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Physicochemical characterization of dried vs. freeze-dried Marine Macroalgae Waste aiming further recovery

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Abstract

Marine macroalgae waste biomass was collected in a beach at Northern Portugal and further characterized concerning the main physicochemical properties (moisture, ash, nitrogen, proteins, lipids and total carbohydrates), using two different initial biomass conditions: dried (MMW1) and freeze-dried (MMW2). *Saccorhiza polyschides* (brown algae) was the most represented species in the collected biomass. MMW1 had a residual moisture of 1.34 wt.% and MMW2 of 8.2 wt.%. The biomass presented low lipid content (0.13 wt.% for MMW1 and 0.40 wt.% for MMW2), high carbohydrate (MMW1: 39.3wt.%; MMW2: 41.1 wt.%) and protein content (MMW1: 9.6 wt.%; MMW2: 9.8 wt.%) and a very high ash content (50.8 wt.% for MMW1 and 48.7 wt.% for MMW2) in agreement with reported values in the literature. Taking into account the differences found between both products, lyophilization is not justified aiming its further recovery.

Keywords: Waste, Marine Macroalgae, *Saccorhiza polyschides*.

Type: Oral communication

Introduction

The increase of Marine Macroalgae Waste (MMW) at coastal regions, like Portugal, is a reality, being associated with tide events and natural biomass accumulation (Lemesle et al. 2015). The lack of appropriate management of MMW, which are mostly left unmanaged or sent to landfills, leads to environmental impacts, health problems, coastal degradation and loss of renewable resources (Barbot et al. 2016). Marine Macroalgae (MM), classified into three main groups (brown, green, red), include in their physicochemical composition polysaccharides (4 - 76 %), proteins (5 - 30 %), minerals/ash (7 - 38 %), lipids (1 - 5%) and a high amount of water (80 - 90 %) (Rodrigues et al. 2015, Sudhakar et al. 2018). The preferential applications of MM (human food, cosmetics and pharmaceutical areas) are considered incompatible with the use of waste biomass, for safety reasons (Rodrigues et al. 2015). In agreement, the aim of the present study was to perform a physicochemical characterization of MMW collected at Northern Portugal, under different biomass initial conditions (dried and freeze-dried), in order to evaluate the influence on the composition of MMW and further recovery of this resource.

Materials and Methods

MMW was collected from Marbelo beach (Vila Nova de Gaia municipality) in july 2018 and directly stored in the freezer (-20 °C) till use. Before analysis, MMW1 was oven dried at 105 ± 2 °C during 24 h, and MMW2 was freeze-dried (Labconco freezone 2.5 plus). Both MMW were ground to < 1 mm in a laboratory mill (Retsch GM200) before characterization.
The following physicochemical parameters were determined: residual moisture, ash, nitrogen, proteins, total lipids and carbohydrates. The ash content was determined according to AOAC (2012) in a furnace by sample calcination at 500 °C up to constant weight. The nitrogen content was obtained using the Kjeldahl

method (AOAC, 2012). The protein content was obtained following Angell et al. (2016), using a nitrogen-to-protein conversion factor of 5, instead of the usual 6.25. The total lipids were determined by the Soxhlet method and the total carbohydrates calculated by difference considering the results obtained for lipids, ash and protein. All determinations were performed at least in triplicate and the results were expressed in dry weight and corrected for residual moisture (measured in an infrared balance, Kern DBS).

Results and Discussion

The collected MMW was mainly composed by *Saccorhiza polyschides* (brown seaweed). **Table 1** shows the results of the oven dried (MMW1) as well as the freeze-dried (MMW2) biomass.

Table 1: Characterization of Marine Macroalgae Waste (oven dried and freeze-dried, < 1mm)

Parameter	MMW1 ($\bar{x}$ ± s)	MMW2 ($\bar{x}$ ± s)
Moisture (wt.%)	1.34 ± 0.04	8.20 ± 0.5
Ash (wt.%)	50.8 ± 0.7	48.7 ± 0.1
Lipids (wt.%)	0.13 ± 0.02	0.40 ± 0.02
Nitrogen (wt.%)	1.9 ± 0.1	1.96 ± 0.04
Protein (wt.%)	9.6 ± 0.7	9.8 ± 0.2
Carbohydrates (wt.%)	39.3 ± 0.9	41.1 ± 0.2

Results are expressed on dry basis and correspond to the sample mean value ± standard deviation.

The samples ash content, in both cases, is similar to the reported values in the literature, which are in the range of 27 to 50 wt.% for *Saccorhiza polyschides* (Jensen et al. 1985, Rodrigues et al. 2015, Rupérez 2002, Sánchez-Machado et al. 2004).

The nitrogen content obtained in the present study is also in agreement with those reported by Michalak et al. (2017), for Baltic seaweeds (around 1.9 wt.%). The protein contents are also in the range of the values reported in the literature by Sánchez-Machado et al. (2004) for seaweeds of the Northwest Iberian Coast (around 13 wt.%) and Rodrigues et al. (2015) for macroalgae from Buarcos Bay (around 14 wt.%). Garcia et al. (2016) evaluated *Saccorhiza polyschides* samples collected in the Barbate Estuary (Spain) which presented a protein value close to 7 wt.%. Vieira et al. (2018) also studied samples from North-Central coast of Portugal and obtained a protein value of 12.4 wt.%. The differences between the values obtained and those in the literature should relate with the use of different nitrogen-to-protein conversion factors.

The samples have low lipid contents (less than 1 wt.%), as expected. Maceiras et al. (2016) showed a lipid content of 0.4 wt.% in *Saccorhiza polyschides* from Galician beaches. Also, Sánchez-Machado et al. (2004) and Rodrigues et al. (2015) obtained low lipid contents in their studies, namely 0.7 wt.% and 1.1 wt.%.

The values for total carbohydrates are in the ranges reported by Rodrigues et al. (2015), being around 46 wt.%, and Sudhakar et al. (2018) which reported values between 30 and 50 wt.% for brown seaweeds.

The presented results concerning to MMW1 and MMW2 are in the range of the reported values for such biomass, as stated. Variations between the results of both materials are in general less than 5 %, except for the lipids content, where the difference is more expressive due to the low content of this component. Taking into account the heterogeneous nature of these materials, such differences are not considered relevant, since results still fall in the expected range. Accordingly, lyophilisation as a sample preparation treatment does not seem to be justifiable aiming further recovery.

Conclusion

The physicochemical characteristics of the MMW analysed in the present study are in agreement with the values reported in the literature for *Saccorhiza polyschides*, the predominant seaweed in the analysed biomass.

No relevant differences were found when comparing the biomass initially dried or freeze-dried taking into account the heterogeneous nature of such type of material. In agreement, considering the main parameters evaluated, samples lyophilisation is not justified for further recovery of this material.

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