



Carotenoid News

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FROM THE EDITOR

"Non omnis moriar" (Horace)

Abandoning false humility, the great Roman poet wrote, "I shall not wholly die". His poetry is still read and admired two millennia after his death. Such immortality awaits also great scientists, like Dr. James Allen Olson, who suddenly died on September 22, 2000, in the full bloom of his scientific career. His contribution to our understanding of vitamin A and carotenoid metabolism will never be forgotten. He was greatly missed at the fourth Gordon Research Conference on Carotenoids, which he helped to organize and was scheduled to lead a session. In the past meetings, Dr. Olson was always leading our discussions, with most pertinent questions, insightful remarks and perfect recall of names, facts and publications. A special symposium in memory of Dr. Olson will take place on June 21-24, 2001, in Ames, Iowa. Dr. Olson was among the founding members of the Carotenoid Research Interaction Group (CARIG), which publishes this newsletter.

CARIG will not have a regular Pre-EB conference this year due to the wealth of other carotenoid meetings (Gordon Conference, symposia in New York (April 10) and in Ames, the 13th International Symposium in Hawaii on January 6-12, 2002). Instead, CARIG will sponsor a special lecture at Experimental Biology in Orlando, on April 2 at 1 pm. Dr. Norman Krinsky will speak about "Carotenoid Research in the Past and Present Millennia". The symposium "Can Lutein Protect against Chronic Disease?", chaired by Drs Mares-Perlman and Erdman, will follow the lecture in the same room, 308 A/B, Orlando Convention Center. More information about these promising gatherings can be found in this issue of Carotenoid News, in order to encourage your participation.

Maria S. Sapuntzakis (Chicago, IL)

In Memoriam: James Allen Olson

James Allen Olson, Distinguished Professor of Liberal Arts and Sciences at Iowa State University, passed away on September 22, 2000, several weeks before his 76th birthday. He graduated from Gustavus Adolphus College in Minnesota and obtained his Ph.D. degree from Harvard University, working with Christian Anfinsen. Subsequently he held postdoctoral positions with Sir Ernst Chain (in Rome) and with Konrad Bloch (at Harvard). In 1956 he joined the Department of Biochemistry at the University of Florida.

His dissertation research and postdoctoral research was in enzymology; as a young faculty member at the University of Florida he turned his attention to the biochemistry of the enzyme which converts β -carotene to vitamin A. During a sabbatic leave in Kyoto he succeeded in characterizing the carotene cleavage enzyme, and demonstrated for the first time that the reaction could be studied using a soluble enzyme preparation (Olson, J.A. and Hayaishi, O. The enzymatic cleavage of β -carotene into vitamin A by soluble enzymes of rat liver and intestine. *Proc. Natl. Acad. Sci. U.S.A.* 54:1364-1370, 1965). Similar work was being done by DeWitt Goodman at Columbia University, and together they published a detailed description of the assay procedure (Goodman, D.S. and Olson, J.A. The conversion of all-trans β -carotene into retinal. *Methods Enzymol.* 15:462-475, 1969). At about the same time he and his students first isolated retinoyl β -glucuronide as a metabolite of vitamin A, a compound which continued to claim his interest for the remainder of his career (Zachman, R.D., Dunagin, P.E., Jr., and Olson, J.A. Formation and enterohepatic circulation of metabolites of retinol and retinoic acid in bile duct-cannulated rats. *J. Lipid Res.* 7:3-9, 1966).

His growing interest in the nutritional biochemistry of vitamin A and carotenoids led him to appreciate the important role of vitamin A in human health and inspired him, as he established the Department of Biochemistry at Mahidol University in Thailand, and when he subsequently continued as a staff member of the Rockefeller Foundation at the Federal University of Bahia in Brazil. He moved to Iowa State University (as chairman of the Department of Biochemistry and Biophysics) in 1975 and continued his research in retinoids and carotenoids, directing research in liver storage and mobilization of vitamin A (cellular sites of storage, esterification and hydrolysis of retinyl esters), deposition of β -carotene in bovine pineal gland, effects of zinc deficiency on vitamin A storage in the eye, teratogenicity of various retinoids, metabolism of retinoid β -glucuronides, retinoylation of proteins, effects of retinoids on cellular

differentiation, human absorption and plasma kinetics of carotenoids, and development of improved methods of assessing human vitamin A status (the Modified Relative Dose Response and isotope dilution). In total, during his career he published well over 400 papers.

James Olson served as president of the American Society of Nutritional Sciences, as well as on a variety of national and international committees, organized and chaired various scientific meetings (including FASEB research conferences and a Gordon Conference), presented lectures around the world, and served on editorial boards of a number of journals and as consultant to numerous governmental and nongovernmental agencies. He was particularly aware of the importance of interaction (including social interactions) among scientists, helping to found CARIG (Carotenoids Research Interaction Group) Conferences and newsletter, and annually sponsoring the VARIG (Vitamin A Research Interaction Group) social at Experimental Biology. To all of these activities he brought scientific rigor and unusually perceptive scientific insight. Although he loved the arts (including classical music), his greatest passion was reserved for his wife Giovanna and their three children.

Those of us who knew Jim Olson may truly say, "if we can see further now, it is because we stand on the shoulders of giants."

Arun B. Barua (Ames, IA)

Harold C. Furr (Storrs, CT)

UPCOMING EVENTS

March 31-April 4, 2001

Experimental Biology 2001. Orlando, Florida. Contact: EB' 2001, Office of Scientific Meetings and Conferences, 9650 Rockville Pike, Bethesda, MD 20814-3998 **tel:** 301-530-7010, **fax:** 301-530-7014, **E-mail:** eb@faseb.org, **website:** www.faseb.org/eb2001 [see program highlights below]

April 2-5, 2001

Second International Conference on Oxidative Stress and Aging. Maui, Hawaii. Technologies for Assessment and Intervention Strategies. Contact: Mr. Kent Lindeman, CMP, Holland-Parlette Associates, Inc., 2950 Buskirk Ave., Ste. 170, Walnut Creek, CA 94596, **tel:** 925-472-5900, **fax:** 925-472-5901, **E-mail:** klindeman@hp-assoc.com, **website:** www.o2sa.org

April 10, 2001

International Symposium on the Role of Tomato Products and Carotenoids in Disease Prevention. New York, New York. Contact: Roz Alexander, American Health Foundation, One Dane Rd., Valhalla, New York 10595, **tel:** 914-7897150, **fax:** 914-592-6317, **E-mail:** leonardcohen@nync.edu [see program below]

April 17 - May 4, 2001

International Graduate Course on Production and Use of Food Composition Data in Nutrition. Kingston, Jamaica, West Indies. The 7th in the series of this international postgraduate course oriented to those who generate, compile and use food composition data in all aspects of nutrition and health. A similar course is offered in the Netherlands in the fall. Contact: Dr. Pauline Samuda, Caribbean Food and Nutrition Institute, P.O. Box 140, Kingston 7, Jamaica, West Indies; **tel:** 876-927-1540, **fax:** 876-927-2657, **E-mail:** e-mail@cfni.paho.org **Website:** www.cfni.paho.org

April 30 - May 3, 2001

ARVO Annual Meeting, Fort Lauderdale, FL. Contact: Association for Research in Vision and Ophthalmology, 123 Twinbrook Parkway, Suite 250, Rockville, MD 20852-1606, **tel:** 240-2212900, **fax:** 240-2210370, **E-mail:** mem@arvo.org **Website:** www.arvo.org [see program below]

May 19 - 22, 2001

European Society for Photobiology Symposium: Photoprotection. Krakow, Poland. Contact: Dr. T. Sarna, **E-mail:** TSARNA@mol.uj.edu.pl or Dr. T.G. Truscott, **E-mail:** cha31@keele.ac.uk

May 30 - June 1, 2001

Bioavailability 2001. Interlaken, Switzerland. Contact: Laboratory for Human Nutrition, Institute of Food Science, Swiss Federal Institute of Technology (ETH), PO Box 474, CH-8803 Ruschlikon, Switzerland, (attn. Mrs. K. Santagata), **Fax:** 411-704-5710, **website:** www.ilw.agrl.ethz.ch/hu/bio2001/main.html
E-mail: bioavailability.2001@ilw.agrl.ethz.ch

June 21 - 24, 2001

Symposium on Functions and Actions of Retinoids and Carotenoids: Building on the Vision of James Allen Olson, Ames, IA. Contact: James Allen Olson Symposium, 3208 Molecular Biology Bldg., Tower State University, Ames, IA 50011-3260, **tel:** 515-2947978, **fax:** 515-2942244, **Website:** molebio.iastate.edu/~gfst/olson.html, **E-mail:** gfst@iastate.edu, [see announcement below]

September 26 - 28, 2001

EUROFOODCHEM XI, Norwich Research Park, Norwich, UK. Biologically Active Phytochemicals in Food: Analysis, Metabolism, Bioavailability and Function. Contact: John Gibson, EUROFOODCHEM XI, Royal Society of Chemistry, Burlington House, Piccadilly, London W1V 0BN, UK, **tel:** 44(0)207-437-8656, **fax:** 44(0)207-7341227, **E-mail:** conferences@rsc.org, **website:** www.rsc.org/lap/confs/eurofoodchemxi.htm

October 1 - 19, 2001

International Graduate Course on Production and Use of Food Composition Data in Nutrition. Wageningen, The Netherlands. The 8th in the series of this international postgraduate course oriented to those who generate, compile and use food composition data in all aspects of nutrition and health. Contact: Dr. Jacqueline Catenmiller, Wageningen Agricultural University, P.O. Box 8129, 6700 EV Wageningen, The Netherlands; **tel:** +31-317-482589, **fax:** +31-317-483342, **E-mail:** Jacqueline.Castenmiller@staff.nutepi.wau.nl

January 6 - 11, 2002

The 13th International Symposium on Carotenoids. Oahu, Hawaii. Contact: John Bertram (Program Chair), University of Hawaii, 1236 Lauhala St., Cancer Center, Honolulu, HI 96813, **tel:** 808-586-2957, **fax:** 808-586-2970, **E-mail:** john@crch.hawaii.edu

HIGHLIGHTS OF EXPERIMENTAL BIOLOGY 2001

Plant Phenolics and Human Health Research Interest Group

(PhenHRIG) Annual Scientific Meeting

Saturday, March 31, 2001 9:00 a.m. - 5:00 p.m.
Rosen Plaza Hotel, Ballroom A, Orlando, Florida

Chairpersons : Myron D. Gross (Minneapolis, MN)

Phyllis E. Bowen (Chicago, IL)

9:00 Welcome to PhenHRIG (M. Gross)

9:10 Introduction to Phenolics and Health (G. Beecher)

9:30 Bioavailability of Anthocyanins (P. Milbury)

10:00 Challenges in Evaluation of Polyphenolic Extract

Bioactivity (M. Smith)

10:30 Epicatechin and its In Vivo Metabolite, 3'-O-methyl Epicatechin, Protect Human Fibroblasts from Oxidative Stress-induced Apoptotic Cell Death (J. Sencer)

12:00 Lunch (on your own)

1:30 Ginkgo Biloba Extract and Cell Signalling: Studies in

Cultured Cells and In Vivo (G. Rimbach)

2:00 Ginkgo Biloba Extract: Clinical Indications, Mechanisms and Preliminary Findings (B. Diamond)

3:15 Evidence Supporting the Effect of Cranberry on Maintaining Urinary Tract Health (M. Leahy, A. Howell)

4:30 Phytonutrient and Health Initiatives at NCI (J. Milner)

CARIG / VARIG Social

The traditional VARIG / CARIG Social will be held from 6 - 8 pm on Saturday evening, March 31. It is anticipated that it will be held in the Suite of the ASNS President in the Rosen Plaza Hotel (but be alert for possible change of venue). Cash bar.

Lecture Sponsored by Carotenoid Research Interaction Group (CARIG): Carotenoid Research in the Past and Present Millennia by Dr. Norman I. Krinsky, (Tufts University, Boston, MA). April 2, 1 pm, Convention Center Room 308 A/B.

Lutein Symposium

Can Lutein Protect Against Chronic Disease?: A Multi Disciplinary Approach Involving Basic Science and Epidemiology to Weigh Evidence and Design Analytic Strategies. Chaired: J.A. Mares-Perlman and J.W. Erdman.

April 2, 2001, 2:30-5:00 pm, Convention Center Room 308 A/B

The body of evidence to support a protective role for lutein and zeaxanthin in delaying chronic diseases. Overview. *J. Mares-Perlman* (University of Wisconsin)

Epidemiologic data of relationships of dietary lutein and zeaxanthin to age-related eye diseases. *S. Hankinson* (Harvard University)

Possible biologic mechanisms for protective role of lutein and zeaxanthin. *N.I. Krinsky* (Tufts University)

Factors that influence lutein and zeaxanthin absorption. *J.W. Erdman* (University of Illinois)

Diet and lifestyle correlates of lutein in the blood and diet. How this information can be used to interpret results and design analytic strategies. *C. Rock* (University of California – San Diego)

Discussants: *G. Beecher*, (USDA, Beltsville, MD), *J. Curran-Celentano* (University of New Hampshire).

NIST Micronutrients Measurement Quality Assurance Workshop . Convention Center, Room 208, April 4, 2001

9:00 Opening remarks

9:15 Review of results from interlaboratory comparison exercises for fat-soluble vitamins and carotenoids in serum (J.Brown Thomas)

9:45 Chemical metrology vs. measuring chemicals: the MMQAP interlaboratory comparisons as research instruments (D.Duewer)

10:30 Analysis of lyophilized vs. liquid-frozen sera (K. Sharpless)

11:00 Review of Vitamin C analyses (S. Margolis)

11:30 Lunch (on your own)

1:00 Stabilization and quantitation of biologically relevant folate monoglutamates in human plasma (B. Nelson)

1:30 Results from CDC 1999+ NHANES for serum folate (C. Pfeifer)

2:00 Discussion of folate measurement needs.

2:30 Vitamin A studies among deficient international populations (A. Sowell, H. Chen)

3:30 CLIA compliance (A. Herbert)

4:30 Wrap-up

International Symposium on the Role of Tomato Products and Carotenoids in Disease Prevention

April 10, 2001, The New York Academy of Medicine

Tomatoes, lycopene and clinical studies on prostate cancer. (S. Clinton)

Biological and clinical effects of lycopene supplementation in patients with localized prostate cancer. (O. Kuczek)

Tomato supplementation reduces DNA damage in men with prostate cancer. (P. Bowen)

Lycopene, arteriosclerosis and coronary heart disease. (T. Rissanen)

Lycopene: anti-oxidant mechanisms for control of coronary artery disease. (A.V. Rao)

Does lycopene play a protective role in the lung? (L. Arab)

Tomato and lycopene intake and cancer risk: epidemiological studies. (E. Giovannucci)
 Tomato consumption and digestive tract and female hormone-related neoplasms. (C. LaVecchia)
 Chemistry, distribution and metabolism of tomato carotenoids. (F. Khachik)
 Bioavailability of all trans and cis isomers of lycopene. (J. Erdman)
 Lycopene uptake from processed foods and anti-oxidant capacity in humans. (S. Schwartz)
 Tomato carotenoids and cancer: experimental model studies. (L. Cohen)
 Overview: mechanisms of lycopene action. (D. Heber)

ARVO Mini-Symposium: Antioxidants and Eye Disease: From the Laboratory Bench To Your Daily Diet

May 2, 2001, 10:45- 12:30, Room 305, Ft. Lauderdale Convention Center. Moderators: J. Landrum and C. Leske

Relations between nutrient intake and risk for age-related cataract. (A. Taylor)
 Basic research on antioxidant risk reduction of cataract: a role for retinal degeneration? (J. Trevithick)
 Carotenoids and the health of the human retina. (M. Snodderly)
 The role of lutein and zeaxanthin in age-related eye disease. Evidence from epidemiological studies. (J. Mares-Perlman)
 Antioxidant relationships with age-related eye disease in the Blue Mountains Eye Study. (P. Mitchell)
 b-Carotene and age-related cataract in randomized trial of U.S. physicians. (W. Christian)
 Supplemental Vitamin E and risk of cataract and AMD: results from the VECAT study. (H. Taylor)

RECENT / FORTHCOMING PUBLICATIONS

Archives of Biochemistry and Biophysics. Carotenoids Highlight Issue. 395 (1). January 1, 2001: 1-69. Contains mini-reviews of various aspects of carotenoid research prepared before recent Gordon Research Conference on Carotenoids .

Sight and Life Manual on Vitamin A Deficiency Disorders (VADD) by D. S. McLaren and M. Frigg, 2nd edition, 2001. Publication of the Task Force SIGHT AND LIFE, PO Box 2116, 4002 Basel, Switzerland, **tel:** 41-61-691-2253/688-7494, **Fax:** 41-61-688-1910, **E-mail:** sight.life@roche.com,

Website: www.sightandlife.org

Dietary Reference Intakes. Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. (2001) National Academy Press, 2101 Constitution Ave, NW Lockbox 285, Washington DC 20055. **tel:** 800-624-6242, **website:** www.nap.edu

Alphabetical Listing of Recent Publications from August 2000

(prepared by Dr. Harold Furr, University of Connecticut)

More complete list available at ICS website: <http://www.carotenoid.uconn.edu>

- (2000) Hunting healthy molecules. *Anal. Chem.* **72**: 580A-581A
- Abe, K. & Saito, H. (2000) Effects of saffron extract and its constituent crocin on learning behaviour and long-term potentiation. *Phytother. Res.* **14**: 149-152
- al Senaidy, A. M. (2000) Serum concentration of retinol, b-carotene, cholesterol, and triglycerides in Saudi school children. *J. Trop. Pediatr.* **46**: 163-167
- Alba, R., Cordonnier-Pratt, M. M. & Pratt, L. H. (2000) Fruit-localized phytochromes regulate lycopene accumulation independently of ethylene production in tomato. *Plant Physiol.* **123**: 363-370
- Albanes, D., Malila, N., Taylor, P. R., Huttunen, J. K., Virtamo, J., Edwards, B. K., Rautalahti, M., Hartman, A. M., Barrett, M. J., Pietinen, P., Hartman, T. J., Sipponen, P., Lewin, K., Teerenhovi, L., Hietanen, P., Tangrea, J. A., Virtanen, M. & Heinonen, O. P. (2000) Effects of supplemental a-tocopherol and b-carotene on colorectal cancer: results from a controlled trial (Finland). *Cancer Causes. Control.* **11**: 197-205
- Albrecht, M., Takaichi, S., Steiger, S., Wang, Z. Y. & Sandmann, G. (2000) Novel hydroxycarotenoids with improved antioxidative properties produced by gene combination in *Escherichia coli*. *Nat. Biotechnol.* **18**: 843-846
- Amaya-Farfán, J. (1999) [Panorama of the investigation on carotenoids in Brasil: perspectives and needs]. *Arch. Latinoam. Nutr.* **49**: 92S-97S
- Arab, L. & Steck, S. (2000) Lycopene and cardiovascular disease. *Am. J. Clin. Nutr.* **71**: 1691S-5S; discuss
- Arcangeli, C. & Cannistraro, S. (2000) *In situ* Raman microspectroscopic identification and localization of carotenoids: approach to monitoring of UV-B irradiation stress on Antarctic fungus. *Biopolymers* **57**: 179-186
- Arellano, J. B., Psencik, J., Borrego, C. M., Ma, Y. Z., Guyoneaud, R., Garcia-Gil, J. & Gillbro, T. (2000) Effect of carotenoid biosynthesis inhibition on the chlorosome organization in *Chlorobium phaeobacteroides* strain CL1401. *Photochem. Photobiol.* **71**: 715-723
- Arikan, S. & Rodway, R. G. (2000) Effects of HDL containing high or low b-carotene concentrations on progesterone production and b-carotene uptake and depletion by bovine luteal cells. *Anim. Reprod. Sci.* **62**: 253-263
- Arnhold, T., Nau, H. & Ruehl, R. (2000) Vitamin A. In: *Modern Analytical Methodologies in Fat- and Water-Soluble Vitamins* (Song, W. O., Beecher, G. R. & Eitenmiller, R. R., eds) pp. 3-49. John Wiley & Sons, Inc., New York.
- Arriaga-Alba, M., Rivera-Sanchez, R., Parra-Cervantes, G., Barro-Moreno, F., Flores-Paz, R. & Garcia-Jimenez, E. (2000) Antimutagenesis of b-carotene to mutations induced by quinolone on *Salmonella typhimurium*. *Arch. Med. Res.* **31**: 156-161
- Ashizawa, K., Tomita, Y., Kanemaru, C. & Tsuzuki, Y. (2000) In vitro effects of b-carotene for the motility, ATP, and intracellular free Ca(2+) concentrations of fowl spermatozoa. *Mol. Reprod. Dev.* **56**: 99-104
- Azais-Braesco, V., Winkhofer-Roob, B., Ribalta, J., Hanley, B., Vasson, M. P., Brtko, J., Brigeluis-Flohe, R. & Bronner, A. (2000) Vitamin A, vitamin E and carotenoid status and metabolism during ageing: functional and nutritional consequences (project proposal). *Endocr. Regul.* **34**: 97-98
- Ball, G. F. M. (1998) *Bioavailability and Analysis of Vitamins in Foods*. Chapman & Hall, London, pp. 1-560.
- Bamji, M. S. & Krinsky, N. I. (1966) The carotenoid pigments of a radiation-resistant *Micrococcus* species. *Biochim. Biophys. Acta* **115**: 276-284
- Barua, A. B. & Olson, J. A. (2000) b-Carotene is converted primarily to retinoids in rats in vivo. *J. Nutr.* **130**: 1996-2001
- Basu, M., Banerjee, A., Bhattacharya, U. K., Bishayee, A. & Chatterjee, M. (2000) b-Carotene prolongs survival, decreases lipid peroxidation and enhances glutathione status in transplantable murine lymphoma. *Phytomedicine* **7**: 151-159
- Baumeister, B. & Matile, S. (2000) Rigid-rod b-barrels as lipocalin models: probing confined space by carotenoid encapsulation. *Chemistry* **6**: 1739-1749
- Bell, J. G., McEvoy, J., Tocher, D. R. & Sargent, J. R. (2000) Depletion of a-tocopherol and astaxanthin in Atlantic salmon (*Salmo salar*) affects autoxidative defense and fatty acid metabolism. *J. Nutr.* **130**: 1800-1808
- Beno, I., Klvanova, J., Magalova, T. & Brtkova, A. (2000) Blood levels of natural antioxidants in gastric and colorectal precancerous lesions and cancers in Slovakia. *Neoplasma* **47**: 37-40
- Berendschot, T. T., Goldbohm, R. A., Kloppe, W. A., van de Kraats, J., van Norel, J. & van Norren, D. (2000) Influence of lutein supplementation on macular pigment, assessed with two objective techniques. *Invest. Ophthalmol. Vis. Sci.* **41**: 3322-3326
- Bjerkeng, B. (2000) Carotenoid pigmentation of salmonid fishes - recent progress. In: *Avances en Nutricion Acuicola V. Memorias del V Simposium Internacional de Nutricion Acuicola 19-22 Noviembre, 2000* (Cruz-Suarez, L. E., Rique-Marie, D., Tapia-Salazar, M., Olvera-Novoa, M. A. & Civera-Cerecedo, R., eds) pp. 71-89. Merida, Yucatan, Mexico.
- Bjerkeng, B. & Berge, G. M. (2000) Apparent digestibility coefficients and accumulation of astaxanthin E/Z isomers in Atlantic salmon (*Salmo salar* L.) and Atlantic

- halibut (*Hippoglossus hippoglossus* L.). *Comp. Biochem. Physiol. [B]*. **127**: 423-432
- Boileau, T. W., Clinton, S. K. & Erdman, J. W., Jr. (2000) Tissue lycopene concentrations and isomer patterns are affected by androgen status and dietary lycopene concentration in male F344 rats. *J. Nutr.* **130**: 1613-1618
- Bon, R. A., Landrum, J. T., Dixon, Z., Chen, Y. & Llerena, C. M. (2000) Lutein and zeaxanthin in the eyes, serum and diet of human subjects. *Exp. Eye Res.* **71**: 239-245
- Breinhold, V., Lauridsen, S. T., Daneshvar, B. & Jakobsen, J. (2000) Dose-response effects of lycopene on selected drug-metabolizing and antioxidant enzymes in the rat. *Cancer Lett.* **154**: 201-210
- Brennan, P., Butler, J., Agudo, A., Benhamou, S., Darby, S., Fortes, C., Jockel, K. H., Kreuzer, M., Nyberg, F., Pohlmann, H., Saracci, R., Wichman, H. E. & Boffetta, P. (2000) Joint effect of diet and environmental tobacco smoke on risk of lung cancer among nonsmokers [letter]. *J. Natl. Cancer Inst.* **92**: 426-427
- Brenner, D. E. (2000) Cancer chemoprevention [editorial]. *Crit. Rev. Oncol. Hematol.* **33**: 155-156
- Brignall, M. & Lamson, D. (2000) Re: b-Carotene: a miss for epidemiology [letter; comment]. *J. Natl. Cancer Inst.* **92**: 1014; disc
- Broekmans, W. M., Klopping-Ketelaars, I. A., Schuurman, C. R., Verhagen, H., van den Berg, H., Kok, F. J. & van Poppel, G. (2000) Fruits and vegetables increase plasma carotenoids and vitamins and decrease homocysteine in humans. *J. Nutr.* **130**: 1578-1583
- Bub, A., Watzl, B., Abrahamse, L., Delincee, H., Adam, S., Wever, J., Muller, H. & Reckemmer, G. (2000) Moderate intervention with carotenoid-rich vegetable products reduces lipid peroxidation in men. *J. Nutr.* **130**: 2200-2206
- Burri, B. J. (2000) Carotenoids and gene expression. *Nutrition.* **16**: 577-578
- Canizares-Villanueva, R. O., Rios-Leal, E., Olvera Ramirez, R., Ponce Noyola, T. & Marquez Rocha, F. (1998) [Microbial sources of pigments]. *Rev. Latinoam. Microbiol.* **40**: 87-107
- Carolin, K. A. & Pass, H. A. (2000) Prevention of breast cancer. *Crit. Rev. Oncol. Hematol.* **33**: 221-238
- Carroll, Y. L., Corridan, B. M. & Morrissey, P. A. (2000) Lipoprotein carotenoid profiles and the susceptibility of LDL to oxidative modification in healthy elderly volunteers. *Eur. J. Clin. Nutr.* **54**: 500-507
- Chavez Perez, J. F. (1999) [Priorities of investigation in the field of carotenoids in Venezuela]. *Arch. Latinoam. Nutr.* **49**: 103S-107S
- Chew, B. P., Park, J. S., Weng, B. C., Wong, T. S., Hayek, M. G. & Reinhart, G. A. (2000) Dietary b-carotene absorption by blood plasma and leukocytes in domestic cats. *J. Nutr.* **130**: 2322-2325
- Chew, B. P., Park, J. S., Weng, B. C., Wong, T. S., Hayek, M. G. & Reinhart, G. A. (2000) Dietary b-carotene is taken up by blood plasma and leukocytes in dogs. *J. Nutr.* **130**: 1788-1791
- Chew, B. P., Park, J. S., Wong, T. S., Kim, H. W., Weng, B. B., Byrne, K. M., Hayek, M. G. & Reinhart, G. A. (2000) Dietary b-carotene stimulates cell-mediated and humoral immune response in dogs. *J. Nutr.* **130**: 1910-1913
- Chopra, M., Fitzsimons, P. E., Strain, J. J., Thurnham, D. I. & Howard, A. N. (2000) Nonalcoholic red wine extract and quercetin inhibit LDL oxidation without affecting plasma antioxidant vitamin and carotenoid concentrations. *Clin. Chem.* **46**: 1162-1170
- Christian, P., West, K. P., Jr., Khatry, S. K., Katz, J., LeClerq, S. C., Kimbrough-Pradhan, E., Dali, S. M. & Shrestha, S. R. (2000) Vitamin A or b-carotene supplementation reduces symptoms of illness in pregnant and lactating Nepali women. *J. Nutr.* **130**: 2675-2682
- Christian, P., West, K. P., Jr., Khatry, S. K., Kimbrough-Pradhan, E., LeClerq, S. C., Katz, J., Shrestha, S. R., Dali, S. M. & Sommer, A. (2000) Night blindness during pregnancy and subsequent mortality among women in Nepal: effects of vitamin A and b-carotene supplementation. *Am. J. Epidemiol.* **152**: 542-547
- Congdon, N. G., Dreyfuss, M. L., Christian, P., Navitsky, R. C., Sanchez, A. M., Wu, L. S., Khatry, S. K., Thapa, M. D., Humphrey, J., Hazelwood, D. & West, K. P. (2000) Responsiveness of dark-adaptation threshold to vitamin A and b-carotene supplementation in pregnant and lactating women in Nepal. *Am. J. Clin. Nutr.* **72**: 1004-1009
- Craig, M. R., Kristal, A. R., Cheney, C. L. & Shattuck, A. L. (2000) The prevalence and impact of 'atypical' days in 4-day food records. *J. Am. Diet. Assoc.* **100**: 421-427
- Dagnelie, G., Zorge, I. S. & McDonald, T. M. (2000) Lutein improves visual function in some patients with retinal degeneration: a pilot study via the Internet. *Optometry* **71**: 147-164
- Dark, E., Schoefs, B. & Lemoine, Y. (2000) Improved liquid chromatographic method for the analysis of photosynthetic pigments of higher plants. *J. Chromatogr. A*. **876**: 111-116
- Davies, J. (2000) Tomatoes and health. *J. R. Soc. Health* **120**: 81-82
- de Ancos, B., Gonzalez, E. & Cano, M. P. (2000) Effect of high-pressure treatment on the carotenoid composition and the radical scavenging activity of persimmon fruit purees. *J. Agric. Food Chem.* **48**: 3542-3548
- de Bustos, F., Jimenez-Jimenez, F. J., Molina, J. A., de Andres, C., Gasalla, T., Orti-Pareja, M., Ayuso-Peralta, L., Berbel, A., Castellano-Millan, F., Arenas, J. & Enriquez de Salamanca, R. (2000) Serum levels of a-carotene, b-carotene, and retinol in patients with multiple sclerosis [letter]. *Acta Neurol. Belg.* **100**: 41-43
- De Stefani, E., Oreggia, F., Boffetta, P., Deneco-Pellegrini, H., Ronco, A. & Mendilaharsu, M. (2000) Tomatoes, tomato-rich foods, lycopene and cancer of the upper aerodigestive tract: a case-control in Uruguay. *Oral Oncol.* **36**: 47-53
- Delgado-Vargas, F., Jimenez, A. R. & Paredes-Lopez, O. (2000) Natural pigments: carotenoids, anthocyanins, and betalains--characteristics, biosynthesis, processing, and stability. *Crit. Rev. Food Sci. Nutr.* **40**: 173-289
- Deli, J., Matus, Z. & Toth, G. (2000) Carotenoid composition in the fruits of *Asparagus officinalis*. *J. Agric. Food Chem.* **48**: 2793-2796
- Deming, D. M., Boileau, A. C., Lee, C. M. & Erdman, J. W., Jr. (2000) Amount of dietary fat and type of soluble fiber independently modulate postabsorptive conversion of b-carotene to vitamin A in Mongolian gerbils. *J. Nutr.* **130**: 2789-2796
- Duester, G. (2000) Families of retinoid dehydrogenases regulating vitamin A function: production of visual pigment and retinoic acid. *Eur. J. Biochem.* **267**: 4315-4324
- Duewer, D. L., Kline, M. C., Sharpless, K. E. & Thomas, J. B. (2000) NIST micronutrients measurement quality assurance program: characterizing the measurement community's performance over time. *Anal. Chem.* **72**: 4163-4170
- During, A., Fields, M., Lewis, C. G. & Smith, J. C. (2000) Intestinal b-carotene 15,15'-dioxygenase activity is markedly enhanced in copper-deficient rats fed on high-iron diets and fructose. *Br. J. Nutr.* **84**: 117-124
- Ekstrom, A. M., Serafini, M., Nyren, O., Hansson, L. E., Ye, W. & Wolk, A. (2000) Dietary antioxidant intake and the risk of cardia cancer and noncardia cancer of the intestinal and diffuse types: a population-based case-control study in Sweden. *Int. J. Cancer* **87**: 133-140
- El-Habit, O. H., Saada, H. N., Azab, K. S., Abdel-Rahman, M. & El-Malah, D. F. (2000) The modifying effect of b-carotene on gamma radiation-induced elevation of oxidative reactions and genotoxicity in male rats. *Mutat. Res.* **466**: 179-186
- Essama-Tjani, J. C., Guillard, J. C., Fuchs, F., Lombard, M. & Richard, D. (2000) Changes in thiamin, riboflavin, niacin, b-carotene, vitamins, C, A, D and E status of French Elderly Subjects during the first year of institutionalization. *Int. J. Vitam. Nutr. Res.* **70**: 54-64
- Facchini, F. S., Humphreys, M. H., DoNascimento, C. A., Abbasi, F. & Reaven, G. M. (2000) Relation between insulin resistance and plasma concentrations of lipid hydroperoxides, carotenoids, and tocopherols. *Am. J. Clin. Nutr.* **72**: 776-779
- Farmer, W. R. & Liao, J. C. (2000) Improving lycopene production in *Escherichia coli* by engineering metabolic control. *Nat. Biotechnol.* **18**: 533-537
- Favaro, R. M. & de Oliveira, J. E. (1999) Enrichment of the diet with synthetic and natural sources of provitamin A. *Arch. Latinoam. Nutr.* **49**: 34S-37S
- Ferreira, A. L., Yeum, K. J., Liu, C., Smith, D., Krinsky, N. I., Wang, X. D. & Russell, R. M. (2000) Tissue distribution of lycopene in ferrets and rats after lycopene supplementation. *J. Nutr.* **130**: 1256-1260
- Froescheis, O., Moalli, S., Liechti, H. & Bausch, J. (2000) Determination of lycopene in tissues and plasma of rats by normal-phase HPLC with photometric detection. *J. Chromatogr. B. Biomed. Sci. Appl.* **739**: 291-299
- Fukuzawa, K. (2000) Singlet oxygen scavenging in phospholipid membranes. *Methods Enzymol.* **319**: 101-110
- Furusato, T., Kataoka, E., Yasuhara, T., Wada, M. & Masushige, S. (2000) Retinol equivalence of carotenoids can be evaluated by hepatic vitamin A content. *Int. J. Vitam. Nutr. Res.* **70**: 43-47
- Gandini, S., Merzenich, H., Robertson, C. & Boyle, P. (2000) Meta-analysis of studies on breast cancer risk and diet: the role of fruit and vegetable consumption and the intake of associated micronutrients. *Eur. J. Cancer* **36**: 636-646
- Geerling, B. J., Badart-Smith, A., Stockbrugger, R. W. & Brummer, R. J. (2000) Comprehensive nutritional status in recently diagnosed patients with inflammatory bowel disease compared with population controls. *Eur. J. Clin. Nutr.* **54**: 514-521
- Gerber, M., Grolier, P., Saintot, M. & Borel, P. (2000) Re: b-Carotene: a miss for epidemiology [letter; comment]. *J. Natl. Cancer Inst.* **92**: 1014-1016
- Goodman, G. E. (2000) Prevention of lung cancer. *Crit. Rev. Oncol. Hematol.* **33**: 187-197
- Gurfinkel, M., Thompson, A. B., Ralston, W., Troy, T. L., Moore, A. L., Moore, T. A., Gust, J. D., Tatman, D., Reynolds, J. S., Muggenburg, B., Nikula, K., Pandey, R., Mayer, R. H., Hawrysz, D. J. & Sevcik-Muraca, E. M. (2000) Pharmacokinetics of ICG and HPPH-car for the detection of normal and tumor tissue using fluorescence, near-infrared reflectance imaging: a case study. *Photochem. Photobiol.* **72**: 94-102
- Haeghe, A. D., Gillette, C., O'Neill, C., Wolfe, P., Heimendinger, J., Sedlacek, S. & Thompson, H. J. (2000) Plasma xanthophyll carotenoids correlate inversely with indices of oxidative DNA damage and lipid peroxidation. *Cancer Epidemiol. Biomarkers. Prev.* **9**: 421-425

- Hannibal, L., Lorquin, J., D'Ortoli, N. A., Garcia, N., Chaintreuil, C., Masson-Boivin, C., Dreyfus, B. & Giraud, E. (2000) Isolation and characterization of canthaxanthin biosynthesis genes from the photosynthetic bacterium *Bradyrhizobium* sp. strain ORS278. *J. Bacteriol.* **182**: 3850-3853
- Hansen, E. & Skibsted, L. H. (2000) Light-induced oxidative changes in a model dairy spread. Wavelength dependence of quantum yields. *J. Agric. Food Chem.* **48**: 3090-3094
- Hata, T. R., Scholz, T. A., Ermakov, I. V., McClane, R. W., Khachik, F., Gellermann, W. & Pershing, L. K. (2000) Non-invasive Raman spectroscopic detection of carotenoids in human skin. *J. Invest. Dermatol.* **115**: 441-448
- Heber, D. (2000) Colorful cancer prevention: α -carotene, lycopene, and lung cancer. *Am. J. Clin. Nutr.* **72**: 901-902
- Hebert, J. R., Gupta, P. C., Mehta, H., Ebbeling, C. B., Bhonsle, R. R. & Varghese, F. (2000) Sources of variability in dietary intake in two distinct regions of rural India: implications for nutrition study design and interpretation. *Eur. J. Clin. Nutr.* **54**: 479-486
- Hornero-Mendez, D., Gomez-Ladron de Guevara, R. & Minguez-Mosquera, M. I. (2000) Carotenoid biosynthesis changes in five red pepper (*Capsicum annuum* L.) cultivars during ripening: cultivar selection for breeding. *J. Agric. Food Chem.* **48**: 3857-3864
- Hu, G. & Cassano, P. A. (2000) Antioxidant nutrients and pulmonary function: the Third National Health and Nutrition Examination Survey (NHANES III). *Am. J. Epidemiol.* **151**: 975-981
- Hu, X., Jandacek, R. J. & White, W. S. (2000) Intestinal absorption of beta-carotene ingested with a meal rich in sunflower oil or beef tallow: postprandial appearance in triacylglycerol-rich lipoproteins in women. *Am. J. Clin. Nutr.* **71**: 1170-1180
- Hughes, D. A., Wright, A. J., Finglas, P. M., Polley, A. C., Bailey, A. L., Astley, S. B. & Southon, S. (2000) Effects of lycopene and lutein supplementation on the expression of functionally associated surface molecules on blood monocytes from healthy male nonsmokers. *J. Infect. Dis.* **182 Suppl 1**: S11-S15
- Iuchi, S., Kobayashi, M., Yamaguchi-Shinozaki, K. & Shinozaki, K. (2000) A stress-inducible gene for 9-cis-epoxycarotenoid dioxygenase involved in abscisic acid biosynthesis under water stress in drought-tolerant cowpea. *Plant Physiol.* **123**: 553-562
- Jez, J. M. & Noel, J. P. (2000) A kaleidoscope of carotenoids [news]. *Nat. Biotechnol.* **18**: 825-826
- Johnson, E. J., Hammond, B. R., Yeum, K. J., Qin, J., Wang, X. D., Castaneda, C., Snodderly, D. M. & Russell, R. M. (2000) Relation among serum and tissue concentrations of lutein and zeaxanthin and macular pigment density. *Am. J. Clin. Nutr.* **71**: 1555-1562
- Jonat, W. (2000) [Nonhormonal prevention of breast cancer]. *Med. Klin.* **95 Suppl 1**: 9-13
- Josse, E. M., Simkin, A. J., Gaffe, J., Laboure, A. M., Kuntz, M. & Carol, P. (2000) A plastid terminal oxidase associated with carotenoid desaturation during chromoplast differentiation. *Plant Physiol.* **123**: 1427-1436
- Karas, M., Amir, H., Fishman, D., Danilenko, M., Segal, S., Nahum, A., Koifmann, A., Giat, Y., Levy, J. & Sharoni, Y. (2000) Lycopene interferes with cell cycle progression and insulin-like growth factor I signaling in mammary cancer cells. *Nutr. Cancer* **36**: 101-111
- Karnauchov, V. N. (2000) [Carotenoid functions--a subject for the biophysical research]. *Biofizika.* **45**: 364-384
- Katz, J., West, K. P., Jr., Khatri, S. K., Pradhan, E. K., LeClerq, S. C., Christian, P., Wu, L. S., Adhikari, R. K., Shrestha, S. R. & Sommer, A. (2000) Maternal low-dose vitamin A or β -carotene supplementation has no effect on fetal loss and early infant mortality: a randomized cluster trial in Nepal. *Am. J. Clin. Nutr.* **71**: 1570-1576
- Kennedy, C. M., Coutosoudis, A., Kuhn, L., Pillay, K., Mburu, A., Stein, Z. & Coovadia, H. (2000) Randomized controlled trial assessing the effect of vitamin A supplementation on maternal morbidity during pregnancy and postpartum among HIV-infected women. *J. Acquir. Immune. Defic. Syndr.* **24**: 37-44
- Kersting, M., Alexy, U. & Sichert-Hellert, W. (2000) Vitamin intake of 1- to 18-year-old German children and adolescents in the light of various recommendations. *Int. J. Vitam. Nutr. Res.* **70**: 48-53
- Kim, H. W., Chew, B. P., Wong, T. S., Park, J. S., Weng, B. B., Byrne, K. M., Hayek, M. G. & Reinhart, G. A. (2000) Dietary lutein stimulates immune response in the canine. *Vet. Immunol. Immunopathol.* **74**: 315-327
- Kimura, M. & Rodriguez-Amaya, D. B. (1999) Sources of errors in the quantitative analysis of food carotenoids by HPLC. *Arch. Latinoam. Nutr.* **49**: 58S-66S
- Konovalova, T. A., Kispert, L. D., Polyakov, N. E. & Leshina, T. V. (2000) EPR spin trapping detection of carbon-centered carotenoid and β -ionone radicals. *Free Radic. Biol. Med.* **28**: 1030-1038
- Krubasik, P. & Sandmann, G. (2000) A carotenogenic gene cluster from *Brevibacterium linens* with novel lycopene cyclase genes involved in the synthesis of aromatic carotenoids. *Mol. Gen. Genet.* **263**: 423-432
- Kudlova, E. (2000) [β -Carotene in the prevention of civilization-related diseases]. *Cas. Lek. Cesk.* **139**: 86-87
- Lahoz Rallo, C., Pena Valverde, R. & Mostaza Prieto, J. M. (2000) [Should antioxidants be recommended for the prevention of cardiovascular diseases?]. *Rev. Clin. Esp.* **200**: 212-217
- Lavine, J. B. (2000) Lutein supplementation or green vegetables [letter; comment]. *Am. J. Clin. Nutr.* **71**: 1210-1211
- Lee, J. J., Hong, W. K., Hittelman, W. N., Mao, L., Lotan, R., Shin, D. M., Benner, S. E., Xu, X. C., Lee, J. S., Papadimitrakopoulou, V. M., Geyer, C., Perez, C., Martin, J. W., El-Naggar, A. K. & Lippman, S. M. (2000) Predicting cancer development in oral leukoplakia: ten years of translational research. *Clin. Cancer Res.* **2000 May**;6(5):1702-10. **6**: 1702-1710
- Leonardi, C., Ambrosino, P., Esposito, F. & Fogliano, V. (2000) Antioxidative activity and carotenoid and tomatine contents in different typologies of fresh consumption tomatoes. *J. Agric. Food Chem.* **48**: 4723-4727
- Liang, C., Rounds, N. K., Dong, E., Stevens, S. Y., Shite, J. & Qin, F. (2000) Alterations by norepinephrine of cardiac sympathetic nerve terminal function and myocardial β -adrenergic receptor sensitivity in the ferret: normalization by antioxidant vitamins. *Circulation* **102**: 96-103
- Lin, S., Quaroni, L., White, W. S., Cotton, T. & Chumanov, G. (2000) Localization of carotenoids in plasma LDL studied by surface-enhanced resonance Raman spectroscopy. *Biopolymers* **57**: 249-256
- Lin, Y., Dueker, S. R., Burri, B. J., Neidlinger, T. R. & Clifford, A. J. (2000) Variability of the conversion of β -carotene to vitamin A in women measured by using a double-tracer study design. *Am. J. Clin. Nutr.* **71**: 1545-1554
- Lisfi, D., Bonnefont-Rousselot, D., Fernet, M., Jore, D., Delattre, J. & Gardes-Albert, M. (2000) Protection of endogenous vitamin E and β -carotene by aminoguanidine upon oxidation of human LDL by $\text{OH}\cdot(2)^{\cdot-}$. *Radiat. Res.* **153**: 497-507
- Lois, L. M., Rodriguez-Concepcion, M., Gallego, F., Campos, N. & Boronat, A. (2000) Carotenoid biosynthesis during tomato fruit development: regulatory role of 1-deoxy-D-xylulose 5-phosphate synthase. *Plant J.* **22**: 503-513
- Longnecker, M. P., Kamel, F., Umbach, D. M., Munsat, T. L., Shefner, J. M., Lansdell, L. W. & Sandler, D. P. (2000) Dietary intake of calcium, magnesium and antioxidants in relation to risk of amyotrophic lateral sclerosis. *Neuroepidemiology.* **19**: 210-216
- Lopez de Mishima, B., Closa, S. J., Samman, N. & de Portela, M. L. (1999) [Investigation needs on carotenoids in the republic of Argentina]. *Arch. Latinoam. Nutr.* **49**: 98S-102S
- Lotito, S. B. & Fraga, C. G. (2000) Catechins delay lipid oxidation and α -tocopherol and β -carotene depletion following ascorbate depletion in human plasma. *Proc. Soc. Exp. Biol. Med.* **225**: 32-38
- Mann, V., Harker, M., Pecker, I. & Hirschberg, J. (2000) Metabolic engineering of astaxanthin production in tobacco flowers. *Nat. Biotechnol.* **18**: 888-892
- Marsit, C. J., Fried, B. & Sherma, J. (2000) HP-TLC analysis of lutein and β -carotene in *Cerithidia californica* (Gastropoda) infected with two species of larval trematodes. *J. Parasitol.* **86**: 635-636
- Martin, K. R., Wu, D. & Meydani, M. (2000) The effect of carotenoids on the expression of cell surface adhesion molecules and binding of monocytes to human aortic endothelial cells. *Atherosclerosis* **150**: 265-274
- Massanyi, P., Bardos, L., Oppel, K., Hluchy, S., Kovacic, J., Csicsai, G. & Toman, R. (1999) Distribution of cadmium in selected organs of mice: effects of cadmium on organ contents of retinoids and β -carotene. *Acta Physiol. Hung.* **86**: 99-104
- Masson, L. (1999) [LATINFOODS and its role in the generation and compilation of data for Latin America]. *Arch. Latinoam. Nutr.* **49**: 89S-91S
- Mathews-Roth, M. M. (2000) Erythropoietic protoporphyria: treatment with antioxidants and potential cure with gene therapy. *Methods Enzymol.* **319**: 479-484
- Mathews, P. D. & Wurtzel, E. T. (2000) Metabolic engineering of carotenoid accumulation in *Escherichia coli* by modulation of the isoprenoid precursor pool with expression of deoxyxylulose phosphate synthase. *Appl. Microbiol. Biotechnol.* **53**: 396-400
- McDowell, L. R. (2000) *Vitamins and Animal and Human Nutrition*. Iowa State University Press, Ames, Iowa, pp. 1-762.
- McMillan, D. C., Sattar, N., Talwar, D., O'Reilly, D. S. & McArdle, C. S. (2000) Changes in micronutrient concentrations following anti-inflammatory treatment in patients with gastrointestinal cancer. *Nutrition.* **16**: 425-428
- Mercadante, A. Z. (1999) Chromatographic separation of carotenoids. *Arch. Latinoam. Nutr.* **49**: 52S-57S
- Michaud, D. S., Feskanich, D., Rimm, E. B., Colditz, G. A., Speizer, F. E., Willett, W. C. & Giovannucci, E. (2000) Intake of specific carotenoids and risk of lung cancer in 2 prospective US cohorts. *Am. J. Clin. Nutr.* **72**: 990-997
- Minguez-Mosquera, M. I., Perez-Galvez, A. & Garrido-Fernandez, J. (2000) Carotenoid content of the varieties Jaranda and Jariza (*Capsicum annuum* L.) and response during the industrial slow drying and grinding steps in paprika processing. *J. Agric. Food Chem.* **48**: 2972-2976
- Monsen, E. R. (2000) Dietary reference intakes for the antioxidant nutrients: vitamin C, vitamin E, selenium, and carotenoids. *J. Am. Diet. Assoc.* **100**: 637-640
- Munoz de Chavez, M., Chavez, A. & Calvo, C. (1999) [Investigation needs on carotenoids in Latin America]. *Arch. Latinoam. Nutr.* **49**: 85S-88S
- Narisawa, T., Fukaura, Y., Hasebe, M., Nomura, S., Oshima, S. & Inakuma, T. (2000) Prevention of N-methylnitrosourea-induced colon carcinogenesis in rats by

- oxygenated carotenoid capsanthin and capsanthin-rich paprika juice. *Proc. Soc. Exp. Biol. Med.* **224**: 116-122
- Nestel, P. & Trumbo, P. (1999) The role of provitamin A carotenoids in the prevention and control of vitamin A deficiency. *Arch. Latinoam. Nutr.* **49**: 26S-33S
- Ng, J. H., Nesaretnam, K., Reimann, K. & Lai, L. C. (2000) Effect of retinoic acid and palm oil carotenoids on oestrone sulphatase and oestradiol-17 β -hydroxysteroid dehydrogenase activities in MCF-7 and MDA-MB-231 breast cancer cell lines. *Int. J. Cancer* **88**: 135-138
- Normile, D. (2000) Agricultural biotechnology. Monsanto donates its share of golden rice [news]. *Science* **289**: 843-845
- Oberholster, R. & Cowan, A. K. (2001) Biochemical basis of color as an aesthetic quality in *Citrus sinensis*. *J. Agric. Food Chem.* **49**: 303-307
- Okai, Y., Higashi-Okai, K., Machida, K., Nakamura, H., Nakayama, K., Fujita, K., Tanaka, T. & Taniguchi, M. (2000) Protective effects of α -tocopherol and β -carotene on para-nonylphenol-induced inhibition of cell growth, cellular respiration and glucose-induced proton extrusion of bacteria. *FEMS Microbiol. Lett.* **187**: 161-165
- Olson, J. A. (1999) Bioavailability of carotenoids. *Arch. Latinoam. Nutr.* **49**: 21S-25S
- Olson, J. A. (1999) Carotenoids and human health. *Arch. Latinoam. Nutr.* **49**: 7S-11S
- Olson, J. A. (2000) The effects of iron and copper status and of dietary carbohydrates on the activity of rat intestinal β -carotene 15, 15'-dioxygenase [comment]. *Br. J. Nutr.* **84**: 3-4
- Ono, A., Sekita, K., Saitoh, M., Umemura, T., Ogawa, Y., Furuya, T., Kaneko, T. & Inoue, T. (1999) [A 13-week subchronic oral toxicity study of *haematococcus color* in F344 rats]. *Kokuritsu. Iyakuhin. Shokuhin. Eisei. Kenkyusho. Hokoku.* **58**: 91-98
- Osterlie, M., Bjerkeng, B. & Liaaen-Jensen, S. (2000) Plasma appearance and distribution of astaxanthin E/Z and R/S isomers in plasma lipoproteins of men after single dose administration of astaxanthin. *J. Nutr. Biochem.* **11**: 482-490
- Palozza, P., Calviello, G., Emilia De Leo, M., Serini, S. & Bartoli, G. M. (2000) Canthaxanthin supplementation alters antioxidant enzymes and iron concentration in liver of Balb/c mice. *J. Nutr.* **130**: 1303-1308
- Pascal, A., Wacker, U., Irrgang, K. D., Horton, P., Renger, G. & Robert, B. (2000) Pigment binding site properties of two photosystem II antenna proteins. A resonance Raman investigation. *J. Biol. Chem.* **275**: 22031-22036
- Pellegrini, N., Riso, P. & Porrini, M. (2000) Tomato consumption does not affect the total antioxidant capacity of plasma. *Nutrition.* **16**: 268-271
- Perez-Galvez, A., Jaren-Galan, M. & Minguéz-Mosquera, M. I. (2000) Effect of high-temperature degradative processes on ketocarotenoids present in paprika oleoresins. *J. Agric. Food Chem.* **48**: 2966-2971
- Persson, V., Ahmed, F., Gebre-Medhin, M. & Greiner, T. (2000) Relationships between vitamin A, iron status and helminthiasis in Bangladeshi school children. *Public Health Nutr.* **3**: 83-89
- Peterson, R. B. & Haver, E. A. (2000) A nonphotochemical-quenching-deficient mutant of *Arabidopsis thaliana* possessing normal pigment composition and xanthophyll-cycle activity. *Planta* **210**: 205-214
- Pfützner, I., Franz, P. I. & Biesalski, H. K. (2000) Carotenoid:methyl- β -cyclodextrin formulations: an improved method for supplementation of cultured cells. *Biochim. Biophys. Acta* **1474**: 163-168
- Prakash, P., Krinsky, N. I. & Russell, R. M. (2000) Retinoids, carotenoids, and human breast cancer cell cultures: a review of differential effects [published erratum appears in Nutr Rev 2000 Jul;58(7):222]. *Nutr. Rev.* **58**: 170-176
- Ribaya-Mercado, J. D., Solon, F. S., Solon, M. A., Cabal-Barza, M. A., Perfecto, C. S., Tang, G., Solon, J. A., Fjeld, C. R. & Russell, R. M. (2000) Bioconversion of plant carotenoids to vitamin A in Filipino school-aged children varies inversely with vitamin A status. *Am. J. Clin. Nutr.* **72**: 455-465
- Rock, C. L., Michael, C. W., Reynolds, R. K. & Ruffin, M. T. (2000) Prevention of cervix cancer. *Crit. Rev. Oncol. Hematol.* **33**: 169-185
- Rodríguez-Amaya, D. B. (1999) Latin American food sources of carotenoids. *Arch. Latinoam. Nutr.* **49**: 74S-84S
- Rodríguez-Amaya, D. B. (1999) Changes in carotenoids during processing and storage of foods. *Arch. Latinoam. Nutr.* **49**: 38S-47S
- Roll, B. (2000) Carotenoid and retinoid—two pigments in a gecko eye lens. *Comp. Biochem. Physiol. A Mol. Integr. Physiol.* **125**: 105-112
- Romer, S., Fraser, P. D., Kiano, J. W., Shipton, C. A., Misawa, N., Schuch, W. & Bramley, P. M. (2000) Elevation of the provitamin A content of transgenic tomato plants. *Nat. Biotechnol.* **18**: 666-669
- Rondo, P. H., Villar, B. S. & Tomkins, A. M. (1999) Vitamin A status of pregnant women assessed by a biochemical indicator and a simplified Food Frequency Questionnaire. *Arch. Latinoam. Nutr.* **49**: 322-325
- Roodenburg, A. J., Leenen, R., van het Hof, K. H., Weststrate, J. A. & Tijburg, L. B. (2000) Amount of fat in the diet affects bioavailability of lutein esters but not of α -carotene, β -carotene, and vitamin E in humans [see comments]. *Am. J. Clin. Nutr.* **71**: 1187-1193
- Ruban, A. V., Pascal, A. A. & Robert, B. (2000) Xanthophylls of the major photosynthetic light-harvesting complex of plants: identification, conformation and dynamics. *FEBS Lett.* **477**: 181-185
- Rumi, G., Jr., Szabo, I., Vincze, A., Matus, Z., Toth, G. & Mozsik, G. (2000) Decrease of serum carotenoids in Crohn's disease. *J. Physiol. Paris.* **94**: 159-161
- Rust, P., Eichler, I., Renner, S. & Elmadfa, I. (2000) Long-term oral β -carotene supplementation in patients with cystic fibrosis - effects on antioxidative status and pulmonary function. *Ann. Nutr. Metab.* **44**: 30-37
- Sambale, C. (1999) Processing characteristics and stability of chemically synthesized carotenoids in food systems. *Arch. Latinoam. Nutr.* **49**: 48S-51S
- Sandmann, G. & Mitchell, G. (2001) In vitro inhibition studies of phytoene desaturase by bleaching ketomorpholine derivatives. *J. Agric. Food Chem.* **49**: 138-141
- Santamaria, R. I., Reyes-Duarte, M. D., Barzana, E., Fernandez, D., Gama, F. M., Mota, M. & Lopez-Munguia, A. (2000) Selective enzyme-mediated extraction of capsainoids and carotenoids from chili guajillo puya (*Capsicum annuum* L.) using ethanol as solvent. *J. Agric. Food Chem.* **48**: 3063-3067
- Sasaki, S., Tsubono, Y., Okubo, S., Hayashi, M., Kakizoe, T. & Tsugane, S. (2000) Effects of three-month oral supplementation of β -carotene and vitamin C on serum concentrations of carotenoids and vitamins in middle-aged subjects: a pilot study for a randomized controlled trial to prevent gastric cancer in high-risk Japanese population. *Jpn. J. Cancer Res.* **91**: 464-470
- Scheen, A. J. (2000) [Antioxidant vitamins in the prevention of cardiovascular diseases. First part: epidemiologic studies]. *Rev. Med. Liege.* **55**: 11-18
- Schmidt-Dannert, C. (2000) Engineering novel carotenoids in microorganisms. *Curr. Opin. Biotechnol.* **11**: 255-261
- Schmidt-Dannert, C., Umeno, D. & Arnold, F. H. (2000) Molecular breeding of carotenoid biosynthetic pathways. *Nat. Biotechnol.* **18**: 750-753
- Schweigert, F. J., Baumann, A., Buchholz, I. & Schoon, H. A. (2000) Plasma and tissue concentrations of β -carotene and vitamin A in rats fed β -carotene in various fats of plant and animal origin. *J. Environ. Pathol. Toxicol. Oncol.* **19**: 87-93
- Sedgh, G., Herrera, M. G., Nestel, P., el Amin, A. & Fawzi, W. (2000) Dietary vitamin A intake and nondietary factors are associated with reversal of stunting in children. *J. Nutr.* **130**: 2520-2526
- Simkin, A. J., Breitenbach, J., Kuntz, M. & Sandmann, G. (2000) In vitro and in situ inhibition of carotenoid biosynthesis in *Capsicum annuum* by bleaching herbicides. *J. Agric. Food Chem.* **48**: 4676-4680
- Simonne, A. H., Smith, M., Weaver, D. B., Vail, T., Barnes, S. & Wei, C. I. (2000) Retention and changes of soy isoflavones and carotenoids in immature soybean seeds (Edamame) during processing. *J. Agric. Food Chem.* **48**: 6061-6069
- Singer, M., Stidwill, R. P., Nathan, A. & Gainer, J. L. (2000) Intravenous crocinate prolongs survival in a rat model of lethal hypoxemia. *Crit. Care Med.* **28**: 1968-1972
- Smith, T. (2000) Picture story. Color me red. *Nat. Struct. Biol.* **7**: 536
- Socaciu, C., Jessel, R. & Diehl, H. A. (2000) Competitive carotenoid and cholesterol incorporation into liposomes: effects on membrane phase transition, fluidity, polarity and anisotropy. *Chem. Phys. Lipids* **106**: 79-88
- Stahl, W., Heinrich, U., Jungmann, H., Tronnier, H. & Sies, H. (2000) Carotenoids in human skin: noninvasive measurement and identification of dermal carotenoids and carotenol esters. *Methods Enzymol.* **319**: 494-502
- Steghens, J. P., Lyan, B., Le Moel, G., Galabert, C., Fayol, V., Faure, H., Grolier, P., Cheribi, N., Dubois, F. & Nabet, F. (2000) [Measurement of carotenoids by HPLC: from difficulties to solutions]. *Ann. Biol. Clin. (Paris)* **58**: 327-335
- Stivala, L. A., Savio, M., Quarta, S., Scotti, C., Cazzalini, O., Rossi, L., Scovassi, I. A., Pizzala, R., Melli, R., Bianchi, L., Vannini, V. & Prosperi, E. (2000) The antiproliferative effect of β -carotene requires p21^{waf1/cip1} in normal human fibroblasts. *Eur. J. Biochem.* **267**: 2290-2296
- Surai, P. F., Royle, N. J. & Sparks, N. H. (2000) Fatty acid, carotenoid and vitamin A composition of tissues of free living gulls. *Comp. Biochem. Physiol. A Mol. Integr. Physiol.* **126**: 387-396
- Suter, P. M. (2000) Effect of vitamin E, vitamin C, and β -carotene on stroke risk. *Nutr. Rev.* **58**: 184-187
- Tai, C. Y. & Chen, B. H. (2000) Analysis and stability of carotenoids in the flowers of daylily (*Heimerocallis disticha*) as affected by various treatments. *J. Agric. Food Chem.* **48**: 5962-5968
- Tanaka, T., Kohno, H., Murakami, M., Shimada, R., Kagami, S., Sumida, T., Azuma, Y. & Ogawa, H. (2000) Suppression of azoxymethane-induced colon carcinogenesis in male F344 rats by mandarin juices rich in β -cryptoxanthin and hesperidin. *Int. J. Cancer* **88**: 146-150
- Tantillo, G., Storelli, M. M., Aprile, A. & Matrella, R. (2000) Quantitative and legislative aspects regarding canthaxanthin and astaxanthin in smoked salmon fillets. *Ital. J. Food Sci.* **12**: 463-468
- Terry, P., Lagergren, J., Ye, W., Nyren, O. & Wolk, A. (2000) Antioxidants and cancers of the esophagus and gastric cardia. *Int. J. Cancer* **87**: 750-754
- Thompson, A. J., Jackson, A. C., Parker, R. A., Morpeth, D. R., Burbidge, A. & Taylor, I. B. (2000) Absciscic acid biosynthesis in tomato: regulation of zeaxanthin epoxidase and 9-cis-epoxycarotenoid dioxygenase mRNAs by light/dark cycles, water stress and absciscic acid. *Plant Mol. Biol.* **42**: 833-845

- Thornquist, M. D., Kristal, A. R., Patterson, R. E., Neuhauser, M. L., Rock, C. L., Neumark-Sztainer, D. & Cheskin, L. J. (2000) Olestra consumption does not predict serum concentrations of carotenoids and fat-soluble vitamins in free-living humans: early results from the sentinel site of the olestra post-marketing surveillance study. *J. Nutr.* **130**: 1711-1718
- Todd, D. J. (2000) Therapeutic options for erythropoietic protoporphyria [letter; comment]. *Br. J. Dermatol.* **142**: 826-827
- Treitinger, A., Spada, C., Verdi, J. C., Miranda, A. F., Oliveira, O. V., Silveira, M. V., Moriel, P. & Abdalla, D. S. (2000) Decreased antioxidant defence in individuals infected by HIV. *Eur. J. Clin. Invest.* **30**: 454-459
- Tsushima, M., Mune, E., Maoka, T. & Matsuno, T. (2000) Isolation of stereoisomeric epoxy carotenoids and new acetylenic carotenoid from the common freshwater goby *Rhinogobius brunneus*. *J. Nat. Prod.* **63**: 960-964
- Upritchard, J. E., Sutherland, W. H. & Mann, J. I. (2000) Effect of supplementation with tomato juice, vitamin E, and vitamin C on LDL oxidation and products of inflammatory activity in type 2 diabetes. *Diabetes Care* **23**: 733-738
- Uteshev, D. B., Kostriukov, E. B., Karabinenko, A. A., Kovaleva, V. L., Makarova, O. V. & Storozhakov, G. I. (2000) [The anti-inflammatory activity of intal and b-carotene in a model of experimental granulomatous lung inflammation]. *Patol. Fiziol. Eksp. Ter.* 19-22
- Valencia, M. E., Astiazaran, H., Esparza, J., Gonzalez, L., Grijalva, M. I., Cervera, A. & Zazueta, P. (1999) Vitamin A deficiency and low prevalence of anemia in Yaqui Indian children in northwest Mexico. *J. Nutr. Sci. Vitaminol. (Tokyo)* **45**: 747-757
- van den Akker, J. T., Speelman, O. C., van Staveren, H. J., Moore, A. L., Moore, T. A., Gust, D., Star, W. M. & Sterenborg, H. J. (2000) Localisation and accumulation of a new carotenoporphyrin in two primary tumour models. *J. Photochem. Photobiol. B* **54**: 108-115
- van het Hof, K. H., de Boer, B. C., Tijburg, L. B., Lucius, B. R., Zijl, I., West, C. E., Hautvast, J. G. & Weststrate, J. A. (2000) Carotenoid bioavailability in humans from tomatoes processed in different ways determined from the carotenoid response in the triglyceride-rich lipoprotein fraction of plasma after a single consumption and in plasma after four days of consumption. *J. Nutr.* **130**: 1189-1196
- Varadi, G., Darko, E. & Lehoczi, E. (2000) Changes in the xanthophyll cycle and fluorescence quenching indicate light-dependent early events in the action of paraquat and the mechanism of resistance to paraquat in *Erigeron canadensis* (L.) cronq. *Plant Physiol.* **123**: 1459-1470
- Vershinin, A. (1996) Carotenoids in mollusca: approaching the functions. *Comp. Biochem. Physiol.* **113B**: 63-71
- Vitor, R. F., Lidon, F. C. & Carvalho, C. S. (1999) Dark stained tissues of the epicarp of encore mandarin: interactions with the production of hydroxyl radicals. *Free Radic. Res.* **31 Suppl**: S163-S169
- Viveiros, M., Krubasik, P., Sandmann, G. & Houssaini-Iraqi, M. (2000) Structural and functional analysis of the gene cluster encoding carotenoid biosynthesis in *Mycobacterium aurum* A^r. *FEMS Microbiol. Lett.* **187**: 95-101
- Vrzheshinskaia, O. A., Beketova, N. A., Nikitina, V. A., Pereverzeva, O. G., Kharitonchik, L. A., Isaeva, V. A., Kodentsova, V. M., Durnev, A. D. & Spirichev, V. B. (2000) [Effects of biologically active food additives with different contents of vitamins on the vitamin status in humans]. *Vopr. Pitan.* **69**: 27-31.
- Wagner, P. D., Hsia, C. C., Goel, R., Fay, J. M., Wagner, H. E. & Johnson, R. L., Jr. (2000) Effects of crocetin on pulmonary gas exchange in foxhounds during hypoxic exercise. *J. Appl. Physiol.* **89**: 235-241
- Walter, M. H., Fester, T. & Strack, D. (2000) Arbuscular mycorrhizal fungi induce the non-mevalonate methylerythritol phosphate pathway of isoprenoid biosynthesis correlated with accumulation of the 'yellow pigment' and other apocarotenoids. *Plant J.* **21**: 571-578
- Wang, X., Willen, R. & Wadstrom, T. (2000) Astaxanthin-rich algal meal and vitamin C inhibit *Helicobacter pylori* infection in BALB/cA mice. *Antimicrob. Agents Chemother.* **44**: 2452-2457
- Wargovich, M. J., Jimenez, A., McKee, K., Steele, V. E., Velasco, M., Woods, J., Price, R., Gray, K. & Kelloff, G. J. (2000) Efficacy of potential chemopreventive agents on rat colon aberrant crypt formation and progression. *Carcinogenesis* **21**: 1149-1155
- Watzl, B., Bub, A., Blockhaus, M., Herbert, B. M., Luhrmann, P. M., Neuhauser-Berthold, M. & Rechkemmer, G. (2000) Prolonged tomato juice consumption has no effect on cell-mediated immunity of well-nourished elderly men and women. *J. Nutr.* **130**: 1719-1723
- Weng, B. C., Chew, B. P., Wong, T. S., Park, J. S., Kim, H. W. & Lepine, A. J. (2000) b-Carotene uptake and changes in ovarian steroids and uterine proteins during the estrous cycle in the canine. *J. Anim. Sci.* **78**: 1284-1290
- Wyss, A., Wirtz, G., Woggon, W. D., Brugger, R., Wyss, M., Friedlein, A., Bachmann, H. & Hunziker, W. (2000) Cloning and expression of b,b-carotene 15,15'-dioxygenase. *Biochemical and Biophysical Research Communications* **271**: 334-336
- Yamaguchi, L. F., Martinez, G. R., Catalani, L. H., Medeiros, M. H. & Di Mascio, P. (1999) Lycopene entrapped in human albumin protects 2'-deoxyguanosine against singlet oxygen damage. *Arch. Latinoam. Nutr.* **49**: 12S-20S
- Ye, L., Landen, W. O. & Eitenmiller, R. R. (2000) Liquid chromatographic analysis of all-trans retinyl palmitate, beta-carotene, and vitamin E in fortified foods and the extraction of encapsulated and nonencapsulated retinyl palmitate. *J. Agric. Food Chem.* **48**: 4003-4008
- Yeum, K. J., dos Anjos Ferreira, A. L., Smith, D., Krinsky, N. I. & Russell, R. M. (2000) The effect of a-tocopherol on the oxidative cleavage of b-carotene. *Free Radic. Biol. Med.* **29**: 105-114
- Zeisel, S. H. (2000) Is there a metabolic basis for dietary supplementation? *Am. J. Clin. Nutr.* **72**: 507S-511S
- Zhang, P. & Omaye, S. T. (2000) b-Carotene and protein oxidation: effects of ascorbic acid and a-tocopherol. *Toxicology* **146**: 37-47
- Zhang, Z. W., Patchett, S. E., Perrett, D., Domizio, P. & Farthing, M. J. (2000) Gastric a-tocopherol and b-carotene concentrations in association with *Helicobacter pylori* infection. *Eur. J. Gastroenterol. Hepatol.* **12**: 497-503

MEETING REPORTS

Gordon Research Conference on Carotenoids

January 14-19, 2001, Ventura, CA

The Carotenoids Gordon Conference was the 4th one in this series, and again it was a success: fully booked (indeed, overbooked), and very lively, with interesting sessions and fascinating posters. The carotenoid field has seen some spectacular advances in the past year, and these were discussed and analyzed. The attendees were from academia, government and industry, and there was a good distribution in terms of age (or level of achievement) and geographic origin. Also, the interdisciplinary aspect was alive, with people from the plant and bacteria fields being present as well as animal science, medicine, chemistry and physics. Since the International Carotenoid Society meeting in Cairns (1999) emphasized chemistry, this Gordon Conference was leaning slightly more to biological sciences, although there was a good chemistry session as well. Richard Cogdell gave a fascinating banquet speech, including numerous personal reminiscences regarding the long, arduous path taken to solve the structure of the major LHII light harvesting complex from photosynthetic bacteria.

The poster award winners were: T. Polivka, B. Pogson, D. Umeno, C. Herrero, A.Y. Yemelyanov, J. Paik, A. Ben-Dor, W.S. White. The next GRC will be held in Ventura, CA in 2004, with Harry Frank (Storrs, CT) as Chair and John Landrum (Miami, FL) as Vice-Chair.

Special feature: A series of minireviews by discussion leaders and/or speakers were written in advance of the Conference. At the registration each participant was given a copy of the January 1, 2001 issue of Archives in Biochemistry and Biophysics, which contained these minireviews (Volume 385, 1-69). They highlight some of the recent advances in the field and will be useful for the general community of scientists interested in carotenoids.

Helmut Sies (Chair)
Harry A. Frank (Vice-Chair)

ANNOUNCEMENTS

CARIG Newsletter on the Web!

We're in the process of putting Carotenoid News on the Web. It will contain all the same information as the printed version, which you are reading now. If the Internet version fills the needs of all readers, eventually the Web version may replace the printed version, to help us save postage costs. Check soon at the Web page of the International Carotenoids Society, and then send us your comments: www.carotenoid.uconn.edu/main.html

CARIG Travel Awards

CARIG will award \$500 for travel to the Experimental Biology meeting. Each applicant should be first author on an abstract submitted to EB 2001. Awards are based on the merit of the abstract and on financial need; students, staff, and scientists beginning their careers are eligible to apply. Please send a copy of your abstract (on the EB 2001 form) and a letter explaining the need for financial aid, by March 12, to: Dr. Harold Furr, Department of Nutritional Sciences, U-4017, University of Connecticut, Storrs, CT 06269-4017 (FAX 860-486-3674).

Special Symposium: Functions and Actions of Retinoids and Carotenoids: Building on the Vision of James Allen Olson

A symposium will be held June 21-24, 2001, at Iowa State University, to honor of the research and public service contributions of Prof. James Olson, who died September 22, 2000. The symposium will be wide-ranging, as were Prof. Olson's contributions, focusing on the physiological roles (functions) and pharmacological roles (actions) of retinoids and carotenoids. The symposium is intended to bring together scientists to share recent findings and to promote interdisciplinary communications. Specific presentations will address: bioavailability of carotenoids and vitamin A as dietary components, and interrelationships among dietary components; mechanisms underlying the relationships between diet and optimal health (including approaches from both epidemiological and laboratory research); cellular and molecular mechanisms of retinoid and carotenoid action, with particular emphasis on regulation of gene expression; and public health recommendations for dietary intakes and for interventions to improve nutritional status and to prevent and ameliorate disease. The symposium is intended to foster interactive collaborations among participants and speakers, to bring attention to different fields of study, and to bring new ideas, methods, and materials to the attention of other workers.

Further information and registration materials may be obtained from: James A. Olson Symposium, 3208 Molecular Biology Building, Iowa State University, Ames, Iowa 50011-3260

e-mail: gfst@iastate.edu,

website: www.molebio.iastate.edu/~gfst/olsonsymp.html

Internet Addresses for Carotenoid Researchers

1. This list is intended to be an open forum for carotenoid researchers from around the world to discuss recent developments in this field: CARIG.Forum@lists.unh.edu. To subscribe, send e-mail to: listproc@lists.unh.edu. In the body of the message write: subscribe CARIG.Forum Your Name
2. International Carotenoid Society Web Page: www.carotenoid.uconn.edu. Anyone wishing to join the society and be listed in the web directory, please visit the [International Carotenoid Society](http://www.internationalcarotenoid.org) web site and click on the Membership link.
3. Carotenoid Food Database: www.nal.usda.gov/fnic/foodcomp/

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