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Halophyte Plants Cultured in Aquaponics Hold the Same Potential for Valorization as Wild Conspecifics from Donor Sites

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Abstract: Halophytes have gradually been introduced in marine integrated multi-trophic aquaculture (IMTA) systems due to their capacity to bioremediate nutrient-rich marine effluents and their potential use for human consumption due to their content of omega-3 and omega-6 fatty acids (FA). To foster the valorization of halophytes produced using an IMTA framework for human consumption, it is important that culture conditions keep or enhance their FA profile, when compared to that displayed by conspecifics in the wild. The main objective of the present study was to compare the FA profiles of three halophyte species (*Halimione portulacoides*, *Salicornia ramosissima* and *Sarcocornia perennis*) cultured in aquaponics coupled to an IMTA system with that of wild conspecifics retrieved from donor sites. The FA profiles were compared considering different plant organs (edible parts and roots) and sampling dates (spring, summer and autumn). Results show that the FA profiles of specimens cultured in aquaponics were significantly different from that of wild conspecifics, displaying a high content of omega-3 FAs in edible parts, particularly during summer, and mostly in the form of α-linolenic acid (ALA, 18:3*n*-3). In more detail, for the specimens cultured in aquaponics, ALA concentration in the edible parts of each species ranged from 5.10 to 7.11 μg mg^{-1} DW in *H. portulacoides*, from 5.66 to 9.19 μg mg^{-1} DW in *S. ramosissima* and from 5.49 to 7.20 μg mg^{-1} DW in *S. perennis*. Concerning the omega-6 linoleic acid (LA, 18:2*n*-6) identified in edible parts, the concentrations ranged from 2.25 to 2.46 μg mg^{-1} DW in *H. portulacoides*, from 3.26 to 4.84 μg mg^{-1} DW in *S. ramosissima*, and from 2.17 to 3.06 μg mg^{-1} DW in *S. perennis*. The nutritional quality was assessed through the ratio of PUFA/SFA, for both wild and cultured plants, and revealed values well above the threshold (0.45), the threshold value indicative of good nutritional quality. Overall, the culture conditions tested in the present work reinforce the potential of aquaponics coupled to marine IMTA to produce high-quality halophytes suitable for human consumption.

Keywords: α-linolenic acid; fatty acids profile; cultured halophytes; aquaponics

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1. Introduction

Building upon the Goals for the Millennium, the United Nations (UN) elaborated further and proposed Sustainable Development Goals (SDG) and targets for the year 2030, with 17 areas of critical importance for humanity and the planet having been identified [1]. From these, SDG 14—"life below water" aiming to "conserve and sustainably use the oceans, seas and marine resources for sustainable development"; and SDG 2—"zero hunger" aiming to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture" [2] are aligned with the UN/FAO's blue growth initiative, targeting responsible and sustainable fisheries and aquaculture [3]. These SDG are also in line with EU blue growth strategy targeting sectors that have a high potential for sustainable