Biochemical composition of the Caspian Sea red macroalga, *Laurencia caspica*

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Abstract

***Laurencia caspica*, a marine macroalga species were analyzed to determine its proximate chemical composition. The investigated species demonstrated high carbohydrate (25.5 ± 0.20 % dry wt) protein (22.22 ± 0.4 % dry wt), ash (26.82 ± 0.31 % dry wt) and moisture components (12.00 ± 0.23 % dry wt) and low lipid content (0.03 ± 0.05 % dry wt). Glutamic acid (192.24 ± 1.4 mg 100g-1 dry wt) and Aspartic acid (160.77 ± 1.1 mg 100g-1 dry wt) were the most abundant free amino acids, while Histidine (21.15 ± 0.1 mg 100g $^{-1}$ dry wt) and Glycine (29.99 ± 0.3 mg 100g-1 dry wt) contents were the lowest in the free amino-acid profiles. All essential amino acids were detected in the species tested. Unsaturated fatty acid constituted about 64% of total fatty acids, mainly 8-Octadecenoic acid and saturated fatty acids represented 36% of the total fatty acids (mainly myristic acid). This study was conducted to create a nutritional data for *Laurencia caspica* in order to popularize its consumption and utilization in the southern coasts of the Caspian Sea.**

Key words: *Laurencia caspica*, Biochemical composition, Caspian Sea.

Introduction

Macroalgae comprising a few thousands of species represent a considerable part of the littoral biomass and they are classified as Rhodophyta, Phaeophyta and Chlorophyta depending on their nutrient and chemical composition (Gressler et al., 2010). As the first organisms in marine food chain, they provide nutrients for other living organisms (Chandraprabha et al., 2012). Macroalgae are known as a highly nutritive food regarding protein, carbohydrate, elements, dietary fibers, vitamin, essential amino acids and essential fatty acids (Marinho-Soriano et al., 2006). That explains why today seaweeds are considered as the food supplement for 21 century. The protein content of dried marine algae is typically 10-30 % dry weight. Proteins are composed of different amino acids and hence the nutritional quality of macroalgae can be determined basically by the content, proportion and availability of its amino acids (Dawczynski et al., 2007). Carbohydrates in algae are stored in different forms like starch in Chlorophyta, floridian starch in Rhodophyta, laminarin in Phaeophyta as food reserves and energy. The lipid content of macroalgae accounts for 1–6% dry weight and exhibit an interesting polyunsaturated fatty acid composition particularly omega-3 and omega-6 acids which play an important role in the prevention of cardio vascular diseases, osteoarthritis and diabetes (Rameshkumar et al., 2013). Fatty acids are important for human and animal health and they are of interested because they are precursors in the eicosanoids biosynthesis, which are viewed as important bioregulators of many cellular processes (Khotimchenko, 2005). To our knowledge, the nutritional composition of Laurencia caspica (Figure 1) has not been determined and a nutritional data on this red algae is not yet available. Thus, the aims of this work were to determine the nutritional and biochemical composition of *Laurencia caspica*.

Materials and methods

The *Laurencia caspica* were collected from submerged rocks on the coast of Ramsar located on the southern part of the Caspian Sea in April 2014. All the samples were kept on ice until transferred to the laboratory. At the laboratory, they were thoroughly cleaned with double-distilled water to remove epiphytes and detritus attached to the fronds. Cleaned samples freeze-dried by Operon Freez-dryer (FDB 5503, Korea) at -50°C under vacuumand stored in a -50°C freezer until extraction. The seaweed samples were analysed in triplicate for their proximate composition. Total crude protein was determined by the Kjeldahl method (protein conversion factor: 6.25). The total carbohydrate contents were evaluated by the Fehling's method (Khan, 1979). The moisture contents were determined by oven-drying of 5 g of sample at 105˚C until a constant weight was obtained. The ash contents were estimated by heating the seaweeds in a muffle furnace at 450˚C for 8 h and weighting the residue (AOAC, 2000). Fatty acids extraction was performed by the Folch method, with slight modification (Silva et al., 2013). Amino acids were determined by high-performance liquid chromatography (HPLC) by the method of Alaiz et al., 1992.

Results and discussion

The proximate composition of *L. caspica* is shown in Table 1. The red alga *L. caspica* was found to contain high carbohydrate and protein contents and low lipid composition. The mean carbohydrate content found in the present study (25.50 ± 0.20 %DW) is in agreement with values reported for *L. papillosa* (25.00 % DW) (Mohammadi et al., 2013). The mean lipid content of *L. caspica* was of the same order as reported for *Laurencia sp*. (0.4 ± 0.04 %DW) (Ahmad et al., 2012). The mean protein content found to be higher than *L. obtusa* (18.10 % DW) (Lewis, 1973). The mean ash and moisture content of *L. caspica* was of the same order as reported for *L. intermedia* (24.17 ± 0.25 % DW; 11.16 ± 0.06 % DW) (Mwalugha et al., 2009). All of the essential amino acids and six non-essential amino acids were found to be present in *L. caspica* (Table 2). Previous experiments described by Lewis (1973) with *Laurencia* species showed similar contents of amino acids when compared to our data.

Table 1: Proximate chemical composition of *Laurencia caspica*.

Protein (%DW)	Carbohydrate (%DW)	Lipid (%DW)	Ash (%DW)	Moisture (%DW)
22.22±0.40	25.50±0.20	0.30±0.05	26.82±0.31	12.00±0.23

Figure 1: *Laurencia caspica*.

Mean lipid content of *L. caspica* was of the same order as reported for *Laurencia sp*. (0.4 ± 0.04 %DW) (Ahmad et al., 2012). The mean protein content found to be higher than *L. obtusa* (18.10 % DW) (Lewis, 1973). The mean ash and moisture content of *L. caspica* was of the same order as reported for *L. intermedia* (24.17 ± 0.25 % DW; 11.16 ± 0.06 % DW) (Mwalugha et al., 2009). All of the essential amino acids and six non-essential amino acids were found to be present in *L. caspica* (Table 2). Previous experiments described by Lewis (1973) with *Laurencia* species showed similar contents of amino acids when compared to our data. The relative percentages of the major fatty acids are presented in Table 3.

Table 2: Amino acid composition of *Laurencia caspica*.

	Amino acids	mg 100g-1 dry wt
EAAs	Arginine	67.14 ± 1.72
	Histidine	21.15 ± 0.38
	Isoleucine	68.43 ± 1.17
	Leucine	108.50 ± 4.03
	Lysine	86.57 ± 2.05
	Methionine	129.58 ± 4.22
	Phenylalanine	77.64 ± 2.11
	Threonine	94.06 ± 3.18
	Tryptophan	107.27 ± 5.51
	Valine	83.14 ± 2.96
NEAAs	Alanine	87.51 ± 3.18
	Aspartic acid	160.77 ± 5.07
	Glutamic acid	192.24 ± 5.36
	Glycine	29.99 ± 0.84
	Serine	54.33 ± 2.08
	Tyrosine	107.30 ± 4.27

The fatty acid contents of *L. caspica* were in the following ranges: saturated fatty acids (SFAs) 0.76 %-26.08 %, monounsaturated fatty acids (MUFAs) 7.62 %-25.36 % and polyunsaturated fatty acids (PUFAs) 1.13 %-11.91 %. Myristic acid (C:14) was detected as the predominant saturated fatty acids. Myristic acid is a physiologically important fatty acid, which the body uses to stabilize many different proteins, including proteins used in the immune system and to fight tumors (Nakahara and Shoyama, 2011). 8-octadecenoic acid (C8:1n-8) and arachidonic acid (C20:4n-6) were recorded as the major mono and polyunsaturated fatty acids, respectively. 8 octadecenoic acid commonly is one of the major monounsaturated fatty acids in macroalgae species (Li et al., 2002). Arachidonic acid, an omega-6 fatty acid that supports brain and muscle function and also promotes inflammation (Khotimchenko and Gusarova, 2004).

Table 3: Fatty acid contents of *Laurencia caspica*.

	Fatty acids	(% of total fatty acids)
C14:0	tetradecanoicacid (myristic acid)	26.08 ± 0.52
C15:0	pentadecanoicacid	0.76 ± 0.04
C17:0	heptadecanoicacid (margaric acid)	1.40 ± 0.06
C18:0	octadecanoicacid (stearic acid)	2.67 ± 0.13
C16:1n-7	9-hexadecenoicacid (palmitoleic acid)	19.14 ± 0.35
C8:1n-8	8-octadecenoicacid	25.36 ± 1.50
C18:1n-9	9 octadecenoicacid (oleic acid)	7.62 ± 0.43
C16:3n-3	4,7,10-hexadecatrienoicacid	1.13 ± 0.09
C18:2n-6	9,12-octadecadienoicacid (linoleic acid)	3.88 ± 0.45
C20:4n-6	5,8,11,14-eicosatetraenoic acid (arachidonic acid)	11.91 ± 0.33
ΣSFAs		30.91 ± 12.26
ΣMUFAs		52.12 ± 9.00
ΣPUFAs		16.92 ± 5.60

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