Triplet-triplet extinction coefficients, rate constants of triplet decay and rate constants of anthracene triplet sensitization by laser flash photolysis of astaxanthin, beta-carotene, canthaxanthin and zeaxanthin in deaerated toluene at 298 K

Triplet-triplet extinction coefficients were evaluated by laser flash photolysis for the all-trans C-40 carotenoids astaxanthin (I), beta-carotene (II), canthaxanthin (III) and zeaxanthin (IV) in deaerated toluene at 298 K in the spectral region from 450 to 600 nm by the energy transfer method combined with a nonlinear regression procedure, employing anthracene as sensitizer. The triplet-triplet extinction coefficients in toluene were more similar to the ground state coefficients than has previously been reported for C-40 carotenoids in hexane or cyclohexane. The maximum triplet-triplet extinction coefficient was 1.0-1.2 X 10(5) dm(3) mol(-1) cm(-1), depending on the carotenoid. Rate constants of triplet decay were I: 1.71 X 10(5) s(-1), II: 1.40 X 10(5) s(-1), III: 1.54 X 10(5) s(-1), IV:1.10 X 10(5) s(-1). For anthracene it was 1.31 X 10(5) s(-1).

Bimolecular rate constants of energy transfer from triplet excited anthracene to the carotenoids were determined from (1) non-linear regression of time traces of carotenoid triplet, and (2) linear regression of the decay rate constant of anthracene triplet at varying carotenoid concentrations; the agreement between these measurements was good, except for canthaxanthin. The results indicated that triplet energy transfer was nearly diffusion-controlled, but faster to I and III than to II and IV. These findings imply that I and III offer better protection against photosensitized oxidation than do II and IV. (C) 1998 Elsevier Science S.A.