

Carotenoid News

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FROM THE EDITOR

“Доверяй, но проверяй.” (“Trust, but verify.”)

This old Russian proverb was a favorite of the late President Ronald Reagan, especially regarding foreign policy matters. We should also keep it in mind while reading about the latest scientific developments and discoveries. The recent scandal of purported human embryo cloning and creating stem lines for specific patients underlines the necessity of great vigilance on the part of editors and reviewers. Peer reviewers of manuscripts submitted to scientific journals bear the burden of responsibility to question, verify and clarify any lingering doubt they may have about the authenticity of the reported data. Less odious, but still very troubling, is the frequent publication of worthless results based on insensitive or inconsistent methods, which is subsequently discovered by other researchers trying to use the same techniques in their laboratories. Countless hours of work, valuable resources and the best efforts of skilled workers are wasted on such futile pursuits, while the original authors are proud of their publication record.

Therefore, a solitary reading of publications and exchange of electronic letters cannot replace scientific meetings, where scientists may present and discuss their findings in an open and honest public debate. Such great opportunity presents itself at Experimental Biology 2006 in San Francisco, on April 1-5, and you may find the detailed program of exciting carotenoid-related events in this newsletter.

Maria S. Sapuntzakis (Chicago, IL)

CARIG TRAVEL AWARDS

Abstract competition

CARIG will award a \$500 grant for travel to Experimental Biology 2006, San Francisco, CA based on the scientific merit of EB 2006 abstracts. Graduate students who have not yet received a doctoral degree are eligible. Please send a copy of your abstract (in the EB 2006 format) and a letter that briefly describes the significance of the research and your role in the research to: Wendy S. White, Ph.D., Department of Food Science and Human Nutrition, 1127 Human Nutritional Sciences Building, Iowa State University, Ames, IA 50011; FAX: 515 294-5390; E-mail (preferred): wswwhite@iastate.edu. The winning entry will be announced at the CARIG Conference. **The extended deadline for submitted abstracts is March 20, 2006.**

Poster competition

New this year! CARIG will award a \$500 travel grant based on a poster competition to be held in conjunction with the CARIG/VARIG social at Experimental Biology 2006. 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'06, printed copies of the slides may be used for the CARIG/VARIG poster competition. All candidates will be required to briefly present their experimental findings in poster format at the CARIG/VARIG social, 6:30-8:30 PM, Saturday, April 1, in the Argent Hotel, Metropolitan III. The winning entry will be announced at the social. Contact: Wendy S. White, Ph.D., Iowa State University, Ames, IA. Phone: 515 294-3447; E-mail: wswwhite@iastate.edu.

UPCOMING EVENTS

March 15-18, 2006

The XV Annual Congress of the Oxygen Club of California on Oxidants and Antioxidants in Biology, Santa Barbara, CA. Contact: **website:** www.oxyclubcalifornia.org

April 1-5, 2006

Experimental Biology 2006, San Francisco, CA

Contact: EB2005, FASEB Office of Scientific Meetings & Conferences, 9650 Rockville Pike, Bethesda MD 20814-3998, **website:** www.faseb.org/meetings/eb2006 [See CARIG Conference Program and other highlights below]

June 6-8, 2006

7th World Congress on the Processing Tomato, Tunisia.

Contact: Sophie Colvine, **tel/fax:** 44-1387-820322, **E-mail:** colvine@tomate.org

July 13-14, 2006

The International Research Conference on Food, Nutrition and Cancer, Washington, DC. **Contact:** tel: 202-328-7744, **website:** www.oxyclubcalifornia.org

October 9-12, 2006

4th International Congress on Pigments in Food, Stuttgart-Hohenheim, Germany. **Contact:** Dr.R. Carle, August-Von-Hartmann-Str 3, 70599 Stuttgart, Germany, **tel:** 0049(0) 711-459-2314, **E-mail:** pf2006@uni-hohenheim.de, **website:** www.pigmentsinfood2006.uni-hohenheim.de

HIGHLIGHTS OF EXPERIMENTAL BIOLOGY 2006

Saturday, April 1. **CARIG Annual Conference**, 1-4:30 PM, Argent Hotel, Metropolitan II

CARIG/VARIG Social and Graduate

Student & Postdoc Poster Competition,

6:30-8:30 PM, Argent Hotel, Metropolitan III

Tuesday, April 4. **Carotenoid Poster Session**, 12:45-2:45 PM,

Moscone Convention Center, Exhibit Hall

W.O. Atwater Memorial Lecture, 12:45-1:45

Colors, Critters, and Cancer, *John Erdman*,

University of Illinois Urbana-Champaign,

Moscone Convention Center, Rm 102

Carotenoid Minisymposium, 3-5 PM,

Moscone Convention Center, Rm 310

2006 CARIG Annual Conference

Saturday, April 1, 2006, 1:00-4:30 PM

Argent Hotel, Metropolitan II

Chair: Elizabeth Johnson, USDA Human Nutrition Research Center on Aging, Tufts University

James Allen Olson Memorial Perspectives on Carotenoids Lecture: “Reflections: Four Decades with Vitamin A and Carotenoids” *Barbara Underwood, Columbia University*
Mechanisms Involved in the Intestinal Absorption of Dietary Carotenoids. *Earl Harrison, USDA Human Nutrition Research Center, Beltsville*

Tomato, Lycopene, and Risk of Prostate Cancer, *John W. Erdman, University of Illinois Urbana-Champaign*
Reviewing the Scientific Evidence for Health Claims, *Kathleen C. Ellwood, FDA/CFSAN*

RECENT / FORTHCOMING PUBLICATIONS

Sight and Life Newsletter 3/2005, publication of the Task Force SIGHT AND LIFE, PO Box 2116, 4002 Basel, Switzerland, **web:** www.sightandlife.org, **tel:** 41-61-688-7494, **fax:** 41-61-688-1910, See especially a report on 14th International Symposium on Carotenoids by H. Pfander and K. Bernhard.

Harvest Plus Technical Monograph Series 3,4,5,6 (2005) Provitamin A carotenoids in foods, their health benefits, bioavailability, intervention programs, study techniques. **web:** www.harvestplus.org/pubs.html

Methods of Analysis for Food Components and Additives. Ed S.Otles, (2005) CRC Press. Contains chapter on "Analysis of Carotenoids and Chlorophylls in Foods" by J.H. Lee and S.J. Schwartz.

Carcinogenic and Anticarcinogenic Food Components. Ed. W.Baer-Dubowska, A. Bartoszek, D Malejka-Giganti, (2005) CRC Press. Contains chapter on "Carotenoids in Cancer Prevention" by C. Fortes.

Lutein and zeaxanthin. Monograph. (2005) *Altern.Med.Rev.* 10: 128-135.

Alphabetical Listing of Recent Publications

Prepared by Dr. Harold Furr, Craft Technologies, Inc.

More extensive list may found at www.carotenoidsociety.org

Abbo, S., Molina, C., Jungmann, R., Grusak, M. A., Berkovitch, Z., Reifen, R., Kahl, G., Winter, P., & Reifen, R. (2005) Quantitative trait loci governing carotenoid concentration and weight in seeds of chickpea (*Cicer arietinum* L.). *Theor.Appl.Genet.* 111: 185-195.

Agner, A. R., Bazo, A. P., Ribeiro, L. R., & Salvadori, D. M. (2005) DNA damage and aberrant crypt foci as putative biomarkers to evaluate the chemopreventive effect of annatto (*Bixa orellana* L.) in rat colon carcinogenesis. *Mutat.Res.* 582: 146-154.

Agte, V., Jahagirdar, M., & Chiplonkar, S. (2005) Apparent absorption of eight micronutrients and phytic acid from vegetarian meals in ileostomized human volunteers. *Nutrition* 21: 678-685.

Agte, V., Jahagirdar, M., & Chiplonkar, S. (2006) GLV supplements increased plasma β -carotene, vitamin C, zinc and hemoglobin in young healthy adults. *Eur.J.Nutr.* 45:29-36.

Aklujkar, M. & Beatty, J. T. (2005) The PufX protein of *Rhodobacter capsulatus* affects the properties of bacteriochlorophyll a and carotenoid pigments of light-harvesting complex 1. *Arch.Biochem.Biophys.* 443: 21-32.

Al Babil, S. & Beyer, P. (2005) Golden Rice - five years on the road - five years to go? *Trends Plant Sci.* 10:565-573.

Al Delaimy, W. K., Ferrari, P., Slimani, N. et al. (2005) Plasma carotenoids as biomarkers of intake of fruits and vegetables: individual-level correlations in the European Prospective Investigation into Cancer and Nutrition (EPIC). *Eur.J.Clin.Nutr.* 59: 1387-1396.

Al Delaimy, W. K., Slimani, N., Ferrari, P. et al. (2005) Plasma carotenoids as biomarkers of intake of fruits and vegetables: ecological-level correlations in the European Prospective Investigation into Cancer and Nutrition (EPIC). *Eur.J.Clin.Nutr.* 59: 1397-1408.

Al Farsi, M., Alasalvar, C., Morris, A., Baron, M., & Shahidi, F. (2005) Comparison of antioxidant activity, anthocyanins, carotenoids, and phenolics of three native fresh and sun-dried date (*Phoenix dactylifera* L.) varieties grown in Oman. *J.Agric.Food Chem.* 53: 7592-7599.

Al Wadei, H. A., Takahashi, T., & Schuller, H. M. (2006) Growth stimulation of human pulmonary adenocarcinoma cells and small airway epithelial cells by β -carotene via activation of cAMP, PKA, CREB and ERK1/2. *Int.J.Cancer* 118:1370-80.

Alfonso, H. S., Fritschi, L., de Klerk, N. H., Ambrosini, G., Beilby, J., Olsen, N., & Musk, A. W. (2005) Plasma concentrations of retinol, carotene, and vitamin E and mortality in subjects with asbestosis in a cohort exposed to crocidolite in Wittenoom, Western Australia. *J.Occup.Environ.Med.* 47: 573-579.

Alper, H., Miyaoku, K., & Stephanopoulos, G. (2005) Construction of lycopene-overproducing *E. coli* strains by combining systematic and combinatorial gene knockout targets. *Nat.Biotechnol.* 23: 612-616.

Alper, H., Jin, Y. S., Moxley, J. F., & Stephanopoulos, G. (2005) Identifying gene targets for the metabolic engineering of lycopene biosynthesis in *Escherichia coli*. *Metab Eng* 7: 155-164.

Alic, J. (2005) *In vivo* carotenoid triplet formation in response to excess light: a supramolecular photoprotection mechanism revisited. *Photosynth.Res.* 83: 335-341.

Aman, R., Schieber, A., & Carle, R. (2005) Effects of heating and illumination on *trans-cis* isomerization and degradation of β -carotene and lutein in isolated spinach chloroplasts. *J.Agric.Food Chem.* 53: 9512-9518.

Anderson, M. L. (2005) A preliminary investigation of the enzymatic inhibition

of 5 α -reduction and growth of prostatic carcinoma cell line LNCap-FGC by natural astaxanthin and Saw Palmetto lipid extract in vitro. *J.Herb.Pharmacother.* 5: 17-26.

Antunes, L. M., Pascoal, L. M., Bianchi, M. L., & Dias, F. L. (2005) Evaluation of the clastogenicity and anticlastogenicity of the carotenoid bixin in human lymphocyte cultures. *Mutat.Res.* 585: 113-119.

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Arruda, S. F., Souza, E. M., & Siqueira, E. (2005) Carotenoids from malanga (*Xanthosoma sagittifolium*) leaves protect cells against oxidative stress in rats. *Int.J.Vitam.Nutr.Res.* 75: 161-168.

Asai, A., Nakano, T., Takahashi, M., & Nagao, A. (2005) Orally administered crocetin and crocins are absorbed into blood plasma as crocetin and its glucuronide conjugates in mice. *J.Agric.Food Chem.* 53: 7302-7306.

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Aust, O., Stahl, W., Sies, H., Tronnier, H., & Heinrich, U. (2005) Supplementation with tomato-based products increases lycopene, phytofluene, and phytoene levels in human serum and protects against UV-light-induced erythema. *Int.J.Vitam.Nutr.Res.* 75: 54-60.

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Baranska, M., Schulz, H., Baranski, R., Nothnagel, T., & Christensen, L. P. (2005) *In situ* simultaneous analysis of polyacetylenes, carotenoids and polysaccharides in carrot roots. *J.Agric.Food Chem.* 53: 6565-6571.

Baranski, R., Baranska, M., & Schulz, H. (2005) Changes in carotenoid content and distribution in living plant tissue can be observed and mapped *in situ* using NIR-FT-Raman spectroscopy. *Planta* 222: 448-457.

Barker, M. E., McCloskey, E., Saha, S., Gossiel, F., Charlesworth, D., Powers, H. J., & Blumsohn, A. (2005) Serum retinoids and β -carotene as predictors of hip and other fractures in elderly women. *J.Bone Miner.Res.* 20: 913-920.

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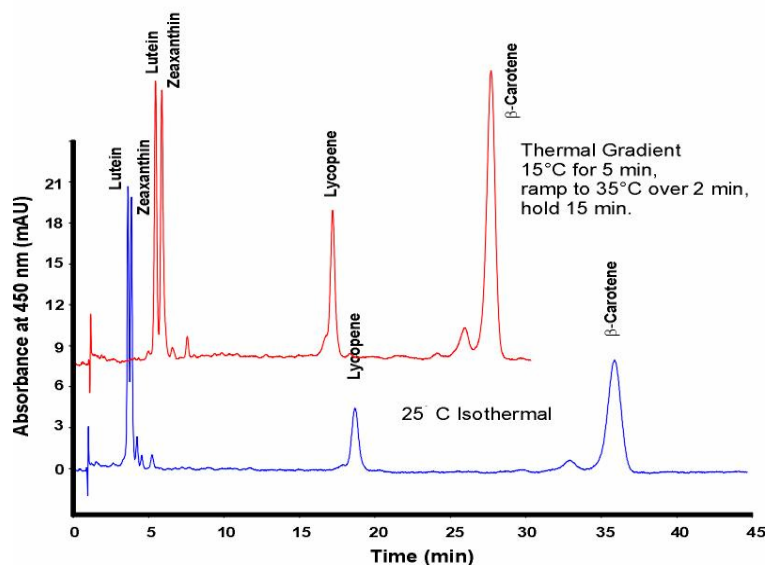
TECHNICAL NOTES

Fast Separation of Carotenoids Using a Temperature Gradient

Quantitation of carotenoids by HPLC is usually done at ambient temperatures using a C_{18} or C_{30} column. Depending on the column, mobile phase, and the components being analyzed, the separations can take more than 60 min and often require complex mobile phases with up to six components. Here we illustrate the application of a temperature program and a simple mobile phase to improve the separation of a mixture of carotenoids compared to an analysis done under isothermal conditions. The HPLC system consisted of a solvent degasser, an autosampler maintaining samples at 20° C, a programmable UV-Visible detector and a computer data system. A Selerity Technologies, Inc. Polaratherm Series 9000 Total Temperature Controller was used to maintain sub-ambient column temperature and perform temperature gradients. The separation uses a simple mobile phase of 1.25% THF in

acetonitrile, at a flow rate of 1 mL/min. The lower trace shows the separation of a carotenoid mixture at 25°C. Isothermally, the analysis takes about 40 min and lutein is not well resolved from zeaxanthin. The upper trace shows the separation of the same carotenoid mixture using a temperature program from 15°C to 35°C. The analysis time was less than 30 min and lutein is nearly baseline resolved from zeaxanthin, while lycopene and β -carotene peaks are sharper at the elevated temperature. Temperature programming can simplify method development, greatly reduce analysis time and improve resolution of carotenoids using sub-ambient temperatures. Additionally, the use of a temperature gradient rather than a solvent gradient permits solvent recycling.

Mixed Carotenoid Separation



Column: Jones Chromatography Genesis C₁₈, 150 x 4.6 mm, 5 μ m.

Craft Technologies, Inc., Wilson, NC
Selerity Technologies, Salt Lake City, UT

NUTRITIONAL TIDBITS

Carotenoid Content of Green Drink Powders

Recently, there has been an increase in popularity of green drink mixes. These mixes are made of powdered juices of a variety of vegetables and sometimes fruits, most often with a base of wheat grass, barley grass, or spirulina. Many of the green drink mixes include additional ingredients such as herbs, probiotics, and vitamins. These powders are marketed as a convenient way for consumers to increase vegetable intake. For this study, six brands of green drink mixes were purchased at a grocery store in Chicago. All testing was done in the laboratory of Drs Bowen and Sapuntzakis at the Department of Human Nutrition, University of Illinois at Chicago. Approximately 100 mg of each mix was tested for content of lutein, β -carotene, α -carotene, β -cryptoxanthin, and lycopene using saponification, solvent extraction and HPLC. Each powder was tested in triplicate and the results are reported in mg per serving suggested by each manufacturer. The powders contained mostly β -carotene and lutein, while α -carotene and β -cryptoxanthin were sometimes present in trace amounts, and lycopene was not detected. A one cup serving of raw spinach delivers more lutein than any of the analyzed powders, but some of them contain significant amounts of β -carotene. Consumers should be aware of the exaggerated claims made by some manufacturers and consider the better value of whole fruits and vegetables.

Product Name	Serving (g)	Carotenoid Content (mg/serving)	
		β -carotene	Lutein
Earth's Promise	13.5	0.09	0.12
Perfect Food	10	0.80	1.83
Green Vibrance	11.5	0.85	1.66
Berry Green	6	0.29	1.45
Greens Today	17	4.10	1.22
Magna Plus	9	4.71	0.75
Raw Spinach	1 cup	1.68	3.58

NDS-R v5.0/35

Jeffrey Bachner, Class '05
University of Illinois at Chicago, IL

NEWS AND VIEWS

Rob M. Russell wins DSM Human Nutrition Award 2005

Dr Rob M. Russell, Professor at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University in Boston (USA), is the winner of the DSM Human Nutrition Award for 2005. Manfred Eggersdorfer, Head of R&D at DSM Nutritional Products, presented the award at a ceremony during the 18th International Congress of Nutrition in Durban, South Africa, on 21 September 2005. In bestowing the honor of the award to Dr Rob M. Russell, DSM Nutritional Products is recognizing his original and outstanding research in the field of retinoid and carotenoid metabolism research, as well as his significant contribution to knowledge on human nutrition and health.

Dangerously Golden

The pathogenic bacterium *Staphylococcus aureus* has a colorful resistance mechanism. According to Liu and colleagues (JEM 202:209-15, 2005), the gold color of *S. aureus* is not just for show; the molecules that give the bug its golden hue also help it resist attack by neutrophils. The characteristic gold color of *S. aureus* sets it apart from its non-virulent relatives, which are mostly unpigmented. The color reflects the production of antioxidant molecules called carotenoids — similar to those originally isolated from carrots and touted for their ability to boost the immune system and decrease tumor growth in humans. Despite the connection between color and virulence of *S. aureus*, a functional link had never been investigated. Liu and colleagues now show that these pigmented molecules can also help *S. aureus* resist the hosts' immune defenses. Carotenoids produced by *S. aureus* defused the reactive oxygen species (ROS) that normally help neutrophils kill bacteria. Expression of these pigments rendered the normally colorless *Streptococcus pyogenes* golden and more virulent. And *S. aureus* that were robbed of the ability to make carotenoids could no longer resist neutrophil attack and were less pathogenic in mice. The protective effect of the carotenoids on the bacteria was a function of their antioxidant activity, as wild-type bacteria had no advantage over carotenoid-deficient bacteria in mice whose neutrophils lacked the ROS-producing machinery. The authors suggest that drugs inhibiting carotenoid synthesis might be useful for treating *S. aureus* infections, which are often resistant to traditional antibiotic treatment.

Heather L. Van Epps
J Exp Med. 202:194, 2005

Editor's note: The pigment of *S. aureus* is staphyloxanthin, which contains 4,4'-diaponeurosporene, a C₃₀ triterpenoid carotenoid.

Carotenoid-Derived Olfactory Cues

Flavor volatiles are derived from an array of nutrients, including amino acids, fatty acids, and carotenoids. In tomato, almost all of the important flavor-related volatiles are derived from essential nutrients. Oxidative cleavage of carotenoids generates apocarotenoids: β -ionone, β -damascenone (products of β -carotene) and 6-methyl-5-hepten-2-one (from lycopene). Humans have a much lower odor threshold for β -ionone (0.007 ppb) than for 6-methyl-5-hepten-2-one (2000 ppb), although both are readily detectable in tomato fruits. Apocarotenoids are important for flavor in diverse food products. For example, β -damascenone, in addition to tomato, is found in berries, apples, and grapes (as well as wine). Safranal, found in saffron, grapefruit, and green tea, is derived from the carotenoid zeaxanthin. Synthesis of β -ionone and 6-methyl-5-hepten-2-one increases 10 to 20-fold as tomatoes reach a fully ripened stage. This pattern of volatile emissions is mutually beneficial, indicating the presence of health-promoting compounds to humans and aiding seed dispersal. Overall, volatiles associated with tomato flavor are somewhat decreased in cultivated varieties, except 6-methyl-5-hepten-2-one, reflecting breeders' emphasis on selection of cultivars with enhanced red color, dependent on lycopene.

Stephen A. Goff & Harry J. Klee
Science 311: 815 – 819, 2006

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. 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.
4. International Carotenoid Society (ICS) Webpage: www.carotenoidsociety.org. Anyone wishing to join the society and be listed in the web directory, please contact Hideki Hashimoto at hassy@sci.osaka-cu.ac.jp
5. LIPID BANK for Web. Carotenoid Section of Bioactive 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.
6. Reference library prepared by LycoRed Natural Product; www.lycopene.com-references

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