CSAC 2021

Nutritional composition of the Atlantic seaweeds *Ulva rigida*, *Codium tomentosum*, *Palmaria palmata* and *Porphyra purpurea*

chemosensors

MDPI

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Introduction

Algae have long been recognized as a healthy food due to their nutritional composition and content in proteins, unsaturated lipids, dietary fiber and minerals [1]. In recent years there has been an increasing consumer interest in vegetarian, natural food sources. In this context, algae could prove valuable. Therefore, deepening the knowledge on their composition as well as identifying suitable analytical methods to determine it is of relevance. In this work, nutritional composition of *Ulva rigida* (UR), *Codium tomentosum* (CT), *Palmaria palmata* (PA) and *Porphyra purpurea* (PU) edible seaweed species widely distributed in Atlantic shores was studied using a variety of standardized analytical methods.

Methods

Total lipids were measured gravimetrically as evaporated mass after petroleum-ether Soxhlet extraction of samples. Fatty acid profile was determined by as chromatography coupled to a flame ionization detector (GC-FID). Proteins were quantified following the macro-Kjedahl method in which the nitrogen content is converted to protein using a conversion factor of 6.25. Total organic acids were determined by ultra-filtration liquid-chromatography coupled to an amperometric detector UFLC-PAD after methaphosphoric acid extraction. Minerals were identified and quantified by ICP-OES. Hydrocarbons were determined as the difference of the rest of components, following AOAC recognized methods.

Results

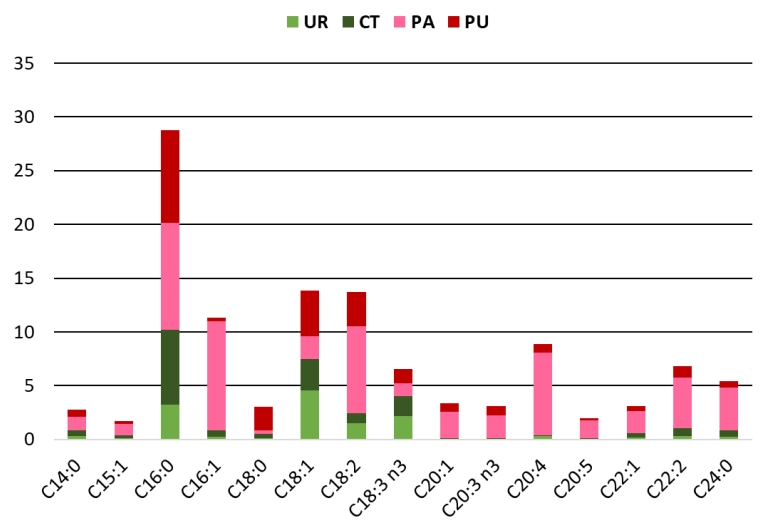
Table 1: Proximate composition (% dw)

Species	*Ash*	*Protein*	*Lipids*	*Fiber*	*Organic acids*
UR	28.7	16.3	0.42	42.9	-
CT	38.9	15.4	0.7	39.1	1.13
PA	23.8	21.5	0.1	46	0.82
PU	27.4	31.8	0.1	44.4	10.61

Table 2: Mineral composition (g / kg dw)

Species	*Ca*	*Fe*	*K*	*Mg*	*Mn*	*P*	*Zn*	*As*	*I*	*F*	*Cl*
UR	2.7	1.1	19.79	22.9	0.08	2	0.006	0.004	0.1	0.8	49.9
CT	5.1	0.1	6.7	10.4	0.03	1.3	-	0.01	0.2	0.01	8.5
PA	4.7	0.1	100	3.8	0.02	3.3	0.02	0.009	0.3	1.1	101
PU	1.5	0.2	33.5	3.1	0.02	5.8	0.03	0.03	0.08	0.6	12.1

Figure 1: Fatty acid composition (%)



Results showed that all studied species were accounted for very low levels of lipids (>1% dw), but proportion of unsaturated fatty acids was high, with *P. palmata* displaying the highest quantities (>200mg C18:1/g extract). Red algae, especially *P. purpurea* showed significant protein content, up to 30% dw. Organic acids content was heterogeneous, with only *P. purpurea* showing a high content (10.61% dw), half of which was determined as citrate. Almost all the analyzed species showed more than 40% dw of insoluble fiber. Regarding mineral content, both algae groups are greatly rich in K and Mg (>15 g / kg), with *U. rigida* also displayed a remarkable iron levels (>1 g Fe/kg). *P. palmata* in particular, showed very high levels of K and Cl (>100 g/kg). Some potentially excessive levels of minerals could be removed by osmotic treatments. Altogether, results corroborate that these edible algae are a good source of nutrients and analytical methods are suitable, in accordance with literature [2,3]. Lipid levels could be improved by employing other extraction solvent.

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Acknowledgements

The research leading to these results was supported by MICINN supporting the Ramón y Cajal grant for M.A. Prieto (RYC-2017-22891) and the FPU grant for A. Carreira-Casais (FPU2016/06135); by Xunta de Galicia for supporting the program EXCELENCIA-ED431F 2020/12, the post-doctoral grant of M. Fraga-Corral (ED481B-2019/096), the program BENEFICIOS DO CONSUMO DAS ESPECIES TINTORERA- CO-0019-2021 that supports the work of F. Chamorro and the program Grupos de Referencia Competitiva that supports the work of J. Echave (GRUPO AA1-GRC 2018); by the Bio Based Industries Joint Undertaking (JU) under grant agreement No 888003 UP4HEALTH Project (H2020-BBI-JTI-2019) that supports the work of P. Otero, P. Garcia-Perez and C. Lourenço-Lopes; and by Ibero-American Program on Science and Technology (CYTED—AQUA-CIBUS, P317RT0003). The JU receives support from the European Union's Horizon 2020 research and innovation program and the Bio Based Industries Consortium. The project SYSTEMIC Knowledge hub on Nutrition and Food Security, has received funding from national research funding parties in Belgium (FWO), France (INRA), Germany (BLE), Italy (MIPAAF), Latvia (IZM), Norway (RCN), Portugal (FCT), and Spain (AEI) in a joint action of JPI HDHL, JPI-OCEANS and FACCE-JPI launched in 2019 under the ERA-NET ERA-HDHL (n° 696295). The authors are grateful to AlgaMar enterprise (www.algamar.com) for the collaboration and algae material provision.

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