Pure & Appl. Chem., Vol. 63, No. 1, pp. 141–146, 1991.
Printed in Great Britain.

206922209100015

Biological functions and activities of animal carotenoids

Wataru Miki

Suntory Institute for Bioorganic Research, Wakayamadai, Shimamoto cho, Mishima gun, Osaka, 618 JAPAN. Present address: Shimizu Laboratory, Marine Biotechnology Institute Co., Ltd., 1900 Sodeshi cho, Shimizu City, Shizuoka 424, JAPAN.

Abstract — Astaxanthin, one of the dominant carotenoids in marine animals, showed both a strong quenching effect against singlet oxygen, and a strong scavenging effect against free radicals. These effects are considered to be defence mechanisms in the animals for attacking these active oxygen species. The activities of astaxanthin are approximately 10 times stronger than those of other carotenoids that were tested, namely zeaxanthin, lutein, tunaxanthin, canthaxanthin and β carotene, and 100 times greater than those of α tocopherol. Astaxanthin also showed strong activity as an inhibitor of lipid peroxidation mediated by these active forms of oxygen. From these results, astaxanthin has the properties of a "SUPER VITAMIN E".

INTRODUCTION

Studies on biological functions and activities of carotenoids have been mainly performed in the fields of photosynthetic plants, algae and bacteria (ref. 1), and two major functions have been revealed: 1) a light-harvesting role in the antenna complexes of the chloroplast in photosynthesis. 2) as protecting agents against the harmful photooxidative effects of bright light.

On the other hand, the well established biological function of carotenoids in animals is as vitamin A precursors (refs. 2-4). β-Carotene or other carotenoids which possess a β retinylidene or 3 dehydroretinylidene end group can easily be bioconverted into retinoids through cleavage of the C 15, 15' double bond by β carotene 15, 15' oxygenase. Carotenoids without such an end group show little or no pro vitamin A activity, and any significance of these carotenoids remains unknown.

For the past ten years, our group has studied ovarian carotenoids in marine fish and shellfish, and astaxanthin was found to be the most widely distributed and major carotenoid (ref. 5). This carotenoid, however, possesses neither β retinylidene nor 3 hydroxyretinylidene end group and shows little pro vitamin A activity (ref. 4). Moreover, it is not considered to be an effective protecting colorant because the color of astaxanthin, pink to red, is far different from that of the surroundings. In the case of the ovaries, astaxanthin usually exists both in the free form and bound to protein as astaxanthin protein complexes, but not in esterified form (ref. 5). These studies showed the possibility of another function of carotenoids, especially astaxanthin in the free form.