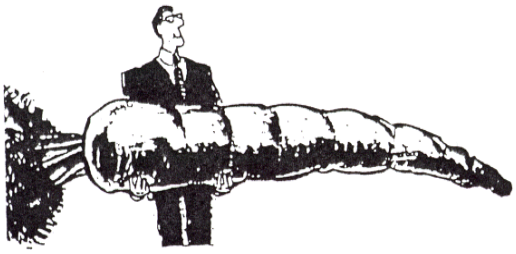

Carotenoid News

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FROM THE EDITOR

"Nothing great in the world has been accomplished without passion." (Hegel, German philosopher, 1770-1831)

Such passion for carotenoids, in all hues, localities, and aspects, was obvious for anyone who observed Dr. Norman Krinsky during many scientific conferences he attended and organized. He considered results and opinions of everybody present, from well-known researchers to young graduate students, with unfailing courtesy, respect and light humor which encouraged discussion. His probing questions and generous comments often threw new light on difficult problems or showed a new direction to solve them.

We are going to miss Norman very much in future carotenoid gatherings, like CARIG Symposium at EB 2009, or the Gordon Research Conference on Carotenoids next January. He was a model of a true scientist, full of passion for his research, possessing encyclopedic knowledge of his field, a great mentor of young academicians and an example to emulate for all. A tribute to Dr. Norman Krinsky will be presented at CARIG minisymposium during EB 2009, on Saturday, April 18, by his long-time collaborator, Dr. Robert Russell from Tufts University.

Maria S. Sapuntzakis, Chicago, IL

In Memoriam
Norman I. Krinsky, 1928-2008

Norman I. Krinsky, a scientist who was a leader in the field of carotenoids, passed away on November 28, 2008 after more than a half century of dedicated research with these plant pigments. One will find few research publications on carotenoids that will not include a reference to Dr. Krinsky's work.

Born in Michigan's Upper Pennisula, Dr. Krinsky grew up in Chicago. His studies in biochemistry began at the University of Southern California where he received a B.S. and M.S. in this field. In 1952, he was awarded a Ph.D. in biochemistry with a dissertation entitled "Studies of Carotenoid and Vitamin A Complexes with Protein in Plasma and Tissues".

In 1953, Norman came to Harvard University. As a U.S. Public Health Service Postdoctoral Fellow, he worked with George Wald who received a Nobel Prize in Medicine for his work with vitamin A and vision. Norman continued his work with Wald with a postdoctoral fellowship from the National Council to Combat Blindness. Norman was at Harvard for 7 years, the latter part of which he served as an instructor and lecturer in the Department of Biology.

In 1960, he accepted a position as an assistant professor at Tufts University School of Medicine, and he remained at Tufts for the rest of his career. In these early days, his studies in algae and bacteria laid down some of the ground work for understanding the biochemical conversions and function of various carotenoids in these organisms. His interest in the photochemistry of carotenoids led him into other areas of radical biochemistry as well. Throughout the decades his research explored the metabolism of carotenoids in a variety of animal models. In later years the monkey model allowed for exploration into the biological control of carotenoids in the primate retina.

It was his collaborations using the ferret model that were particularly interesting. This work was spawned from the epidemiological studies that had shown that carotenoid status was related to decreased risk of lung cancer. Contrary to these observations, intervention studies using supplemental β-carotene showed that smokers were at a greater risk of lung cancer. Norman and his longtime collaborators, Robert M. Russell and Xiang-Dong Wang, proposed that large doses of β-carotene, in an oxidatively stressed environment, e.g. smokers' lungs, were oxidized to harmful compounds. Their work in this animal model confirmed it. This was a beginning of the realization that pharmaceutical doses of β-carotene could have pro-oxidant effects.

Another significant contribution that Norman made was the studies that evaluated the bioconversion to vitamin A of carotenoids in various food vehicles. Norman, Rob Russell, and Guangwen Tang at Tufts showed that the bioavailability of vitamin A from β-carotene varied considerably from one food source to another. This lead to the realization that not only was the amount of carotenoid contained in a food of importance, but also the amount that was available for absorption from the gut into the body. These findings were of such importance that Norman was invited to chair the panel that set the Recommended Daily Allowance of antioxidants. The World Health Organization also changed its recommendations in light of this work. He wrote many review articles and edited two influential books, "Carotenoids: Chemistry and Biology" (with his long-time collaborator Micheline Mathews-Roth and with R. F. Taylor), and "Carotenoids in Health and Disease" (with Susan Mayne and Helmut Sies).

Dr. Krinsky was one of the leaders who set a tone of collegiality and cooperation in the field of vitamin A and carotenoids research. He was deeply interested in the research advances of others. This was reflected in the many conferences and committees that he helped organize. In 1973, the increasing interest in the field of free radicals and related oxidants in relation to health and disease initiated a Gordon Conference on "Oxy-Radicals in Biology and Medicine." Norman was a part of this initiative and was the first chair of a conference that continues today. By the early 1990s, it was realized that there were carotenoids of interest beyond the major ones found in diet and human tissues. This led to the creation of yet another conference. In 1992, he chaired the first

Gordon Research Conference on "Chemistry and Biology of Carotenoids" which also continues to this day.

Throughout this rich and colorful career Norman was continually involved with students and teaching. When he retired from Tufts in 2001, he and his wife established the Norman & Susan Krinsky Excellence in Teaching Award for students in the Sackler School of Graduate Biomedical Sciences and the Medical School at Tufts. This award honors Norman's 40 years of service in the Sackler School and is meant to recognize individuals who have shown sustained teaching excellence.

Dr. Krinsky continued his sincere and dedicated interest in carotenoids up until the year of his death with his last publication. This research report was reminiscent of that which began his career, with a study of the distribution of carotenoids in the blood circulation. Also, reminiscent of his early work, this work contained several co-authors, a testimony to his giving and sharing of his gift of bringing new eyes to view and study these special colors that surround us.

Norman passed away the day after Thanksgiving 2008, an occasion which he enjoyed with his wife Susan, their daughter Lisa, their son Adam, and their two grandchildren, Colin and Jenna. The color that Norman brought to the carotenoid community cannot be measured.

Elizabeth Johnson, Boston, MA

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, on April 18, 6:00-8:30pm, in New Orleans Marriott, Galerie 4-6. 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. 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

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, **e-mail**:eb@faseb.org **tel:** 301-634-7010 [see highlights below].

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 Ave. NW,Washington DC, 20009, tel: 202-884-8785, e-mail: mnforum@aed.org

May 13-14, 2009

5th Biennial Conference on Diet and Optimum Health, Portland, OR. Contact**: e-mail:** lpi@oregonstate.edu, **Tel:** 541-737-5675,**website**:lpi.oregonstate.edu/conf2009

October 4-9, 2009

19th International Congress of Nutrition - Nutritional Security for All. Bangkok, Thailand. Contact: w**ebsite:** www.icn2009.com,

January 17-22, 2010

7th Gordon Research Conference on Carotenoids, Ventura, CA. Contact: **website:** www.grc.org

HIGHLIGHTS OF EXPERIMENTAL BIOLOGY 2008

Friday, April 17, CARIG 2009 Symposium, 1:00-5:00pm

Saturday, April 18, Minisymposium CARIG (Carotenoids), 3:00–5:00pm, Convention Center, Room 333/334

Saturday, April 18, CARIG/VARIG Social and Student Poster Competition, 6:00-8:30pm, New Orleans Marriott, Galerie 4-6.

Monday,April 20, Minisymposium Vitamin A and Retinoids, 8:00-10.00am, Convention Center

Monday, April 20, Poster session Vitamin A and Retinoids, Convention Center

Tuesday, April 21, Poster session CARIG (Carotenoids), Convention Center

. **CARIG 2009 Symposium Program**
Molecular Aspects of Carotenoid Metabolism
Friday, April 17, 2009, 1:00 - 5:00 pm
Marriott Hotel (555 Canal Street)
New Orleans, LA
Chair: Lewis Rubin
Co-Chair: Sherry Tanumihardjo

1:00 Carotenoids, their metabolic products, and the metabolic syndrome. *William S. Blaner, Columbia University*

1:45 New functions of CMO1 and CMO2 in cell regulation. *Lewis P. Rubin, University of South Florida*

2:30 The role of β-carotene-15,15'-oxygenase (CMO1) during mammalian embryonic development. *Loredana Quadro, Rutgers University*

3:15 Alterations in carotenoid bioaccumulation in mice lacking the CMO I or the CMO II carotenoid cleavage enzyme. *Nikki Ford, University of Illinois at Urbana-Champaign*

4:00 The molecular link between PPARγ and lycopene metabolites: a double-edged sword. *Xiang Dong Wang, Tufts University*

RECENT / FORTHCOMING PUBLICATIONS

SIGHT AND LIFE Magazine 3/2008, 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:
Britton G. Highlights of the 15th International Symposium on Carotenoids.

Lycopene. Nutritional, Medicinal and Therapeutical Properties. Ed. Preedy V.R. & Watson R.R. Science Publishers (USA) 2008.

Tomatoes and Tomato Products. Nutritional, Medicinal and Therapeutical Properties. Ed. Preedy V.R, & Watson R.R. Science Publishers (USA) 2008.

Distribution and Biosynthesis of Carotenoids by S. Takaichi in *The Purple Photosynthetic Bacteria*, ed. Hunter N et al, vol 28 of *Advances in Photosynthesis and Respiration*, pp 97-117, Springer, 2009.

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.

. Abadie-Guedes, R., Santos, S. D., Cahu, T. B., Guedes, R. C., & de Souza, B. R. Dose-dependent effects of astaxanthin on cortical spreading depression in chronically ethanol-treated adult rats. Alcohol Clin.Exp.Res. 2008; 32: 1417-1421.

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Akbaraly, T. N., Fontbonne, A., Favier, A., & Berr, C. Plasma carotenoids and onset of dysglycemia in an elderly population: results of the EVA Study. Diabetes Care 2008; 31: 1355-1359.

Albert, G. I., Hoeller, U., Schierle, J., Neuringer, M., Johnson, E. J., & Schalch, W. Metabolism of lutein and zeaxanthin in rhesus monkeys: identification of (3R,6'R)- and (3R,6'S)-3'-dehydro-lutein as common metabolites and comparison to humans. Comp.Biochem.Physiol.B Biochem.Mol.Biol. 2008; 151: 70-78.

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Alper, H. & Stephanopoulos, G. Uncovering the gene knockout landscape for improved lycopene production in *E. coli*. Appl. Microbiol. Biotechnol. 2008; 78: 801-810.

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Alquezar, B., Rodrigo, M. J., & Zacarias, L. Regulation of carotenoid biosynthesis during fruit maturation in the red-fleshed orange mutant *Cara Cara*. Phytochemistry 2008; 69: 1997-2007.

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TECHNICAL NOTE

NIST Develops Multivitamin Reference Material

A new reference material for assessing the amounts of vitamins, carotenoids, and trace elements in dietary supplements has been developed by the National Institute of Standards and Technology (NIST). The certified reference material, named Standard Reference Material (SRM) 3280 for multivitamin/multimineral tablets, was created in collaboration with the Office of Dietary Supplements (ODS) at the National Institutes of Health (NIH). A definitive, independently certified standard has been lacking and the new standard helps fill that gap. The reference material is priced currently at $587 for 150 tablets in 5 bottles. The material was prepared by a tablet manufacturer as a non-commercial batch of tablets according to their normal procedures. NIST scientists then tested and certified the concentrations of 24 elements and 17 vitamins and carotenoid compounds in the tablets. According to certificate of analysis, it contains 514±87 µg of total β-carotene, 205±50 µg of lutein, and 780±190 µg of retinol (added as retinyl acetate) per gram of product. "We are not saying what a product should contain, but what it does contain," said Dr Katherine Sharpless from the NIST's Analytical Chemistry Division. "Our SRMs are intended for analytical chemists to use to make sure their methods are working properly, not a benchmark for what a good product should be." According to a National Institutes of Health (NIH) State-of-the-Science Panel, half of the American population routinely use dietary supplements, with their annual spending estimated at over $20 billion.

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NEWS AND VIEWS

Novel Hormones Regulate Shoot Branching in Plants

A carotenoid-derived hormonal signal that inhibits shoot branching in plants has long escaped identification. Strigolactones are compounds thought to be derived from carotenoids and are known to trigger the germination of parasitic plant seeds and stimulate symbiotic fungi. Two recent studies *(Nature 2008, 455:189-194 and 195-200)* found that mutants defective in carotenoid cleavage dioxygenase (CCD7 or CCD8) have enhanced shoot branching. They are strigolactone-deficient and the root application of strigolactones inhibits shoot branching in these mutants. In agreement with the expected properties of the hormonal signal, exogenous strigolactones can be transported in shoots and act at low concentrations. Endogenous strigolactones or related compounds inhibit shoot branching in plants. Furthermore, *ccd8* mutants demonstrate the diverse effects of strigolactones in shoot branching, mycorrhizal symbiosis and parasitic weed interaction. Thus, strigolactones act as a new hormone class in regulating above-ground plant architecture, and also have a function in underground communication with other neighboring organisms.

Nature 2008, 455 (9/11/2008)

Genetic variability of β-Carotene Conversion in Humans

The key enzyme responsible for β-carotene conversion into retinal is β-carotene 15,15`-monoxygenase (BCMO1). Since it has been reported that the conversion of β-carotene into vitamin A is highly variable in up to 45% of healthy individuals, we hypothesized that genetic polymorphisms in the BCMO1 gene could contribute to the occurrence of the poor converter phenotype. We identified two common non-synonymous single nucleotide polymorphisms (267S, 379V) with variant allele frequencies of 42 and 24%, respectively. *In vitro* biochemical characterization of the recombinant 267S+379V double mutant revealed a reduced catalytic activity of BCMO1 by 57% (P<0.001). Assessment of the responsiveness to a pharmacological dose of β-carotene in female volunteers confirmed that carriers of both the 379V and 267S+379V variant alleles had a reduced ability to convert β-carotene, as indicated through reduced retinyl palmitate to β-carotene ratios in the triglyceride-rich lipoprotein fraction [-32% (P=0.005) and -69% (P=0.001), respectively] and increased fasting β-carotene concentrations [+160% (P=0.025) and +240% (P=0.041), respectively]. Our data show that there is genetic variability in β-carotene metabolism and it may provide an explanation for the molecular basis of the poor converter phenotype within the population.

Leung WC, et al. FASEB J. 23,2009, online(12/22/2008)

Lutein Bioavailability from Fortified Fermented Milk

Fortifying fermented milk with lutein may be a suitable vehicle to boost intakes of the compound (*J. Nutr. Biochem. 2009)*. In Spain, 24 volunteers were recruited and randomized to consume the fortified fermented milk with two different lutein doses (equivalent to 4 or 8 mg free lutein in 100 mL milk). A single dose study and a multiple dose study for 14 days were performed. Consumption of the milk resulted in increases in the blood levels of lutein, with the higher dose milk raising levels more than the lower dose. The results show that the regular consumption of lutein ester-fortified fermented milk, at the level of fortification and consumption used (4–8 mg/day), may increase the serum levels of lutein above the 90 percentile of the reference ranges in the US and European populations (greater than 0.50 µmol/L). Lutein, a nutrient found in various foods including green leafy vegetables, yellow corn and egg yolk, has a 10-year history in the dietary supplement market as a nutrient to reduce the risk of age related macular degeneration.

www.nutraingredients-usa.com (2/9/2009)

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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