

Supplemental Methods

Purification of 3'-hydroxy- ϵ,ϵ -caroten-3-one, 3-hydroxy- β,ϵ -caroten-3'-one, and ϵ,ϵ -carotene-3,3'-dione

The extract from the reaction mixture with lutein was dissolved in dichloromethane and passed through a silica column equilibrated with dichloromethane. The eluate was developed into 3'-hydroxy- ϵ,ϵ -caroten-3-one and ϵ,ϵ -carotene-3,3'-dione on a silica-TLC plate using dichloromethane:ethyl acetate (80:20, v/v) as the solvent system. The oxidation products recovered from the TLC band were finally purified by reverse-phase HPLC on a Wakopak Navi C30-5 column (100 x 250 mm; Wako Pure Industries, Osaka, Japan), with methanol containing 0.05% ammonium acetate as a mobile phase. 3-Hydroxy- β,ϵ -caroten-3'-one and ϵ,ϵ -carotene-3,3'-dione were also obtained from the reaction mixture with zeaxanthin in the same manner as described above.

Purification of 3'-hydroxy- β,ϵ -caroten-3-one

The extract from the reaction mixture with lutein was dissolved in dichloromethane and developed on a silica-TLC plate using dichloromethane:ethyl acetate (80:20, v/v) as the solvent system. The oxidation product recovered from the TLC band was purified by normal-phase HPLC on a cyanopropyl column of Inertsil CN-3 (10 × 250 mm; GL Sciences, Tokyo, Japan) attached to an Inertsil CN-3 guard column (7.6 × 30 mm) with the following mobile phase at a flow rate of 5 mL/min: *n*-hexane:dichloromethane:methanol (85:15:0.15, by vol.). The eluate was finally purified by reverse-phase HPLC on a Wakopak Navi C30-5 column (100 x 250 mm) with methanol:ethyl acetate (94:6, v/v) as a mobile phase.

Purification of β,β -caroten-3-one and β,ϵ -caroten-3'-one

The extract from the reaction mixture with β -cryptoxanthin was developed on a silica-TLC plate using dichloromethane:ethyl acetate (95:5, v/v) for β,β -caroten-3-one and dichloromethane:ethyl acetate (90:10, v/v) for β,ϵ -caroten-3'-one as the solvent system. The oxidation products recovered from the TLC band were purified by reverse-phase HPLC on a Wakopak Navi C30-5 column (100 x 250 mm) with methanol:ethyl acetate (70:30, v/v) containing 0.05% ammonium acetate as a mobile phase.