

Article

The Sea Urchin *Arbacia lixula*: A Novel Natural Source of Astaxanthin

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Abstract: Several echinoderms, including sea urchins, are valuable sources of bioactive compounds but their nutraceutical potential is largely unexplored. In fact, the gonads of some sea urchin species contain antioxidants including carotenoids and polyhydroxylated naphthoquinones (PHNQ's), such as echinochrome A. Astaxanthin is known to have particular bioactivity for the prevention of neurodegenerative diseases. This carotenoid is produced by microalgae, while several marine invertebrates can bioaccumulate or synthesize it from metabolic precursors. We determined the carotenoid content and analyzed the bioactivity potential of non-harvested Atlantic-Mediterranean sea urchin *Arbacia lixula*. The comparison of methanol crude extracts obtained from eggs of farmed and wild specimens revealed a higher bioactivity in farmed individuals fed with a customized fodder. HPLC-analysis revealed a high concentration of astaxanthin (27.0 µg/mg), which was the only pigment observed. This study highlights the potential of farmed *A. lixula* as a new source of the active stereoisomer of astaxanthin.

Keywords: echinoderms; carotenoids; bioactive compounds; DPPH assay; harvesting; dietary supplement

1. Introduction

Carotenoids are naturally occurring pigments widely distributed among photosynthetic organisms, bacteria, and fungi. Some of the main biological activities and biochemical processes of carotenoids in organisms are pro-vitamin A activity, photoprotection, radical quenching, and immunological modulation [1–3]. Animals can obtain carotenoids directly from the diet or through biochemical conversion from dietary precursors. In particular, high carotenoid concentrations occasionally found in the reproductive organs of animals suggest that they could have a role in the reproductive process [3,4]. Carotenes (i.e., β-Carotene) and xanthophylls (i.e., β-echinenone, astaxanthin, lutein, zeaxanthin, and fucoxanthin) are known for their antioxidant activity and for their potential in the prevention and treatment of various diseases. There is increasing evidence that sea urchins, together with other echinoderms, may represent potential sources of valuable bioactive compounds [5–11]. However, their biotechnological potential remains largely unexplored, and research in this area is still a niche topic [12], particularly in Mediterranean species. Studies conducted on the gonads of some species of sea urchin revealed powerful antioxidant activity due to the presence