composites was performed with UV/visible detector with sweepings of the Shimadzu company (model 10A VP), selecting wave lengths of 206 maximum nm absorption for cholesterol and oxides 25-OH, 7α - OH and 7β-OH and 233 nm for oxide 7-K. Standards of cholesterol oxides were obtained from the Steroids company (Wilton, U.S.A.). Isocratic race of 25 minutes was carried through, employing the composed mobile phase for a hexane mixture and isopropanol in ratio 97:3 to a flow of 1mL/min. The mobile phase was filtered in a 0,45µm membrane and degassed. For composite separation was chose the column of intermediate phase Luna CN 5µ of the Phenomenex brand, with 25cm of length. They were injected 20µL of sample and five different concentrations of standard cholesterol (of 0,15 the 1,89mg/mL) and of each oxide (4,6 the 230µg/mL) analyzed. Cholesterol and cholesterol oxides were monitored at 206nm, while 7-ketocholesterol was monitored at 233nm.

Detection and quantification limits were determined as described by Leite[11], using standard solutions (Table 1). Repeatability values were obtained with multiple injections (n=3) of the more diluted point of standard curve. Recovery experiments were performed by Vicente and Torres [12], obtaining the values presented in Table 1.

Profile of fatty acids

Lipoid extracts obtained by the method of Folch were esterified according to Hartman and Lago[13], regarding acid determination of the composition in fatty acids for chromatography in the gaseous phase and sent to the Laboratory of Bromatology of the Department of Nutrition of the Public Health College at USP, São Paulo, where they were injected in a gas chromatograph. For the identification of the fatty acids, methylic ester standards of fatty acids were employed (37 FAME Mix 47885, Supelco), comparing the retention time of methylic esters of the samples and of the standards. Quantification of fatty acids was made through area normalization, expressing results in the percentage of each acid over the total of fatty acids.

Operational parameters of the equipment are told as follow. Gas Chromatograph Chrompack CP 9002 (Middelburg, Holland), equipped with hair column CiolaWax of 20m, 0.32mm diameter and thickness of 0.25µm film. The oven was operated at an initial temperature of 60^0C for two minutes, and the temperature slope was of 4°C/min until reaching 141°C, 3.5°C until 176°C, 2°C/min until reaching 186°C, and 3.5°C/min until reaching the final temperature of 240°C. Injector temperature was of 270°C and detector temperature was of 300°C. The dragging gas used was the hydrogen, with flow of 1.9mL/min, reason of division 1:30. A volume of 1µL of sample was injected.

Statistical analyses

The Analysis of Variance (ANOVA) was used with the aid of the statistical program Epi-info, version 2002, to a level of significance of 0.05. Whenever variances were not homogeneous, tested for the Qui-square of Bartlett's, the Kruskal-Wallis test was used in the same level of significance, through the same program.

RESULTS AND DISCUSSION

Proximate composition

The results of the centesimal composition of the studied crustaceans are in Table 2.

It can be verified that the crustaceans present amounts of moisture varying from 79.82 g/100g to 78.85g/100g, lower than the ones found by Pedrosa and Cozzolino[14], in raw shrimp (88.34 g/100g) and raw crab (84.42g/100g), in the city of Natal/RN. However, moisture values of the samples are in accordance with the ones found in two studies. Skonberg and Perkins[3] studying the composition of nutrients of raw *Carcinus maenus* crab, from the Gulf of Maine (U.S.A.), had verified that moisture content of raw crab leg meat corresponded to 79.0 g/100g. Lourenço et al.[15] analyzing uçá-crab meat (*Ucides cordatus* L.) collected in the cities of the state of Pará (São Caetano de Odivelas and Belém), had detected amounts of moisture corresponding to 79.35g/100g and 77.35g/100g, respectively.

The ash amounts of Pilar soft crab was of 2.18g/100g and of 2.06g/100g in uçá-crab. Skonberg and Perkins[3] had found 2.2g/100g of ash in raw crab leg meat (*Carcinus maenus*), a value similar to the ones found in the present study. Lourenço et al.[15] relate percentages of ash superior to those detected in this research for samples of uçá-crab (*Ucides cordatus* L.), 2.69g/100g and 3.60g/100g, in the two analyzed cities. Pedrosa and Cozzolino[14] detected amounts of 1.05g/100g in raw shrimp;

Table 1. Detection and quantification limits (n = 7) for cholesterol (mg) and cholesterol oxides (µg), recovery % (n = 6) of extraction and quantification methods and repeatability values %.

Component	Detection Limit	Quantification Limit	Recovery (%)	Repeatability (%)
Cholesterol	$8.52.10^{-4}$	$2.84.10^{-3}$	92.8±2.0	2.76
7-K	0.01	0.02	94.4±1.7	1.69
25-OH	0.12	0.41	91.2±1.8	1.27
7α–OH	0.10	0.33	91.3±2.2	2.39
7β-OH	0.03	0.09	91.9±2.5	0.71

0.71g/100g in raw crab and 1.57g/100g for raw lobster, all inferior to the values found in the present study.

The protein percentages found by Radrosa and Cozzolino[14] in raw crab and shrimp (13.3g/100g and 10.62g/100g, respectively) were lower than the 17.71g/100g and 17.99g/100g detected in this research. Lira et al.[16] had found similar protein amounts for the raw clams sururu (*Mytella falcata*), 17.26g/100g and maçunim (*Anomalocardia brasiliana*), 17.46g/100g in the city of Maceió-AL. Results present an advantage of these crustaceans for the consumer, since they are a protein source of high biological value.

Skonberg and Perkins[3] relate protein content of 16.8g/100g in raw crab leg meat (*Carcinus maenus*), inferior to the one in the current research. Lourenço et al.[15] relate percentages of 14.34g/100g and 17.12g/100g of proteins in samples of uçá-crab (*Ucides cordatus* L.) collected in the cities of São Caetano de Odivelas and Belém-Pará, inferior amounts to the ones detected in this research, mainly regarding the samples obtained in São Caetano de Odivelas. According to the authors, these results can be explained due to the difference between fat amounts.

Lipids percentages presented by Pilar soft crab (2.78g/100g) and of uçá-crab (2.57g/100g) were superior to the ones of raw crab, shrimp and lobster, 0.49g/100g, 0.36g/100g and 0.66g/100g, respectively[14]. Bragagnolo and Rodriguez-Amaya[17] had also found lower results than the ones of the crustaceans of this study in various species of shrimp (*Penaeus brasiliensis, Penaeus schimitti, Macrobrachium rosenbergii, Xiphopenaeus kroyeri*), general average of 1.0g/100g. Skonberg and Perkins[3] had found 0.5 g/100g of fat in raw crab leg meat (*Carcinus maenus*) and 1.2g/100g when cooked in vapor per 12 minutes. In both situations, values were inferior to the ones of this study. However, results obtained are inferior to the percentages of lipids of raw clams sururu (3.84g/100g), maçunim (2.68g/100g) and unha-de-velho (*Tagelus plebeus*) (2.84g/100g), of the research of Lira et al.[16].

Lourenço et al.[15] reports percentages of 2.59g/100g and 0.59g/100g of gross fat in samples of uçá-crab; the difference between fat amounts, according to authors, must come from the period when collection of the raw material was made, since samples from São Caetano de Odivelas were collected at the beginning of September of 2002, a time where crabs present considerable fat amounts. The results of the present study are similar to the ones detected in the samples proceeding from São Caetano de Odivelas.

It is worth to mention that Pilar soft crab and uçá-crab can be considered as foods of low fat amount, contributing to human health by reducing the risk of cardiovascular problems.

Regarding caloric value, results varied between 95.0kcal and 96.0kcal. In raw sururu clams, maçunim and unha de velho, values were higher: 107.72kcal, 103.52kcal and 100.52kcal, respectively[16]. When comparing the caloric values with those presented by Pedrosa and Cozzolino[14] , inferior values to the ones found in this study are observed: raw shrimp (45.72kcal), raw crab (61.93kcal) and raw lobster (91.98kcal). Also Lourenço et al.[15] had found inferior caloric values to the ones present in this study 81.92kcal and 78.65kcal in samples of uçá-crab.

Free cholesterol

The crustaceans had presented low cholesterol amounts, which represents an important dietary factor for the health of human beings regarding prevention of atherosclerosis coronary illness.

Average cholesterol amounts corresponded to 34.65mg/100g in Pilar soft crab and 35.37mg/100g in uçá-crab. These values are lower than those reported by Skonberg and Perkins[3] for raw crab leg (*Carcinus maenus*) 57.4mg/100g and crab leg of the same species cooked in vapor for 12min (64.8mg/100g) and are also inferior to the cholesterol values cited in these authors' revision. The cholesterol levels obtained by Bragagnolo and Rodriguez-Amaya[17] varied from 114mg/100g in large pink shrimp (*Penaeus brasiliensis*) to 139mg/100g in small prawn (*Macrobrachium rosenbergii*) with a mean of 127mg/100g.

Cholesterol amounts detected in the crustaceans are quite lower than the limit recommended by The National Cholesterol Education Program[18] and IV Brazilian Lines of Direction on Dyslipidemias[19] recommending a daily cholesterol intake of 300mg /day at the most.

Cholesterol oxides had not been detected. The heat is the major responsible for its generation, mainly in extensively processed food. In this study, the crabs were not exposed to abusive conditions during the preparation of the samples.

Table 2. Proximate and caloric composition of crustaceans of the lagoone-estuary complex Mundaú/Manguaba-AL.

Proximate Composition (g/100g)*	Soft crab	Crab
Moisture	79.82^a (±2.44)	78.85^a (±1.07)
Proteins	17.71^a (±3.01)	17.99^a (±1.66)
Lipids	2.78^a (±0.71)	2.57^a (±0.38)
Ash	2.18^a (±0.46)	2.06^a (±0.53)
Calories (kcal)	96	95

*Average of 20 samples analyzed in three replicates, with deviation standard between parentheses.
Same letters in the line for mean values do not show statistical significant differences ($p < 0.05$).

Moura et al.[20] evaluated the effects of boiling and deep-frying on the cholesterol oxidation in pink-shrimp samples (*Penaeus brasiliensis* and *Penaeus paulensis*) and found concentrations 7-Keto that varied from 0.185 to 0.366μg/g, with an average value of 0.230μg/g. These authors concluded that the reduction of free cholesterol and 7-Keto concentrations in processed pink-shrimp was related to elution of these compounds by the cooking medium, i.e., water in boiling and oil in frying.

Sampaio et al.[21] analyzed cholesterol oxides in salty dry shrimp and found 7α-OH, 7β-OH (predominat), 7- Keto and 25-OH in amounts that varied from 4.52 μg/g to 77.30μg/g. The shrimp passes through several processing stages: immersion in brine, drainage, drying under the direct incidence of the sun-light, addition of salt and boiling. In this process, occurs an abusive condition that may collaborate to formation of cholesterol oxidation products and shrimps are rich in polyunsaturated fatty acids and cholesterol, therefore possessing great potential for the cholesterol oxides formation.

Profile of fatty acids

In Pilar soft crab, twelve (12) fatty acids were detected (Table 3), the predominant being: palmitic acid (C16:0) 24.3%; oleic acid (C18:1 ω9) 13.9%; eicosapentaenoic (EPA - C20:5 ω3) 10.9%; stearic acid (C18:0) 9.4%. Also were found polyunsaturated acid: linoleic (C18:2 ω6) 6.9%; palmitoleic (C16:1 ω7) 6.0%; α-Linolenic (C18:3 ω3) 5.2% and docosahexaenoic (DHA - C22:6 ω3) 2.8%.

In the fatty acids profile of the uçá-crab (Table 2), eight were identified, being the main ones: α oleic (C18:1 ω9) 26.1%; palmitic (C16:0) 21.0%; linoleic (C18:2 ω6) 14.8%; stearic (C18:0) 9.0%; eicosapentenoic (EPA - C20:5 ω3) 8.6% and α-linolenic (C18:3 ω3) 5.4%.

Results reveal a positive aspect in the profile of the fatty acids of these crustaceans, since they present essential fatty acids.

Amongst the saturated fatty acids, the predominance of the palmitic and stearic have been observed in the two species of crustaceans, which had presented similar values statistically ($p < 0,05$).

Palmitic acid is presented as dietary risk factor in the development of atherosclerotic coronary illness[6]. The elevated percentile of palmitic acid found in Pilar soft crab and in the uçá-crab, had also been found by Lira et al.[16], in raw clams: sururu (27.06%), maçunim (22.45%), unha-de-velho (26.75%) and in lesser ratio for Bragagnolo and Rodriguez-Amaya[22] in the pink shrimp (14.9%).

The saturated fatty acid stearic (C18:0) possesses hypocholesterolemic effect, it quickly becomes the oleic acid in the organism after its ingestion, not affecting the plasmatic cholesterol[23]. Bragagnolo and Rodriguez-Amaya[22] had found for the pink shrimp 8.6% of estearic, inferior value as the ones of Pilar soft crab and uçá-crab.

In the uçá-crab they had detected the double of monounsaturated oleic fatty acid and fatty acid linoleic polyunsaturated ω-6, when compared with the results of Pilar soft crab.

According to the revision of Lira et al.[24], monounsaturated oleic acid (C18:1), of the omega 9 family, has been pointed as hypolipidemic, diminishing lipoproteins of low density (LDL), presenting hypocholesterolemic and protective effect against the development of atherosclerotic coronary illness. It has a direct correlation between the incidence and gravity of atheromatosic injuries and plasmatic concentrations of LDL.

Table 3. Fatty acids profile (%) of crustaceans of the lagoone-estuary complex Mundaú/Manguaba-AL.

Fatty Acids	Pilar soft crab*	Uçá-crab*
Myristic (C14:0)	2.6 (±1.28)	—
Palmitic (C16:0)	24.3^a(±2.45)	21.0^a(±3.69)
Palmitoleic (C16:1) (ω 7)	6.0^a(±1.45)	5.3^a(±2.48)
Heptadecanoic (C17:0)	1.6 (±1.05)	—
Stearic (C18:0)	9.4^a(±0.72)	9.0^a(±1.02)
Oleic (C18:1) (ω 9)	13.9^a(±3.04)	26.1^b(±3.68)
Elaidic (C18:1)(ω9)	3.3 (±0.86)	—
Linoleic (C18:2) (ω6)	6.9^a(±2.44)	14.8^b(±3.15)
α linolenic (C18:3)(ω3)	5.2^a(±4.12)	5.3^a(±1.36)
Eicosatrienoic (C20:3) (ω3)	4.6^a(±1.87)	6.2^a(±1.11)
Eicosapentenoic (C20:5) (ω3)	10.9^a(±2.60)	8.6^a(±2.30)
Docosahexenoic (C22:6) (ω3)	2.3 (±2.38)	—
Not identified	8.9	3.7

*Average of 14 samples analyzed in two replicates, with standard deviation between parentheses.
Same letters in the line for mean values do not show statistical significant differences ($p < 0.05$).
— Not detected.

Bragagnolo and Rodriguez-Amaya[22] had found 7.9% of acid oleic for the pink shrimp, inferior value to the ones of Pilar soft crab and uçá-crab, evidencing the advantages of these crustaceans.

Lira et al.[16] had found inferior amounts of linoleic acid in raw sururu (4.47%), raw unha-de-velho (4.64%) and raw maçunim (3.63%). Bragagnolo and Rodriguez-Amaya[22] report inferior values in pink shrimp (1.5%). These results demonstrate a positive plus by the nutritional point of view of the analyzed crustaceans, mainly of the crab-uçá.

Similar concentrations were detected in the two studied species (5.3 and 5.2%), polyunsaturated fatty acid ∝ linolenic (ω3). Lira et al.[16] had found 2.22% of this fatty acid for raw sururu, 1.13% for raw maçunim and 1.27% for unha-de-velho.

Polyunsaturated fatty acid EPA (ω3) was detected in more elevated percentage in soft crab, differing statistically from crab ($p<0,05$), however, being inferior to the amounts of pink shrimp (18.7%), in the study of Bragagnolo and Rodriguez-Amaya [22]. Lira et al.[16] detected percentages of EPA of 8.67% in raw sururu, 6.76% in maçunim, and 6.12% raw unha-de-velho.

The biological effect of essential fatty acids depends on the acid reason between the families ω6/ω3 present in the phospholipids that constitute the membranes. The Japan Society of Lipid Nutrition recommends a maximum of 4:1 for the reason ω6/ω3 for healthful adults and of 2:1 in the prevention of chronic illnesses in aged people[25]. In the present work, the ratio of polyunsaturated fatty acids ω6/ω3 found was of 0.3:1 for Pilar soft crab and 0.74:1 for the uçá-crab.

Total percentages of fatty acids of the analyzed crustaceans evidence a positive nutritional factor of the uçá-crab in relation to Pilar soft crab (Table 4): saturated (30.0 %), monounsaturated (31.4%) and polyunsaturateds (34.9%). Bragagnolo and Rodriguez-Amaya[22] tell saturated values of 30.2%; 22.6% of monounsaturated and 45.0% of polyunsaturated for pink shrimp.

CONCLUSIONS

The samples of Pilar soft crab and uçá-crab presented high levels of moisture, proteins and ash and reduced values lipidic and caloric.

The crustaceans presented low cholesterol basis, substantially below the recommended limit of 300mg/dia.

The main fatty acids found in the samples of Pilar soft crab were: Palmitic (C16:0), Oleic (C18:1 ω9), EPA (C20:5 ω3) and Stearic (C18:0); soft crab can also be considered an source of polyunsaturated fatty acids linoleic (C18:2ω-6) α–linolenic (C18:3ω3) and DHA (C22:6 ω3). In the samples of uçá-crab the main fatty acids found had been: oleic (C18:1 ω9); Palmitic (C16:0); Linoleic (C18:2 ω6); Stearic (C18:0) and EPA (C20:5 ω3). The uçá-crab, also can be considered an alimentary source of polyunsaturated fatty acid α-linolenic (C18:3 ω3).

The profile of fatty acids of uçá-crab is slightly more favorable. However, the two species can be seen as healthy foods and their consumption may be stimulated.

Results obtained are very important both from economical and nutritional points of view and will contribute for higher consumption of these crustaceans.

ACKNOWLEDGEMENTS

To the Foundation of Research Support of the State of Alagoas (FAPEAL) for the financial aid and the Scientific Initiation scholarships granted to the pupils; to the PIBIC/CNPq/UFAL for the Scientific Initiation scholarships granted to the pupils.

Table 4. Composition of fatty acids present in crustaceans of the lagoon-estuary complex Mundaú/Manguaba-AL.

Fatty Acids	Pilar soft crab*	Uçá-Crab*
∑ Saturated (%)	37.9	30.0
∑ Monounsaturated (%)	23.2	31.4
∑ Polyunsaturated (%)	29.9	34.9
Reason ω 6/ω 3	0.3:1	0.74:1
∑ ω 3	23.0	20.1
∑ ω 6	6.9	14.8

*Average of 14 samples analyzed in two replicates.

REFERENCES

1. Calado TCS, Sousa EC. Crustáceos do Complexo Estuarino-Lagunar Mundaú/Manguaba - Alagoas. 1° ed. Maceió: FAPEAL; 2002.
2. Rodrigues AMT. A exploração do caranguejo *Ucides cordatus* (*Decapoda: Ocypodidae*) e o processo de gestão participativa para a normatização da atividade na região sudeste-sul do Brasil. Bol Inst Pesca. 2000; 26(1): 63-78.
3. Skonberg DI, Perkins BL. Nutrient composition of green crab (*Carcinus maenus)* leg meat and claw meat. Food Chem. 2002; 77, 401-4.
4. Connor WE, Ling DS. The effect of shellfish in the diet upon the plasma lipid levels in humans. Metabolism. 1982; 31:1046- 51.
5. Roos NM, Siebelink E, Botts ML, Van Tol A, Schouten EG, Katan MB. Trans monounsaturated fatty acid and saturated fatty acids have similar effects on postprandial flow-mediated vasodilatoin. Eur J Clin Nutr. 2002; 56(7):674-9.
6. Curi R, Pompéia C, Miyasaka K, Procópio J. Entendendo as gorduras – os ácidos graxos. 1ª ed. São Paulo, Ed. Manole Ltda; 2002.
7. AOAC - Association of Official Analytical Chemists. Official Methods of Analysis, 17th ed. Association of Official Analytical Chemists, Gaithersburg, MD, USA. 2000.
8. Folch J, Lees M, Sloanne Stanley GH. A simple method for the isolation and purification of total lipids from animal tissues. J Biol Chem. 1957; 226:497-507.
9. Brasil. Leis, Decretos, etc. Portaria nº 33/98 da Secretaria de Vigilância Sanitária do Ministério da Saúde. Diário Oficial da República Federativa do Brasil, Poder Executivo, Brasília - DF 30 mar. 1998. Seção I, n.º 60- E, p. 5-6. Adota os valores constantes das tabelas do anexo desta portaria como níveis de IDR (Ingestão Diária Recomendada) para as vitaminas, minerais e proteínas.
10. Csallany AS, Ayaz KL. Quantitative determination of organic solvent soluble lipofresein pigments in tissues. Lipids. 1976; 11(11):412-17.
11. Leite F. Sensibilidade, seletividade e limites de detecção e quantificação. In: Leite F. Validação em análises químicas. 3ª ed. Campinas: Editora Átomo, 1998. p.67-9.
12. Vicente SJV, Torres EAFS. Formation of four cholesterol oxidation products and loss of free lipids, cholesterol and water in beef hamburgers as a function of thermal processing. Food Control. 2007;(18)63-68.
13. Hartman L, Lago BCA. Rapid preparation of fatty methyl esters from lipids. Lab Pract. 1973;22:475-77.
14. Pedrosa LFC, Cozzolino SMF. Composição centesimal e de minerais de mariscos crus e cozidos da cidade de Natal/RN. Ciênc Tecnol Aliment. 2001;21(2):154-7.
15. Lourenço LFH, Oliveira ML, Pinto CMC, Pereira DXP. Análises físico-químicas e microbiológicas de carne de caranguejo-uçá *Ucides cordatus* (Linnaeus, 1763), comercializada nos municípios de São Caetano de Odivelas e Belém, PA. Hig Aliment. 2006; 20(142):90-5.
16. Lira GM, Mancini Filho J, Sant'ana LS, Torres RP, Oliveira AC, Omena CMB. et al. Perfil de ácidos graxos, composição centesimal e valor calórico de moluscos crus e cozidos com leite de coco da cidade de Maceió-AL. Rev Bras Ciênc Farm. 2004;40(4):529-37.
17. Bragagnolo N, Rodriguez-Amaya DB. Total lipid, cholesterol, and fatty acids of farmed freshwater prawn (*Macrobrachium rosenbergii*) and wild marine shrimp (*Penaeus brasiliensis, Penaeus schimitti, Xiphopenaeus kroyeri*). J Comp Anal. 2001;14:359-369.
18. National Cholesterol Education Program. Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. Circulation. 2002; 106: 3143–3421.
19. IV Diretriz Brasileira Sobre Dislipidemias e Prevenção da Aterosclerose do Departamento de Aterosclerose da Sociedade Brasileira de Cardiologia. Arq Bras Cardiol. 2007;88(Supl 1).
20. Moura AFP, Tenuta-Filho A. Efeito do processamento sobre os níveis de colesterol e 7-cetocolesterol em camarão-rosa. Ciênc Tecnol Aliment. 2002;22(2):117-21.
21. Sampaio GR, Bastos DHM, Soares RAM, Queiroz YS, Torres EAFS. Fatty acids and cholesterol oxidation in salted dried shrimp. Food Chem. 2006 95(2):344-51.
22. Bragagnolo N, Rodriguez-Amaya D. Otimização da determinação de colesterol por CLAE e teores de colesterol, lipídeos totais e ácidos graxos em camarão rosa (*Penaeus brasiliensis*). Ciênc Tecnol Aliment. 1997;17(3):275-80.
23. Bonanome AMD, Grundy SM. Effect of dietary stearic acid on plasma cholesterol and lipoprotein levels. New England J Medicine. 1988;318(19):1244-47.
24. Lira GM, Mancini Filho J, Torres RP, Oliveira AC, Vasconcelos AMA, Omena CMB. et al. Composição centesimal, valor calórico, teor de colesterol e perfil de ácidos graxos da carne de búfalo (*Bubalis bubalis*) da cidade de São Luiz do Quitunde-AL. Rev Inst. Adolfo Lutz. 2005;64(1):31-8.
25. Uauy R, Mena P, Valenzuela A. Essential fatty acids as determinants of lipids requeriments in infants, children and adults. European J Clin Nutrition. 1999;53(1):66-7.