

Carotenoid News

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FROM THE EDITOR

Verba volant, scripta manent.

(Words vanish, writings remain—Latin proverb)

Human memory is imperfect and needs various aids to convey information and experience to the next generation, both to keep tradition alive and to enable progress. More than 25,000 years ago our Paleolithic ancestors made notches on bone to keep records. Writing first evolved about 5,300 years ago in Middle East. By the time of Roman Empire it was a necessary element of civilization and Romans were keenly aware of the importance and permanence of the written word. Is it still so important in the age of sound bites and pictures flashing across screens of computers, cell phones and TV sets? Although many young people do not relish reading and/or writing anything longer than SMS, it is difficult to imagine the further progress of science without publication of inspired lectures, experimental results, new books and reviews. Even reports from scientific meetings and informal newsletters are valuable, inasmuch they preserve memory of important events in the life and history of a particular scientific discipline. Therefore we are thankful to all who contributed articles and information to this issue of Carotenoid News and ask for your help in future.

Maria S. Sapuntzakis, Chicago, IL

In Memoriam

Trevor W. Goodwin, C.B.E., F.R.S., 1916 – 2008

It is with much sadness that we report that one of the all-time greats of the carotenoid world, Trevor (T. W.) Goodwin, died on 7th October 2008 at the age of 92. He has left a great legacy of research papers and reviews and is particularly well known for his numerous books, notably the two volumes of *The Biochemistry of the Carotenoids*, which were published in the 1980s but remain a most valuable source of information today. Although he retired in 1983, he maintained a keen interest in carotenoids and in carotenoid people. Through his enthusiasm, Trevor Goodwin introduced many of us to the wonderful world of carotenoids and was a great influence and inspiration throughout our careers. His contribution to the carotenoid field is enormous and enduring. He was also a special person who will be much missed by all those who knew him.

George Britton, Liverpool, UK

Carotenoid Research Interactive Group (CARIG) RIS

Carotenoid Research Interactive Group (CARIG) has been active for nearly 20 years; this is our first year as ASN RIS. The CARIG Steering Committee has decided that we will retain the well known CARIG name for our group. The 2008-2009 Chair of the CARIG RIS will be Dr Elizabeth Johnson, from Jean Mayer Human Nutrition Research

center on Aging at Tufts University.

RIS Name: Carotenoid Research Interactive Group (CARIG)

Purpose and/or Mission: CARIG's mission is to promote research into nutritional roles, functions, and actions of carotenoids and their metabolites; provide a mechanism for the dissemination of new research; serve as a liaison representing the interests of the carotenoid research community to government agencies and other organizations; promote and support the training of young researchers; communicate to the wider research community and the public.

General Organizational Structure: CARIG shall be managed by a Steering Committee consisting of, at minimum: a Chairperson (Elizabeth Johnson), a Chair-elect (Sherry Tanumihardjo), a Past-chair (John Landrum), a Treasurer (Mario Ferruzzi), an Advisory Committee consisting of 4-6 members.

Membership on the Steering Committee shall, so far as is possible, include representation from industry, government and the academy. Steering Committee members shall be elected for a term of 3 yrs. Members of the Steering Committee may serve multiple, consecutive terms.

The Advisory Committee shall consist of not less than four and not more than six members). Nomination to serve on the Steering Committee will be open to the general membership of the RIS and nominations may be made by any member of the CARIG RIS. Nominations will be solicited each year at the annual meeting of the CARIG RIS which shall be held during the EB meeting. The Steering Committee shall elect Advisory Committee members from among the nominees. The number of Advisory Committee members to be elected each year shall be determined at the annual Steering Committee meeting and shall be sufficient in number to ensure that the interests of the general membership are well represented. The election will be managed by the Chair and will be conducted by conference call or email.

Election of officers will be for a 1 year term with the exception of the treasurer who will serve a two year term.

The Steering Committee shall nominate and elect officers from among its membership at the annual meeting of the Steering Committee. Terms shall begin June 1 and end May 31. In the event of a mid-term vacancy an officer may be replaced by a vote of the Steering Committee to be conducted by the Chair, past-Chair, or the Chair-elect.

The Chairperson, or his/her designate from among the Steering Committee membership, shall represent the RIS on the ASN Symposia Advisory Committee. The Treasurer shall be responsible for fundraising activities and shall maintain a record of the funds available for RIS

activities in concert with the ASN.

Planned Activities and Special Events: The CARIG RIS will hold a symposium devoted to recent advances in the field of carotenoids in conjunction with the annual Experimental Biology meeting. The keynote address of this symposium will be the James Allen Olson Memorial Lecture. A meeting of the general membership will be held during each Experimental Biology meeting at which business will be conducted, a young researcher poster session will be held, and awards and announcements shall be made.

News from the CARIG Steering Committee

The annual meeting of the CARIG Steering Committee was held during EB '08 in San Diego, CA. The Committee thanked Elizabeth Johnson for her excellent work as Chair of this year's CARIG Conference (see report below), and Harold Furr for organizing CARIG/VARIG social with poster competition and continuing preparation of the literature review, which is a traditional highlight of this newsletter. Elizabeth Johnson was elected the Chair of CARIG RIS for June 1, 2008 – May 31, 2009 and Sherry Tanumihardjo the next Chair for June 1, 2009 – May 31, 2010. The current membership of the CARIG Steering Committee includes:

Elizabeth Johnson (Chair, CARIG RIS) – Jean Mayer USDA Human Nutrition Research Center on Aging, Tufts University

John Landrum (Past Chair) – Florida International University

Sherry Tanumihardjo (Chair Elect) – University of Wisconsin, Madison

Mario Ferruzzi (Treasurer, Fundraising) – Purdue University

Klaus Kraemer – Task Force Sight and Life

Lewis Rubin (Chair, CARIG Conference 2009) – Cleveland Clinic

Maria Stacewicz-Sapuntzakis (Newsletter Editor and member *ex officio*) – University of Illinois, Chicago

The next issue of Carotenoid News will include the agenda for the CARIG Conference at EB 2009 in New Orleans, LA.

CARIG Travel Awards

CARIG will award one or more \$500 travel grants based on a poster competition to be held in conjunction with the CARIG/VARIG social at Experimental Biology 2009. Graduate students and postdoctoral trainees are eligible. Posters must address carotenoid and/or vitamin A research. For those assigned an oral presentation rather than a poster at EB'09, printed copies of the slides may be used for the CARIG/VARIG poster competition. The time and location of the CARIG/VARIG Social will be announced in the February 2009 issue of Carotenoid News. No advance registration is required to participate in the poster competition. Contact: Dr. Elizabeth J. Johnson, Carotenoids & Health Laboratory, Jean Mayer USDA Human Nutrition Research Center on Aging, Tufts University, Boston, MA 02111, USA, **tel:** 1-617-556-3204, **fax:** 1-617-556-3344, **E-mail:** elizabeth.johnson@tufts.edu

2008 CARIG Conference Report

The Carotenoid Research Interactive Group (CARIG) annual conference was held on April 5, 2008 in conjunction

with the Experimental Biology meeting in San Diego, CA. This year's conference was chaired by Elizabeth Johnson, Jean Mayer USDA Human Nutrition Research Center on Aging, Tufts University.

Dr. Arun Barua, emeritus faculty member at the Iowa State University, presented the 7th Annual James Allen Olson Memorial Lecture, entitled "The Hidden Beauty of Carotenoids". Dr. Barua provided a comprehensive view of the diverse roles carotenoids play in plant and animal kingdoms. These include β -carotene and other provitamin A carotenoids as precursors of vitamin A, the importance of lutein and zeaxanthin in the prevention of eye diseases, such as cataract and age-related macular degeneration, and the photoprotective action of carotenoids against sunburn and other skin conditions, such as photoaging. It was an excellent preview to the subsequent program.

The first half of the symposium evaluated the role of carotenoids in early life. **Dr. Sherry Tanumihardjo**, of the University of Wisconsin-Madison, spoke on "Carotenoid Content in Human Breast Milk" which described the mechanism of transport of dietary carotenoids to the mammary gland and secretion into milk, as well as the implications for carotenoids providing a source of vitamin A in early life. She provided data on the considerable variation in maternal milk carotenoid concentrations among various countries worldwide, as well as information on the relationships between dietary sources of carotenoids and their levels in breast milk. Information was presented on the milk carotenoids as a source of vitamin A. Dr. Tanumihardjo noted that the non provitamin A carotenoids may have health implications in early life. Such a role was explored in the following two talks.

Dr. John Landrum, of Florida International University, spoke on "Macular Pigment in Retina of Neonate Monkey". Macular pigment in humans and macaques develops during the early stages of life. The research from Dr. Landrum's research group finds that at birth retina contains more lutein than zeaxanthin and that there is virtually no *meso*-zeaxanthin. In humans, the ratio zeaxanthin to lutein increases with age, from a value of less than 1, until approximately 2 years of age, when zeaxanthin becomes dominant. In macaques, this ratio similarly changes, with zeaxanthin increasing to dominance at a rate roughly four times that of humans. Dr. Landrum concluded that the composition and distribution on the macular pigments may have a specific role in ocular health.

Dr. B. Randy Hammond, of the University of Georgia-Athens, carried the theme of xanthophylls in early life with a talk entitled "Dietary Lutein and Zeaxanthin in Vision and Visual Development". Dr. Hammond reviewed the studies in rhesus monkeys fed diets devoid of carotenoids, resulting in distinct abnormal morphological changes in the retina, which could be reversed with xanthophyll supplementation. Retinal lutein and zeaxanthin, for instance, would influence the development of the visual system if they (1) altered input during a critical/sensitive period of visual development, (2) influenced maturation, (3) protected the retina when it was particularly vulnerable. Evidence was presented to

indicate that the pigments may play a role in all three areas.

The next half of the symposium focused on aspects of carotenoids in skin. **Dr. Susan Mayne** of Yale University spoke of the validation of an assessment tool for measures of carotenoids in skin, using a non-invasive method. The measure was discussed in the context of its use as biomarkers of dietary fruit and vegetable. Dr. Mayne presented data from a longitudinal study involving 75 subjects, in which dermal carotenoids were measured using the resonance Raman spectroscopy. The measure was evaluated against biochemical assays of carotenoids in skin biopsies. The results found a high correlation between the Raman and the biochemical measures. Dr. Mayne discussed the advantages of this noninvasive approach to assessing dietary carotenoid exposure, including its low costs.

The symposium concluded with **Dr. Helmut Sies** of the Heinrich Heine University presentation on "Carotenoids and Skin Health". Dr. Sies discussed the results from his research group demonstrating the protective effects of carotenoid supplementation against erythema formation in skin exposed to UV radiation. Of interest was the finding that skin protection resulted from treatments with carrot juice, tomato paste, tomato extracts, and lycopene supplement containing phytoene and phytofluene, but not from a pure lycopene supplement. It was suggested that interaction among carotenoids provided protection against UV radiation.

The CARIG/VARIG social and poster competition was held on Saturday evening, after the conference. The competition was open to the graduate and post-doctoral students. Youn-Kyung Kim, of Rutgers University was awarded top prize for her poster entitled "The Role of β -Carotene 15,15'-Oxygenase (CMO1) during Mammalian Embryonic Development".

The CARIG Committee would like to thank our sponsors: **General Mills, Harvest Plus, International Food Policy Research Institute, Kemin Industries, Sight and Life, and Wyeth**. The full text of the James Allen Olson memorial lecture and an expanded summary of CARIG 2008 can be found in the Sight and Life Newsletter 2/2008 (www.sightandlife.org).

Elizabeth Johnson, Boston, MA

The 15th International Symposium on Carotenoids, June 22-27, 2008

The 15th International Symposium on Carotenoids was held in the Moon Beach Hotel, Okinawa Island, Japan, with Wataru Miki as Chairman and Hideki Hashimoto as Secretary. We thank them and the 'Hashimoto Army' of willing helpers for making this an enjoyable, informative and stimulating event. In total, there were almost 300 participants and more than 30 countries were represented. The location was an opportunity for many of our Japanese colleagues to attend an International Carotenoid Symposium for the first time, and for all of us to enjoy this interesting Pacific island. An awe-inspiring demonstration of martial arts by the Symposium Secretary made sure that attendance in the lecture rooms was good in spite of the lure of the beach. The program, highlighted by the Plenary Lectures of Masayoshi Ito, Fred Khachik, Wataru Miki,

Stefan Branth, Hideki Hashimoto, John Erdman, Gerhard Sandmann and Hansgeorg Ernst, and supported by about 70 other invited lectures, oral communications and lively poster sessions, gave us new research findings and progress reports covering all areas of the carotenoid field. There was a strong emphasis on astaxanthin, including its effects in relation to sports science and performance. At the Symposium banquet, the Otto Isler and Trevor Goodwin Awards of the International Carotenoid Society were presented, respectively, to Masayoshi Ito and, *in absentia*, to Johannes von Lintig. Fred Khachik has now taken over as President of the ICS and, following the elections, Hideki Hashimoto was announced as President Elect, and Liz Johnson, Bruno Robert, Wolfgang Schalch, Carmen Socaciu, and Johannes von Lintig as new Councilors. We congratulate them and thank Richard Cogdell and the retiring Councilors for their work on behalf of the Society. A note for your diary: the 16th International Symposium on Carotenoids will be held in July 2011 in the World Heritage city of Krakow, Poland, with Kazimierz Strzalka as Chairman. A more extensive report will appear shortly on the new website of the ICS.

George Britton, Liverpool, UK

UPCOMING EVENTS

April 18-22, 2009

Experimental Biology 2009, New Orleans, LA. Contact: EB2009, FASEB Office of Scientific Meetings & Conferences, 950 Rockville Pike, Bethesda, MD 20814-3998, **website:** www.eb2009.org, **tel:** 301-634-7010, **e-mail:** eb@faseb.org

12-15 May, 2009

Micronutrient Forum "Micronutrients, Health and Development: Evidence Based Programs", Beijing, China. Contact: Micronutrient Forum Secretariat at A2Z Project, AED, 1825 Connecticut Avenue NW, Washington, DC, 20009, **tel:** 202-884-8785, **e-mail:** mnforum@aed.org

October 4-9, 2009

19th International Congress of Nutrition, Bangkok, Thailand. Contact: AsiaCongress Events Co., Ltd. 10 Soi Lasalle 56, Sukhumvit Rd, Bangna, Bangkok 10260, Thailand. **Website:** www.icn2009.com, **e-mail:** icn2009@asiacongress.com

RECENT / FORTHCOMING PUBLICATIONS

SIGHT AND LIFE Magazine 1 & 2/2008, PO Box 2116, 4002 Basel, Switzerland, **website:** www.sightandlife.org, **e-mail:** klaus.kraemer@sightandlife.org **tel:** 41-61-815-8756, **fax:** 41-61-815-8190. See especially: Barua, AB. Hidden beauty of carotenoids: from brilliant colors to human health (2/2008) Solomons, NW. Carotene Research Interest Group meets in San Diego, California (2/2008)

Carotenoids, Vol. 4: Natural Functions. Eds. Britton, G, Liaaen-Jensen, S, Pfander, H. Birkhäuser-Springer,

2008

Carotenoids Volume 5: Nutrition and Health. Eds. Britton, G, Liaaen-Jensen, S, Pfander, H. Birkhäuser-Springer, 2009

Vegetables and Fruits: Nutritional and Therapeutic Values. Ed. TSC Li, CRC Press, 2008

Phytochemicals: Aging and Health. Eds. MS Meskin, WR Bidlack, RK Randolph, CRC Press, 2008

James Allen Olson (1924-2000). Biographical article by AB Barua and HC Furr, J. Nutr. 138:825-26, 2008

Vitamin A Deficiency and Clinical Disease: An Historical Overview. By A Sommer, J. Nutr. 138: 1835-1839, 2008

Alphabetical Listing of Recent Publications

Prepared by Dr. Harold Furr, Institute of Nutrition, Mahidol University, Thailand, and Department of Nutritional Sciences, University of Wisconsin, Madison. More extensive list may be found at www.carotenoidsociety.org.

Anonymous. [Pigmented basidiomycete yeasts are a promising source of carotenoids and ubiquinone Q10]. Mikrobiologija. 2008; 77: 5-10.

Ahn, C. S. & Pai, H. S. Physiological function of IspE, a plastid MEP pathway gene for isoprenoid biosynthesis, in organelle biogenesis and cell morphogenesis in *Nicotiana benthamiana*. Plant Mol.Biol. 2008; 66: 503-517.

Ajila, C. M. & Prasada Rao, U. J. Protection against hydrogen peroxide induced oxidative damage in rat erythrocytes by *Mangifera indica* L. peel extract. Food Chem.Toxicol. 2008; 46: 303-309.

Al Delaimy, W. K., Natarajan, L., Sun, X., Rock, C. L., & Pierce, J. J. Reliability of plasma carotenoid biomarkers and its relation to study power. Epidemiology. 2008; 19: 338-344.

Anjos Ferreira, A. L., Russell, R. M., Rocha, N., Placido Ladeira, M. S., Favero Salvadori, D. M., Oliveira Nascimento, M. C., Matsui, M., Carvalho, F. A., Tang, G., Matsubara, L. S., & Matsubara, B. B. Effect of lycopene on doxorubicin-induced cardiotoxicity: an echocardiographic, histological and morphometrical assessment. Basic Clin.Pharmacol.Toxicol. 2007; 101: 16-24.

Aoi, W., Naito, Y., Takanami, Y., Ishii, T., Kawai, Y., Akagiri, S., Kato, Y., Osawa, T., & Yoshikawa, T. Astaxanthin improves muscle lipid metabolism in exercise via inhibitory effect of oxidative CPT I modification. Biochem.Biophys.Res.Comm. 2008; 366: 892-897.

Arkkola, T., Uusitalo, U., Kronberg-Kippila, C., Mannisto, S., Virtanen, M., Kenward, M. G., Veijola, R., Knip, M., Ovaskainen, M. L., & Virtanen, S. M. Seven distinct dietary patterns identified among pregnant Finnish women--associations with nutrient intake and sociodemographic factors. Public Health Nutr. 2008; 11: 176-182.

Asai, A., Yonekura, L., & Nagao, A. Low bioavailability of dietary epoxyxanthophylls in humans. Br.J.Nutr. 2008; 100:273-7

Assouly, P., Cavelier-Balloy, B., & Dupre, T. Orange palpebral spots. Dermatology. 2008; 216: 166-170.

Augusti, P. R., Conterato, G. M., Somacal, S., Einsfeld, L., Ramos, A. T., Hosomi, F. Y., Graca, D. L., & Emanuelli, T. Effect of lycopene on nephrotoxicity induced by mercuric chloride in rats. Basic Clin.Pharmacol.Toxicol. 2007; 100: 398-402.

Augusti, P. R., Conterato, G. M., Somacal, S., Sobieski, R., Spohr, P. R., Torres, J. V., Charao, M. F., Moro, A. M., Rocha, M. P., Garcia, S. C., & Emanuelli, T. Effect of astaxanthin on kidney function impairment and oxidative stress induced by mercuric chloride in rats. Food Chem.Toxicol. 2008; 46: 212-9.

Avenson, T. J., Ahn, T. K., Zigmantas, D., Niyogi, K. K., Li, Z., Ballottari, M., Bassi, R., & Fleming, G. R. Zeaxanthin radical cation formation in minor light-harvesting complexes of higher plant antenna. J.Biol.Chem. 2008; 283: 3550-3558.

Badyaev, A. V., Young, R. L., Hill, G. E., & Duckworth, R. A. Evolution of sex-biased maternal effects in birds. IV. Intra-ovarian

growth dynamics can link sex determination and sex-specific acquisition of resources. J.Evol.Biol. 2008; 21: 449-460.

Baeta, R., Faivre, B., Motreuil, S., Gaillard, M., & Moreau, J. Carotenoid trade-off between parasitic resistance and sexual display: an experimental study in the blackbird (*Turdus merula*). Proc.Biol.Sci. 2008; 275: 427-434.

Baldi, A. & Pinotti, L. Lipophilic microconstituents of milk. Adv.Exp.Med.Biol. 2008; 606: 109-125.

Barrero, J. M., Rodriguez, P. L., Quesada, V., Alabadi, D., Blazquez, M. A., Boutin, J. P., Marion-Poll, A., Ponce, M. R., & Micol, J. L. The ABA1 gene and carotenoid biosynthesis are required for late skotomorphogenic growth in *Arabidopsis thaliana*. Plant Cell Environ. 2008; 31: 227-234.

Berthouly, A., Helfenstein, F., Tanner, M., & Richner, H. Sex-related effects of maternal egg investment on offspring in relation to carotenoid availability in the great tit. J.Animal Ecol. 2008; 77: 74-82.

Biesalski, H. K. & Tinz, J. Nutritargeting. Adv.Food Nutr.Res. 2008; 54: 179-217.

Bonente, G., Howes, B. D., Caffarri, S., Smulevich, G., & Bassi, R. Interactions between the Photosystem II Subunit PsbS and xanthophylls studied *in vivo* and *in vitro*. J.Biol.Chem. 2008; 283: 8434-8445.

Bub, A., Moseneder, J., Wenzel, G., Rechkemmer, G., & Briviba, K. Zeaxanthin is bioavailable from genetically modified zeaxanthin-rich potatoes. Eur.J.Nutr. 2008; 47: 99-103.

Buijsse, B., Feskens, E. J., Kwape, L., Kok, F. J., & Kromhout, D. Both α - and β -carotene, but not tocopherols and vitamin C, are inversely related to 15-year cardiovascular mortality in Dutch elderly men. J.Nutr. 2008; 138: 344-350.

Burns Kraft, T. F., Dey, M., Rogers, R. B., Ribnicky, D. M., Gipp, D. M., Cefalu, W. T., Raskin, I., & Lila, M. A. Phytochemical composition and metabolic performance-enhancing activity of dietary berries traditionally used by Native North Americans. J.Agric.Food Chem. 2008; 56: 654-660.

Capanoglu, E., Beekwilder, J., Boyacioglu, D., Hall, R., & de Vos, R. Changes in antioxidant and metabolite profiles during production of tomato paste. J.Agric.Food Chem. 2008; 56: 964-973.

Cena, H., Roggi, C., & Turconi, G. Development and validation of a brief food frequency questionnaire for dietary lutein and zeaxanthin intake assessment in Italian women. Eur.J.Nutr. 2008; 47: 1-9.

Christen, W. G., Liu, S., Glynn, R. J., Gaziano, J. M., & Buring, J. E. Dietary carotenoids, vitamins C and E, and risk of cataract in women: a prospective study. Arch.Ophthalmol. 2008; 126: 102-109.

Cong, H., Niedzwiedzki, D. M., Gibson, G. N., & Frank, H. A. Ultrafast time-resolved spectroscopy of xanthophylls at low temperature. J.Phys.Chem.B. 2008; 112: 3558-3567.

Cucco, M., Guasco, B., Malacarne, G., Ottonelli, R., & Tanvez, A. Yolk testosterone levels and dietary carotenoids influence growth and immunity of grey partridge chicks. Gen.Comp Endocrinol. 2008; 156: 418-425.

Dahan, K., Fennal, M., & Kumar, N. B. Lycopene in the prevention of prostate cancer. J.Soc.Integr.Oncol. 2008; 6: 29-36.

Davis, C., Jing, H., Howe, J. A., Rocheford, T., & Tanumihardjo, S. A. β -Cryptoxanthin from supplements or carotenoid-enhanced maize maintains liver vitamin A in Mongolian gerbils (*Meriones unguiculatus*) better than or equal to β -carotene supplements. Br.J.Nutr. 2008; 1-8.

de Azeredo, V. B. & Trugo, N. M. Retinol, carotenoids, and tocopherols in the milk of lactating adolescents and relationships with plasma concentrations. Nutrition. 2008; 24: 133-139.

Dewell, A., Weidner, G., Sumner, M. D., Chi, C. S., & Ornish, D. A very-low-fat vegan diet increases intake of protective dietary factors and decreases intake of pathogenic dietary factors. J.Am.Diet.Assoc. 2008; 108: 347-356.

Efremov, E. V., Ariele, F., & Gooijer, C. Achievements in resonance Raman spectroscopy review of a technique with a distinct analytical chemistry potential. Anal.Chim.Acta. 2008; 606: 119-134.

Evans, J. R. & Henshaw, K. Antioxidant vitamin and mineral supplements for preventing age-related macular degeneration. Cochrane.Database.Syst.Rev.2008; CD000253.

- Failla, M. L., Huo, T., & Thakkar, S. K. In vitro screening of relative bioaccessibility of carotenoids from foods. *Asia Pac.J.Clin.Nutr* 2008; 17 Suppl 1: 200-203.
- Failla, M. L., Chitchumroonchokchai, C., & Ishida, B. K. In vitro micellarization and intestinal cell uptake of cis isomers of lycopene exceed those of all-*trans* lycopene. *J.Nutr.* 2008; 138: 482-486.
- Fanciullino, A-L., Cercós, M., Dhuique-Mayer, C., Froelicher, Y., Talón, M., Ollitrault, P., & Morillon, R. Changes in carotenoid content and biosynthetic gene expression in juice sacks of four orange varieties (*Citrus sinensis*) differing in flesh fruit color. *J. Agric.Food Chem.* 2008; 56: 3628-38.
- Farwell, W. R., Michael, G. J., Norkus, E. P., & Sesso, H. D. The relationship between total plasma carotenoids and risk factors for chronic disease among middle-aged and older men. *Br.J.Nutr.* 2008; 12: 1-7.
- Fernandez-Robredo, P., Rodriguez, J. A., Sadaba, L. M., Recalde, S., & Garcia-Layana, A. Egg yolk improves lipid profile, lipid peroxidation and retinal abnormalities in a murine model of genetic hypercholesterolemia. *J.Nutr.Biochem.* 2008; 19: 40-48.
- Fernandez, M. M. & Afshari, N. A. Nutrition and the prevention of cataracts. *Curr.Opin.Ophthalmol.* 2008; 19: 66-70.
- Fierce, Y., de, M., V, Piantedosi, R., Wyss, A., Blaner, W. S., & Paik, J. *In vitro* and *in vivo* characterization of retinoid synthesis from β -carotene. *Arch.Biochem.Biophys.* 2008; 472: 126-138.
- Fuster, A., Pico, C., Sanchez, J., Oliver, P., Zingaretti, M. C., Murano, I., Morroni, M., Hoeller, U., Goralczyk, R., Cinti, S., & Palou, A. Effects of 6-month daily supplementation with oral β -carotene in combination or not with benzo[a]pyrene on cell-cycle markers in the lung of ferrets. *J.Nutr.Biochem.* 2008; 19: 295-304.
- Galpaz, N., Wang, Q., Menda, N., Zamir, D., & Hirschberg, J. Abscisic acid deficiency in the tomato mutant high-pigment 3 leading to increased plastid number and higher fruit lycopene content. *Plant J.* 2008; 53: 717-730.
- Giuliano, G., Tavazza, R., Diretto, G., Beyer, P., & Taylor, M. A. Metabolic engineering of carotenoid biosynthesis in plants. *Trends Biotechnol.* 2008; 26: 139-145.
- Greene, G. W., Resnicow, K., Thompson, F. E., Peterson, K. E., Hurley, T. G., Hebert, J. R., Toobert, D. J., Williams, G. C., Elliot, D. L., Goldman, S. T., Domas, A., Midthune, D., Stacewicz-Sapuntzakis, M., Yaroch, A. L., & Nebeling, L. Correspondence of the NCI Fruit and Vegetable Screener to repeat 24-H recalls and serum carotenoids in behavioral intervention trials. *J.Nutr.* 2008; 138: 200S-204S.
- Grewe, C., Menge, S., & Griehl, C. Enantioselective separation of all-*E*-astaxanthin and its determination in microbial sources. *J.Chromatogr.A.* 2007; 1166: 97-100.
- Herbert, R. A., Gall, A., Maoka, T., Cogdell, R. J., Robert, B., Takaichi, S., & Schwabe, S. Phototrophic purple sulfur bacteria as heat engines in the South Andros Black Hole. *Photosynth.Res.* 2008; 95: 261-268.
- Huang, C. S., Liao, J. W., & Hu, M. L. Lycopene inhibits experimental metastasis of human hepatoma SK-Hep-1 cells in athymic nude mice. *J.Nutr.* 2008; 138: 538-543.
- Ibanez, S., Rosa, M., Hilal, M., Gonzalez, J. A., & Prado, F. E. Leaves of *Citrus aurantifolia* exhibit a different sensibility to solar UV-B radiation according to development stage in relation to photosynthetic pigments and UV-B absorbing compounds production. *J.Photochem.Photobiol.B.* 2008; 90: 163-169.
- Isaksson, C., Johansson, A., & Andersson, S. Egg yolk carotenoids in relation to habitat and reproductive investment in the great tit *Parus major*. *Physiol Biochem.Zool.* 2008; 81: 112-8.
- Isaksson, C. & Andersson, S. Oxidative stress does not influence carotenoid mobilization and plumage pigmentation. *Proc.Biol.Sci.* 2008; 275: 309-314.
- Jacob, K., Periago, M. J., Bohm, V., & Berrueto, G. R. Influence of lycopene and vitamin C from tomato juice on biomarkers of oxidative stress and inflammation. *Br.J.Nutr.* 2008; 99: 137-146.
- Johnson, M. P., Davison, P. A., Ruban, A. V., & Horton, P. The xanthophyll cycle pool size controls the kinetics of non-photochemical quenching in *Arabidopsis thaliana*. *FEBS Lett.* 2008; 582: 262-266.
- Juola, F. A., McGraw, K., & Dearborn, D. C. Carotenoids and throat pouch coloration in the great frigatebird (*Fregata minor*). *Comp Biochem.Physiol B Biochem.Mol.Biol.* 2008; 149: 370-377.
- Kalariya, N. M., Ramana, K. V., Srivastava, S. K., & van Kuijk, F. J. Carotenoid derived aldehydes-induced oxidative stress causes apoptotic cell death in human retinal pigment epithelial cells. *Exp.Eye Res.* 2008; 86: 70-80.
- King-Batoon, A., Leszczynska, J. M., & Klein, C. B. Modulation of gene methylation by genistein or lycopene in breast cancer cells. *Environ.Mol.Mutagen.* 2008; 49: 36-45.
- Kiokias, S., Varzakas, T., & Oreopoulou, V. *In vitro* activity of vitamins, flavonoids, and natural phenolic antioxidants against the oxidative deterioration of oil-based systems. *Crit Rev.Food Sci.Nutr.* 2008; 48: 78-93.
- Klassen, J. L. & Foght, J. M. Differences in carotenoid composition among hymenobacter and related strains support a tree-like model of carotenoid evolution. *Appl.Environ.Microbiol.* 2008; 74: 2016-2022.
- Kruk, J. & Szymanska, R. Occurrence of neoxanthin and lutein epoxide cycle in parasitic *Cuscuta* species. *Acta Biochim.Pol.* 2008; 55: 183-190.
- Liu, W. L., Zheng, Z. R., Dai, Z. F., Liu, Z. G., Zhu, R. B., Wu, W. Z., Li, A. H., Yang, Y. Q., & Su, W. H. Effect of solvent on absorption spectra of all-*trans*- β -carotene under high pressure. *J.Chem.Phys.* 2008; 128: 124501-8.
- Loane, E., Nolan, J. M., O'Donovan, O., Bhosale, P., Bernstein, P. S., & Beatty, S. Transport and retinal capture of lutein and zeaxanthin with reference to age-related macular degeneration. *Surv.Ophthalmol.* 2008; 53: 68-81.
- Lopez, A. B., Van Eck, J., Conlin, B. J., Paolillo, D. J., O'Neill, J., & Li, L. Effect of the cauliflower Or transgene on carotenoid accumulation and chromoplast formation in transgenic potato tubers. *J.Exp.Bot.* 2008; 59: 213-223.
- Maoka, T. & Akimoto, N. Carotenoids and their fatty acid esters of spiny lobster *Panulirus japonicus*. *J.Oleo.Sci.* 2008; 57: 145-152.
- Martin, J., Amo, L., & Lopez, P. Parasites and health affect multiple sexual signals in male common wall lizards, *Podarcis muralis*. *Naturwissenschaften.* 2008; 95: 293-300.
- Merzlyak, M. N., Melo, T. B., & Naqvi, K. R. Effect of anthocyanins, carotenoids, and flavonols on chlorophyll fluorescence excitation spectra in apple fruit: signature analysis, assessment, modelling, and relevance to photoprotection. *J.Exp.Bot.* 2008; 59: 349-359.
- Miglio, C., Chiavaro, E., Visconti, A., Fogliano, V., & Pellegrini, N. Effects of different cooking methods on nutritional and physicochemical characteristics of selected vegetables. *J.Agric.Food Chem.* 2008; 56: 139-147.
- Misbahuddin, M., Momin, A., & Al Amin, M. All-E lutein and 3'-epilutein in the epidermis of chronic arsenic poisoning. *Clin.Toxicol.(Phila).* 2008; 46: 176-180.
- Moeller, S. M., Volland, R., Tinker, L., Blodi, B. A., Klein, M. L., Gehrs, K. M., Johnson, E. J., Snodderly, D. M., Wallace, R. B., Chappell, R. J., Parekh, N., Ritenbaugh, C., & Mares, J. A. Associations between age-related nuclear cataract and lutein and zeaxanthin in the diet and serum in the Carotenoids in the Age-Related Eye Disease Study (CAREDS), an ancillary study of the Women's Health Initiative. *Arch.Ophthalmol.* 2008; 126: 354-364.
- Mougeot, F. Ornamental comb colour predicts T-cell-mediated immunity in male red grouse *Lagopus lagopus scoticus*. *Naturwissenschaften.* 2008; 95: 125-132.
- Mozzo, M., Dall'Osto, L., Hienerwadel, R., Bassi, R., & Croce, R. Photoprotection in the antenna complexes of Photosystem II: role of individual xanthophylls in chlorophyll triplet quenching. *J.Biol.Chem.* 2008; 283: 6184-6192.
- Ni, H., Chen, Q. H., He, G. Q., Wu, G. B., & Yang, Y. F. Optimization of acidic extraction of astaxanthin from *Phaffia rhodozyma*. *J.Zhejiang.Univ.Sci.B.* 2008; 9: 51-59.
- Nicolas, F. E., Calo, S., Murcia-Flores, L., Garre, V., Ruiz-Vazquez, R. M., & Torres-Martinez, S. A RING-finger photocarotenogenic repressor involved in asexual sporulation in *Mucor circinelloides*. *FEMS Microbiol.Lett.* 2008; 280: 81-88.
- O'Brien, E. L. & Dawson, R. D. Parasite-mediated growth patterns and nutritional constraints in a cavity-nesting bird. *J.Anim Ecol.* 2008; 77: 127-134.
- Obana, A., Hiramitsu, T., Gohto, Y., Ohira, A., Mizuno, S., Hirano, T., Bernstein, P. S., Fujii, H., Iseki, K., Tanito, M., & Hotta, Y. Macular carotenoid levels of normal subjects and age-related maculopathy patients in a Japanese population. *Ophthalmology.* 2008; 115: 147-157.

- Ohira, T., Hozawa, A., Iribarren, C., Daviglus, M. L., Matthews, K. A., Gross, M. D., & Jacobs, D. R., Jr. Longitudinal association of serum carotenoids and tocopherols with hostility: the CARDIA Study. *Am.J.Epidemiol.* 2008; 167: 42-50.
- Olsson, M., Wilson, M., Isaksson, C., Uller, T., & Mott, B. Carotenoid intake does not mediate a relationship between reactive oxygen species and bright colouration: experimental test in a lizard. *J.Exp.Biol.* 2008; 211: 1257-1261.
- Ozaki, M. & Ozaki, K. [Insect proteins transporting hydrophobic substances: Introduction.]. *Tanpakushitsu Kakusan Koso.* 2008; 53: 101-103.
- Palozza, P., Barone, E., Mancuso, C., & Picci, N. The protective role of carotenoids against 7-keto-cholesterol formation in solution. *Mol.Cell Biochem.* 2008; 309: 61-68.
- Pan, X., Chen, M., Liu, Y., Wang, Q., Zeng, L., Li, L., & Liao, Z. A new isopentenyl diphosphate isomerase gene from *Campylothea acuminata*: Cloning, characterization and functional expression in *Escherichia coli*. *DNA Seq.* 2008; 19: 98-105.
- Papas, K. A., Sontag, M. K., Pardee, C., Sokol, R. J., Sagel, S. D., Accurso, F. J., & Wagener, J. S. A pilot study on the safety and efficacy of a novel antioxidant rich formulation in patients with cystic fibrosis. *J.Cyst.Fibros.* 2008; 7: 60-67.
- Parisi, V., Tedeschi, M., Gallinaro, G., Varano, M., Saviano, S., & Piermarocchi, S. Carotenoids and antioxidants in age-related maculopathy italian study: multifocal electroretinogram modifications after 1 year. *Ophthalmology.* 2008; 115: 324-333.
- Park, S. K., Lee, H. J., Lee, D. H., Lee, S. K., Chun, B. Y., Kim, S. A., Lee, H. S., Son, H. K., & Kim, S. H. [Associations of non alcoholic fatty liver with the metabolic syndrome and serum carotenoids]. *J.Prev.Med.Pub.Health.* 2008; 41: 39-44.
- Peters, U., Leitzmann, M. F., Chatterjee, N., Wang, Y., Albanes, D., Gelmann, E. P., Friesen, M. D., Riboli, E., & Hayes, R. B. Serum lycopene, other carotenoids, and prostate cancer risk: a nested case-control study in the prostate, lung, colorectal, and ovarian cancer screening trial. *Cancer Epidemiol.Biomarkers Prev.* 2007; 16: 962-968.
- Rehak, M., Fric, E., & Wiedemann, P. [Lutein and antioxidants in the prevention of age-related macular degeneration.]. *Ophthalmologie.* 2008; 105: 37-45.
- Ruppel, S., Krumbein, A., & Schreiner, M. Composition of the Phyllospheric Microbial Populations on Vegetable Plants with Different Glucosinolate and Carotenoid Compositions. *Microb.Ecol.* 2008; 58: 364-372.
- Saino, N., Bertacche, V., Bonisoli-Alquati, A., Romano, M., & Rubolini, D. Phenotypic correlates of yolk and plasma carotenoid concentration in yellow-legged gull chicks. *Physiol Biochem.Zool.* 2008; 81: 211-225.
- Sakudoh, T. & Tsuchida, K. [Insect proteins transporting hydrophobic substances: Transport system of carotenoids responsible for the body coloration]. *Tanpakushitsu Kakusan Koso.* 2008; 53: 125-131.
- Schnabele, K., Briviba, K., Bub, A., Roser, S., Pool-Zobel, B. L., & Rechkemmer, G. Effects of carrot and tomato juice consumption on faecal markers relevant to colon carcinogenesis in humans. *Br.J.Nutr.* 2008; 99: 606-613.
- Schwarz, S., Obermuller-Jevic, U. C., Hellmis, E., Koch, W., Jacobi, G., & Biesalski, H. K. Lycopene inhibits disease progression in patients with benign prostate hyperplasia. *J.Nutr.* 2008; 138: 49-53.
- Seino, Y., Miki, T., Kiyonari, H., Abe, T., Fujimoto, W., Kimura, K., Takeuchi, A., Takahashi, Y., Oiso, Y., Iwanaga, T., & Seino, S. Isx participates in the maintenance of vitamin A metabolism by regulation of β -carotene 15,15'-monooxygenase (Bcmo1) expression. *J.Biol.Chem.* 2008; 283: 4905-4911.
- Seren, S., Lieberman, R., Bayraktar, U. D., Heath, E., Sahin, K., Andic, F., & Kucuk, O. Lycopene in cancer prevention and treatment. *Am.J.Ther.* 2008; 15: 66-81.
- Simkin, A. J., Moreau, H., Kuntz, M., Pagny, G., Lin, C., Tanksley, S., & McCarthy, J. An investigation of carotenoid biosynthesis in *Coffea canephora* and *Coffea arabica*. *J.Plant Physiol.* 2008; 165: 1087-1106.
- Spada, P. D., de Souza, G. G., Bortolini, G. V., Henriques, J. A., & Salvador, M. Antioxidant, mutagenic, and antimutagenic activity of frozen fruits. *J.Med.Food.* 2008; 11: 144-151.
- Stacewicz-Sapuntzakis, M., Borthakur, G., Burns, J. L., & Bowen, P. E. Correlations of dietary patterns with prostate health. *Mol.Nutr.Food Res.* 2008; 52: 114-130.
- Stahl-Stajner, D., Igic, R., Popovic, B. M., & Malencic, D. Comparative study of antioxidant properties of wild growing and cultivated *Allium* species. *Phytother.Res.* 2008; 22: 113-117.
- Stringham, J. M. & Hammond, B. R. Macular pigment and visual performance under glare conditions. *Optom.Vis.Sci.* 2008; 85: 82-88.
- Stroch, M., Kuldova, K., Kalina, J., & Spunda, V. Dynamics of the xanthophyll cycle and non-radiative dissipation of absorbed light energy during exposure of Norway spruce to high irradiance. *J.Plant Physiol.* 2008; 165: 612-622.
- Sugiura, M., Nakamura, M., Ogawa, K., Ikoma, Y., Ando, F., & Yano, M. Bone mineral density in post-menopausal female subjects is associated with serum antioxidant carotenoids. *Osteoporos.Int.* 2008; 19: 211-219.
- Szilagyi, A., Selstam, E., & Akerlund, H. E. Laurdan fluorescence spectroscopy in the thylakoid bilayer: the effect of violaxanthin to zeaxanthin conversion on the galactolipid dominated lipid environment. *Biochim.Biophys.Acta.* 2008; 1778: 348-355.
- Terry, K. L., Missmer, S. A., Hankinson, S. E., Willett, W. C., & De Vivo, I. Lycopene and other carotenoid intake in relation to risk of uterine leiomyomata. *Am.J.Obstet.Gynecol.* 2008; 198: 37-38.
- Thurnham, D. I., Mburu, A. S., Mwaniki, D. L., Muniu, E. M., Alumas, F., & de Wagt, A. Using plasma acute-phase protein concentrations to interpret nutritional biomarkers in apparently healthy HIV-1-seropositive Kenyan adults. *Br.J.Nutr.* 2008; 1-9.
- Tu, C. Y., Guo, W. H., & Hu, C. H. Theoretical study of the enthalpies of formation for $C_{40}H_{56}$ carotenes. *J.Phys.Chem.A.* 2008; 112: 117-124.
- Valverde, J. & This, H. 1H NMR quantitative determination of photosynthetic pigments from green beans (*Phaseolus vulgaris* L.). *J.Agric.Food Chem.* 2008; 56: 314-320.
- Veeramachaneni, S., Ausman, L. M., Choi, S. W., Russel, R. M. & Wang, X-D. High dose lycopene supplementation increases hepatic cytochrome P450E1 protein and inflammation in alcohol-fed rats. *J. Nutr.* 2008; 138:1329-1335.
- Vijayalakshmi, A. M. Carotenoderma. *Indian Pediatr.* 2008; 45: 61.
- Wang, W., Shinto, L., Connor, W. E., & Quinn, J. F. Nutritional biomarkers in Alzheimer's Disease: the association between carotenoids, n-3 fatty acids, and dementia severity. *J.Alzheimers.Dis.* 2008; 13: 31-38.
- Widomska, J. & Subczynski, W. K. Transmembrane localization of cis-isomers of zeaxanthin in the host dimyristoylphosphatidylcholine bilayer membrane. *Biochim.Biophys.Acta.* 2008; 1778: 10-19.
- Wigle, D. T., Turner, M. C., Gomes, J., & Parent, M. E. Role of hormonal and other factors in human prostate cancer. *J.Toxicol.Environ.Health B Crit Rev.* 2008; 11: 242-259.
- Winichagoon, P. Limitations and resolutions for dietary assessment of micronutrient intakes. *Asia Pac.J.Clin.Nutr* 2008; 17 Suppl 1: 296-298.
- Wood, L. G., Garg, M. L., Powell, H., & Gibson, P. G. Lycopene-rich treatments modify noneosinophilic airway inflammation in asthma: proof of concept. *Free Radic.Res.* 2008; 42: 94-102.
- Yamaguchi, N. & Suruga, K. Triiodothyronine stimulates CMO1 gene expression in human intestinal Caco-2 BBe cells. *Life Sci.* 2008; 82: 789-796.
- Yaroch, A. L., Nebeling, L., Thompson, F. E., Hurley, T. G., Hebert, J. R., Toobert, D. J., Resnicow, K., Greene, G. W., Williams, G. C., Elliot, D. L., Goldman, S. T., Stacewicz-Sapuntzakis, M., Salkeld, J., Rossi, S., Domas, A., McGregor, H., Defrancesco, C., Mccarty, F., Costello, R. B., & Peterson, K. E. Baseline design elements and sample characteristics for seven sites participating in the Nutrition Working Group of the Behavior Change Consortium. *J.Nutr.* 2008; 138: 185S-192S.
- Yoshimura, K. & Kouyama, T. Structural role of bacterioruberin in the trimeric structure of archaerhodopsin-2. *J. Mol.Biol.* 2008; 375: 1267-1281.

TECHNICAL NOTE

Nanoemulsions show potential for fighting cancer

Nanoemulsions containing bioactive compounds such as curcumin, or antioxidants like lycopene, may reduce the growth and spread of cancer cells. The research may lead to new and cost-effective ways of reducing the risk or improving the fight against certain cancers, if the results of early animal studies can be repeated in humans. Professor Robert Nicolosi from the University of Massachusetts told attendees at the IFT International Food Nanoscience Conference in New Orleans that nanoemulsions created using a high-pressure microfluidiser have led to the reduction in the size and growth of cancer cells in lab animals. Animals injected with neuroblastoma to promote the growth of cancer cells and then exposed to antioxidant nanoemulsions experienced shrinkage in tumours by 65%. A combination of antioxidants called the antioxidant synergy formulation (ASF) showed potential to reduce cancer cell growth. An added advantage of the nanoemulsions is that smaller quantities of the bioactives can be used to achieve the beneficial effects. This makes for cost-saving on the ingredients. The bioavailability and efficacy of vitamin E, for example, is increased when formulated in the nanoemulsions. Preparation of the nanoemulsions, oil-in-water or water-in-oil mixture with particles in the nanometre scale, is achieved using a microfluidiser. Water and an emulsifier, like lecithin, are mixed with the bioactive compound, and then poured into the microfluidiser, which compresses the solution and forces it through tiny channels. These microchannels are then split and the solution forced to collide with itself at extremely high speed. The collision produces a stable nanoemulsion. Using the microfluidiser has enabled the production of stable nanoemulsions, making them commercially viable. Previously, the particles in nanoemulsions were found in a wide size range, from 5 nm to 5 µm and they weren't very stable. The University of Massachusetts researchers are exploring the potential of the microfluidised particles to formulate food; beverages, and nutritional supplements to reduce inflammation, and cholesterol, and thereby reduce the risk of chronic disease such as cardiovascular disease.

www.nutraingredients-usa.com (7/2/2008)

NEWS AND VIEWS

Steven Schwartz – 2008 ITF Fellow

Steven Schwartz, Carl E. Haas Endowed Professor of Food Science & Technology, Ohio State University, was recognized by the Institute of Food Technologists for research on antioxidants and food components related to chronic disease, oxidative stress, bioavailability, and cancer prevention and control. His laboratory focuses on the application of food chemistry toward understanding the chemopreventative properties of bioactive components in the diet, particularly the carotenoid compounds. Schwartz reported about the effects of food processing and food formulation on enhancing carotenoid bioavailability and has expanded this research to the study of other phytochemicals in foods. His laboratory has employed several analytical techniques toward understanding the metabolism of bioactives from functional foods and their role in chronic disease prevention.

High Dose Lycopene Supplementation Increases Hepatic CYP2E1 Protein and Inflammation in Alcohol-Fed Rats

Excessive alcohol intake results in liver inflammation which may be prevented by antioxidant supplementation. The effect of supplementing the antioxidant lycopene has not been investigated in alcohol induced inflammation. Furthermore, it is not known if the effects of lycopene are dependent on the dose in which it is consumed. This study tested the effects of two doses of lycopene (1.1 or 3.3 mg/kg body weight per day) on liver inflammation in rats that were fed with or without alcohol for 11 weeks. Rats fed both alcohol and lycopene accumulated higher amounts of lycopene in the liver compared to rats that were fed the same dose of lycopene without alcohol. In addition, rats fed both the higher dose of lycopene and alcohol had higher amount of cytochrome p4502E1 protein and tumor necrosis factor alpha, both of which are elevated with inflammation. Furthermore, these rats also had an increased number of inflammatory cells in the liver. Similar effects were not observed in animals that were fed the high dose of lycopene without alcohol. Our data indicate an interaction between excessive alcohol intake and high dose lycopene consumption and suggest a need for caution among individuals consuming high amounts of both alcohol and lycopene.

Veeramachaneni, S. et al. J. Nutr. 138:1329-35(2008)



Xanthophylls are preferentially taken up by retinal cells via a SRBI-dependent mechanism

The purpose of this study was to investigate the mechanisms by which carotenoids (xanthophylls vs. β -carotene) are taken up by retinal pigment epithelial (RPE) cells. The human RPE cell line, ARPE-19, was used. When ARPE-19 cells were fully differentiated (7–9 weeks), the xanthophylls lutein and zeaxanthin were taken up by cells to an extent 2-fold higher than β -carotene ($P < 0.05$). At 9 weeks, cellular uptakes were 1.6%, 2.5%, and 3.2%, respectively, for β -carotene, lutein and zeaxanthin. Similar extents were observed when carotenoids were delivered in either Tween 40 or "chylomicrons" produced by Caco-2 cells. Differentiated ARPE-19 cells did not exhibit any detectable β -carotene-15,15'-oxygenase activity or convert exogenous β -carotene into vitamin A. When using specific antibodies against the lipid transporters cluster determinant 36 (CD36) and scavenger receptor class B type I (SR-BI), cellular uptake of β -carotene and zeaxanthin were significantly decreased (40–60%) with anti-SR-BI, but not with anti-CD36. Small interfering RNA transfection for SR-BI led to marked knockdown of SR-BI protein

expression ($\sim 90\%$), which resulted in decreased β -carotene and zeaxanthin uptakes by 51% and 87%, respectively. Thus, the present data show that RPE cells preferentially take up xanthophylls versus β -carotene by a process that appears to be entirely SR-BI-dependent for zeaxanthin and partly so for β -carotene. This mechanism may explain, in part, the preferential accumulation of xanthophylls in the macula of the retina.

During, A. et al., J. Lipid Res. 49:1715-24 (2008)

Aguaje, Amazon's Next Miracle Fruit?

Once obscure Amazon fruits, like açai, are riding health claims to supermarket success. Could a scaly palm fruit be the rain forest's next popular export? In the rain forests of Peru's remote Pacaya-Samiria National Reserve, mothers don't make kids eat their carrots. Instead, kids munch on aguaje, a crisp, yellow fruit of *Mauritia flexuosa* palm tree, covered in maroon scales. It tastes a bit like a carrot, but packs three times the vitamin A punch. Oil high in provitamin A may be extracted from the pulp and is frequently used to treat burns because of its soothing qualities. The oil contains high concentrations of oleic acid, tocopherols and carotenoids, especially β -carotene. Aguaje is just one of more than a hundred wild and domesticated fruits available to people each year in this 8,000-square-mile chunk of protected Amazon wetland at the confluence of two rivers in northeastern Peru. And with so much variety and abundance, it's not surprising that these fruits form the centerpiece of the local diet. The reserve's 100,000 residents depend on them for many nutrients, like vitamins, protein, and oils that the rest of us normally get from a variety of other foods, including vegetables and nuts.

National Geographic Magazine, (10/14/ 2008)

Internet Addresses for Carotenoid Researchers

1. USDA Nutrient Database for Standard Reference (SR17) is a major source of food composition data for epidemiologists and nutritionists. Carotenoid Food Database contains best available estimates of carotenoid content in foods:

www.nal.usda.gov/fnic/foodcomp/Data/car98/car98.html

2. Agricultural Research Service (ARS) prepared searchable database to view 60-nutrient profile (including carotenoids) for more than 13,000 foods:

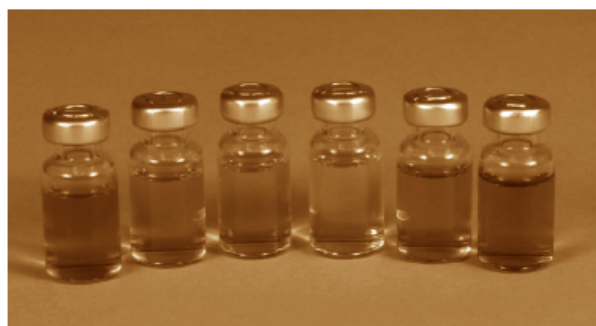
www.ars.usda.gov/foodsearch

3. International Carotenoid Society (ICS) Webpage: www.carotenoidsociety.org.

4. LIPID BANK for Web. Carotenoid Section of Lipid Database developed by Research Institute, International Medical Center of Japan, <http://lipidbank.jp>. Also available on ICS webpage: www.carotenoidsociety.org through Articles button.

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