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FULL ARTICLE

Dermal carotenoid measurements via pressure mediated reflection spectroscopy

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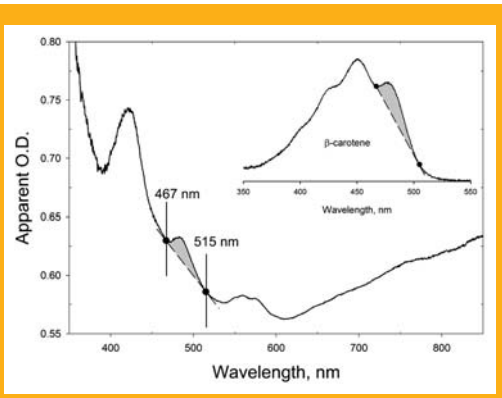
We describe a reflection-based method for the quantitative detection of carotenoid antioxidants in living human skin. The skin tissue site of interest is illuminated with broad-band white light spanning the spectral range from 350–850 nm and the spectral composition of the diffusively reflected light is analyzed in real time. Topical pressure is applied to temporarily squeeze blood out of the illuminated tissue volume. In this way the influence of oxy-hemoglobin on the reflection spectra is effectively reduced. After a short optical clearing time the carotenoid absorption becomes easily discernable in a 460–500 nm spectral window and its optical density can be calculated with high accuracy. Our empirical methodology provides a non-invasive rapid determination of skin carotenoid levels, can be used to monitor skin carotenoid concentration changes over time in response to carotenoid containing natural or supplemental diets, and is easily adaptable for applications in clinical and field settings.



Determination of human skin carotenoid levels from reflection-based absorption spectra. After temporally squeezing blood out of the measured tissue volume, a carotenoid-related absorption band (shaded area), which is superimposed on a residual scattering background, is discernible in the 467 to 515 nm region. It is due to the one-phonon vibronic absorption transition of carotenoids, shown for comparison also in the insert for a pure β-carotene solution. The optical density of the skin carotenoid one-phonon absorption is used as a quantitative measure for the skin carotenoid levels.

1. Introduction

Carotenoids have widespread distributions in fruits and vegetables. Taken up through the diet, their presence in living human skin can serve as an objective biomarker of fruit and vegetable intake. Fruit and vegetable consumption is generally regarded as an important factor for increased energy and overall good health. For example, high dietary consumption of fruits and vegetables has been associated with protection against various cancers [1, 2], cardiovascular disease [3], and macular degeneration [4].

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