Let astaxanthin be thy medicine

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ABSTRACT
Astaxanthin is known as a "marine carotenoid" and occurs in a wide variety of living organisms such as salmon, shrimp, crab, and red snapper. Astaxanthin antioxidant activity has been reported to be more than 100 times greater than that of vitamin E against lipid peroxidation and approximately 550 times more potent than that of vitamin E for singlet oxygen quenching. Astaxanthin exhibits no pro-oxidant activity and its main site of action is on/in the cell membrane. To date, various important benefits suggested for human health include immunomodulation, anti-stress, anti-inflammation, LDL cholesterol oxidation suppression, enhanced skin health, improved semen quality, attenuation of eye fatigue, increased sports performance and endurance, limiting exercised-induced muscle damage, and the suppression of the development of lifestyle related diseases such as obesity, atherosclerosis, diabetes, hyperlipidemia and hypertension. Recently, there has been an explosive increase worldwide in both the research and demand for natural astaxanthin in human health applications. Japanese clinicians are especially using astaxanthin extracted from the microalgae, Haematococcus pluvialis, as add-on supplementation for patients who are unsatisfied with conventional medications or cannot take other medications due to serious symptoms. For example, in heart failure or overactive bladder patients, astaxanthin treatment enhances patient’s daily activity levels and QOL. Other ongoing clinical trials and case studies are examining chronic diseases such as non-alcoholic steatohepatitis, diabetes, diabetic nephropathy and CVD, as well as infertility, atopic dermatitis, androgenic alopecia, ulcerative colitis and sarcopenia. In the near future, astaxanthin’s role may be stated as, "Let astaxanthin be thy medicine".

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1. Introduction

Astaxanthin is widely and naturally distributed in marine organisms including crustaceans such as shrimp and crabs, and fish such as salmon and sea bream. In fact, astaxanthin is one of the oldest carotenoids originally isolated and identified from lobster,
Astaxanthin is a totally unique antioxidant that possesses three simultaneous novel distinctions that include being a powerful antioxidant, safe antioxidant, and having a superior position within the cell membrane.

1.2. Powerful antioxidant activity

The inhibitory activity of astaxanthin on the peroxyl radical mediated lipid peroxidation was more than 100 times greater than that of α-tocopherol in the homogenate of rat mitochondria [2]. Among 27 common hydrophilic and lipophilic antioxidants such as polyphenols, tocopherols, carotenoids, ascorbic acid, coenzyme Q10 and α-lipoic acid, astaxanthin has been shown to have the strongest singlet oxygen (1O2) quenching activity when using the same test conditions. Table 1 shows the chemiluminescence detection system that was used for the direct 1O2 counting that utilized the thermodissociable endoperoxides of 1,4-dimethyl-naphthalene as the 1O2 generator in DMF: CDCl3 (9:1) [3]. The hydroxyl radical scavenging ability of astaxanthin encapsulated in liposomes has also been shown to be more potent than that of α-tocopherol [4].

1.3. Safe antioxidant activity

Martin et al. investigated 17 carotenoids and then divided them into three classes; (i) without significant antioxidative properties, (ii) anti- and pro-oxidants, and (iii) pure anti-oxidants. Astaxanthin was classified as a “pure anti-oxidant” as it did not possess any pro-oxidative properties similar to β-carotene and lycopene [5]. Non-polar carotenoids such as lycopene and β-carotene caused disorder of the membrane bilayer enriched with polyunsaturated fatty acids and showed a potent pro-oxidant effect (>85%...
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