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Exogenously incorporated ketocarotenoids in large unilamellar vesicles. Protective activity against peroxidation

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Abstract

The ability of astaxanthin and canthaxanthin as chain-breaking antioxidants was studied in Cu^{2+}-initiated peroxidation of phosphatidylcholine large unilamellar vesicles (LUVs). Both carotenoids increased the lag period that precedes the maximum rate of lipid peroxidation, though astaxanthin showed stronger activity. For these experiments, different amounts of xanthophylls were exogenously added to previously made LUVs, non-incorporated pigment being afterwards removed. Differential scanning calorimetry assays with L-β,γ-dimyristoyl-α-phosphatidylcholine LUVs demonstrated that xanthophylls incorporated as described interact with the lipid matrix becoming interspersed among the phospholipid molecules.

Keywords: Carotenoid; Liposome; Antioxidant; Lipid peroxidation; Lipid-carotenoid interaction

1. Introduction

Carotenoids are probably the most widespread natural pigments. They are also essential in several important biological processes. They can be found in microorganisms regulating, among other functions, membrane fluidity, in plants, in either photosynthetic or non-photosynthetic tissues, and providing the coloration of many plant and animal species, e.g. insects, fish or birds. Apart from these and other well-described functions of carotenoids, other roles or actions have been assigned to these natural pigments in recent years. Many of these newly discovered actions of carotenoids are related to their preventive properties against several diseases affecting humans, e.g. cataracts, cancer and atherosclerosis [1,2], that seem to be associated with their putative antioxidant properties. Experiments evaluating the antioxidant properties of different carotenoids, both in vivo and in vitro, have been reviewed and discussed by several authors [3–6]. However, the experimental evidence provided up to now is less than definitive. Much either depends on the system and on the assay conditions, or is even contradictory.

Since Burton and Ingold studied the antioxidant effect of β-carotene [7], it has been shown that, under certain conditions, carotenoids act as chain-breaking antioxidants in organic solutions [8–12,41]. It has also been found that the antioxidant properties of carotenoids are tightly dependent on the O_2 pressure in the system, the chemical structure of the pigment itself and the presence of other antioxidant molecules [1]. Model lipid peroxidation systems into which carotenoids can be exogenously incorporated have been

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