



Carotenoid News

Vol. 20, No. 1
February 2010

FROM THE EDITOR

"Scientia potentia est"
(Sir Francis Bacon, 1561-1626)

Francis Bacon, English philosopher, statesman and scientist, is the father of the scientific method, the planned procedure of investigation, indispensable for scientific inquiry. He was the first to understand the potential of the experiment and the power of the resulting knowledge. The XXI century is the age of information. A deluge of data is at our disposal, skillfully handled by computer programs, as we try to extract useful knowledge by means of less-well developed objective paradigms and intuition. Still, we must remember that the data are only as good as the question asked while planning our research, and as valid as our methodology.

This issue of Carotenoid News is the first to be disseminated exclusively through the Internet, so if you want to read about the wonderful studies conducted by the carotenoid scientists worldwide during the last year, you may find them in the ARTICLES list on the webpage of the ICS (www.carotenoidsociety.org). And if you want to discuss them with their authors, you should attend the conferences listed in this issue, especially the CARIG Symposium and other carotenoid events of Experimental Biology 2010.

Maria S. Sapuntzakis (Chicago)

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 2010. 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'10, 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. Sherry Tanumihardjo, University of Wisconsin-Madison, 1415 Linden Drive, Madison, WI 53706, e-mail: sherry@nutrisci.wisc.edu fax: 608-262-5860.

UPCOMING EVENTS

March 17 - 20, 2010

Oxygen Club of California 2010 World congress.

**Oxidants and Antioxidants in Biology –
Translational Redox Science. Santa Barbara, CA.**
Website: www.oxyclubcalifornia.org

April 26, 2010

**Antioxidants 2010: Science, Testing and
Regulation, Hotel Metropole, Brussels, Belgium.**
Website: www.ni-antioxidants.com

April 24 - 28, 2010

Experimental Biology 2010, Anaheim, CA.
Contact: EB2010, FASEB Office of Scientific
Meetings & Conferences, 950 Rockville Pike,
Bethesda, MD 20814-3998, website:
www.eb2010.org, e-mail: eb@faseb.org
tel: 301-634-7010 [see highlights below]

June 20 – 24, 2010

**6th International Congress on Pigments in Foods:
Chemical, Biological and Technological Aspects,
Budapest, Hungary. E-mail: foodpigments2010@mke.org.hu**

HIGHLIGHTS OF EB 2010

Friday, April 23, CARIG 2010 Symposium, 1:00-5:00 pm., CARIG/VARIG Social and Student Poster Competition, 6:30-8:30 pm (both in Anaheim Hilton Hotel, California Ballroom B).

Sunday, April 25. Minisymposium on Carotenoids and Health, 10:30-12:30, Convention Center, Room 207C

Poster Session on Carotenoids, 12:45-1:45, Convention Center Exhibit Hall

CARIG 2010 Symposium Tentative Program Carotenoids and Cancer

Friday, April 23, 2010, 1:00 - 5:00 pm

Anaheim Hilton Hotel

California Ballroom B

Chair: Elizabeth Johnson

Co-Chair: Sherry Tanumihardjo

1:00 Lessons learned from β -carotene supplement trials. *John W. Erdman, University of Illinois at Urbana-Champaign*

1:45 Eccentric cleavage products of dietary carotenoids: Occurrence and possible biological functions. *Earl E. Harrison, Ohio State University*

- 2:30 Excentric cleavage of hydroxy carotenoids by carotene-9',10'-oxygenase. *Jonathan Mein, Tufts University*
- 3:15 Inter-individual variation in provitamin A conversion. *Anthony Oxley, Newcastle University*
- 4:00 Enhancing carrot colors for the prevention of disease. *Sherry Tanumihardjo, University of Wisconsin-Madison*

Conference Reports

CARIG Symposium 2009 Report

The annual Carotenoid Research Interactive Group (CARIG) Symposium was held in the Marriott Hotel in New Orleans on Friday, April 17, 2009. Co-organizers were Lewis P. Rubin and Sherry Tanumihardjo. As custom, the Symposium was held one day prior to the opening of Experimental Biology, of which the American Society for Nutrition (ASN) is a member organization. It also marked the first year CARIG assumes membership as an ASN Research Interest Group (RIS).

CARIG 2009 was organized around the theme of *Molecular Aspects of Carotenoid Metabolism*, emphasizing the expanding roles of the carotene monooxygenase enzyme family. The session was delayed for about 45 minutes; it turns out that New Orleans has at least 13 Marriott hotels and the EB program hadn't specified which one! Nevertheless, we began with an audience of more than 60 carotenoid enthusiasts.

Dr William Blaner (Columbia University), the annual James A Olson Memorial Speaker, presented a superb and current perspective on "*Carotenoids, their retinoid and non-retinoid metabolites and the metabolic syndrome*." It was an especially pointed tribute to Jim Olson, co-discoverer of the enzyme originally designated as carotene 15,15'-dioxygenase (currently CMO1). Prof. Olson, no doubt, would delight in the new insights into carotenoid functions in lipid metabolism, development and cancer. The following were:

Lewis P. Rubin (University of South Florida, Tampa) presented "*New functions of CMO1 and CMO2 in cell regulation*," emphasizing new research on the interactive roles of lycopene and CMO2 in suppression of prostate cancer.

Loredana Quadro (Rutgers University) spoke next on "*The role of β -carotene-15,15'-oxygenase (CMO1) during mammalian embryogenic development*," discussing new data from her lab that maternal β -carotene contributes to fetal vitamin A status.

Nikki Ford, a doctoral candidate at the University of Illinois at Champaign-Urbana with John Erdman, presented a talk entitled "*Alterations in carotenoid bioaccumulation in mice lacking the CMO1 or the CMO2 carotenoid cleavage enzyme*." Ms. Ford

showed intriguing data from these enzyme null mice that shed new light on specificity of carotenoid oxygenases. I should note that offered a benchmark for future trainee presentations at CARIG.

Xiang-Dong Wang (Human Nutrition Research Center on Aging, Tufts University, Boston) closed the Session with a talk on "*The molecular link between PPAR- γ and lycopene metabolites: a double edged sword*." Dr. Wang tied together lycopene supplementation with effects on hepatic steatosis and carcinogenesis in various rat models of exposure to ethanol, high fat and carcinogen.

The consensus of participants and speakers (non-rigorous poll) voiced that the meeting was scientifically enriching; updated a broad audience on the current state of knowledge about carotenoid metabolism; and wove together emerging areas of biological and public health importance of carotenoids. A full report on the Symposium, authored by Noel Solomons, appeared in SIGHT AND LIFE Magazine 2009; 2:37-39.

Lewis P. Rubin, Symposium Chair (Tampa, FL)

Gordon Research Conference Report

The 7th Gordon Research Conference on Carotenoids was held in Ventura, CA, January 17-22, 2010 (see <http://www.grc.org/programs.aspx?year=2010&program=carotenoid> for program, speakers, and a list of our sponsors). We had a robust attendance with tremendous representation by many international scientists and including a very diverse audience with strong representation from students and post-doctoral fellows working in carotenoid research. The conference included state-of-the-science presentations in genomics/modeling/systems biology; biosynthesis and regulation; photosynthesis; metabolic engineering of provitamin A carotenoids; carotenoid transport and metabolism; biological actions of carotenoids and their metabolites; carotenoids and chronic disease prevention including eye, cognition and cancer.

Five students were selected for their award-winning posters: Je Min Lee, Cornell University, Jonathan R. Mein, Tufts University, Matt Johnson, Queen Mary University of London, Younkyung Kim, Rutgers University, Karin Linnewiel Hermoni, Ben-Gurion University.

George Britton gave a fabulous tribute to Norman Krinsky, the founder of the Gordon Research Conference on Carotenoids series. Elections were held for the next Vice Chair; Johannes von Lintig was elected to join Eleanore Wurtzel and Xiang-Dong Wang in organizing the 8th Gordon Research Conference on Carotenoids (anticipated for January 2013). We had an unusually rainy week for sunny

southern California, but the rain did not dampen the enthusiasm for all the exciting carotenoid work ongoing in our field. Carotenoid science is alive and well!

Susan T. Mayne, Conference Chair (Yale, CT)

RECENT / FORTHCOMING PUBLICATIONS

SIGHT AND LIFE Magazine 3/2009. PO Box 2116, 4002 Basel, Switzerland, **tel:** 41-61-815-8756, **fax:** 41-61-815-8190, **website:** www.sightandlife.org
e-mail: klaus.kraemer@sightandlife.org

See especially:

Lietz G. Can the β -carotene low responder phenotype be caused by genetic polymorphisms in the β -carotene 15, 15'-monooxygenase gene? pp. 22-25.

Boy E, Miloff A. Provitamin A carotenoid retention in orange sweet potato. pp. 26-33.

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

Carotenoids. Physical, Chemical, and Biological Function and Properties. Ed. JT Landrum, CRC Press, 2010

Alphabetical Listing of Recent Publications may be found at www.carotenoidsociety.org **under Articles.** It is prepared by Dr. Harold Furr, Institute of Nutrition, Mahidol University, Thailand, and Department of Nutritional Sciences, University of Wisconsin, Madison.

TECHNICAL NOTE

Carotenoid Producers and Suppliers

Most carotenoids are still produced by chemical synthesis, with DSM, BASF and a more recent entrant, Allied Biotech Corporation of Taiwan, generally dominating the market. DSM supplies a wide range of carotenoids, and along with BASF, dominates the world supply of synthetic β -carotene. DSM also produces lycopene, lutein, zeaxanthin and astaxanthin, while BASF, in addition to β -carotene, markets lycopene-based products. In Spain, Vitatene produces natural β -carotene from fungus *Blakeslea trispora*, as does DSM, but at much lower amounts when compared to its synthetic β -carotene operation. Kemin Health of the US has patented a number of lutein based preparations including its FloraGLO range, which first appeared in the US market in 1996. Kemin's main rivals in the lutein sector include Biolut owned by Industrias Alcosa of Mexico and Cognis with its natural lutein esters, Xangold. Key suppliers in the lycopene arena include LycoRed

with its LycoMato tomato derived extract. The Italian firm BioLyco's facility became operational in 2008 and it extracts lycopene extract from tomato waste using patented technology. Japanese market entrant, Fuji Chemical, produces astaxanthin through its two subsidiaries, AstaReal AB in Sweden and BioReal in Hawaii, which utilizes proprietary technology to cultivate and grow naturally occurring microalgae for the production of astaxanthin. Cyanotech Corporation markets astaxanthin cultivated from microalgae in Hawaii, while Israel-based biotech firm Algatech's patented cultivation process employs a closed tubular system for cultivating enriched cells that provide a high concentration of astaxanthin from the algal biomass.

www.nutraingredients-usa.com (1/28/2010)

NEWS AND VIEWS

Consumption of Egg Yolks May Improve Macular Pigment Concentrations in Older Adults

In a study involving older adults with low macular pigment, taking cholesterol-lowering medications, the results indicate that daily consumption of 4 egg yolks, and possibly 2 egg yolks, may improve macular health. The subjects consumed 2 egg yolks/day for 5 weeks. After a 4-week washout period the subjects consumed 4 egg yolks/day for another 5 weeks. Subjects with low macular pigment optical density (MPOD) showed a 31% increase in MPOD with daily intake of 2 egg yolks, and larger increases in MPOD (at most 50%) at the 3 retinal eccentricities with daily intake of 4 egg yolks. Serum lutein and zeaxanthin increases were also observed in the 2 egg yolks (16% for lutein, 36% for zeaxanthin) and 4 egg yolks/day (24% for lutein, 82% for zeaxanthin) interventions. The interventions did not affect serum LDL cholesterol, but were associated with a 5% increase in serum HDL cholesterol. Therefore, the consumption of 4 egg yolks/day, and possibly of 2 egg yolks/day, for 5 weeks benefited macular health in older adults with low MPOD and did not impair their cholesterol status.

(Vishwanathan R, et al, *Am J Clin Nutr* 90:1272-79, 2009)

www.insiderhealth.com (12/11/2009)

Carotenoids May Reduce the Risk of Breast Cancer

The role of β -carotene in cancer is controversial, with several studies reporting that β -carotene supplements may increase the risk of lung cancer in smokers. The new study, which followed 36,664

women for almost a decade, reports no link between dietary carotenoids and overall breast cancer risk. However, increased dietary intakes of α - and β -carotene were associated with over 60% reduction in hormone-sensitive breast cancer in female smokers. Hormone-sensitive estrogen-receptor (ER) positive and progesterone-receptor (PR) positive tumors are said to be the most common type diagnosed among breast cancer patients in the US. These tumors are stimulated to grow by the female hormones, estrogen and progesterone. Dr. Larsson and her co-workers from Karolinska Institutet analyzed data from the Swedish Mammography Cohort. Over the course of 9.4 years, the researchers documented 1,008 cases of breast cancer. Only α - and β -carotene intakes were associated with breast cancer risk, and only with ER and PR breast cancer in female smokers. The highest intakes of α - and β -carotene were associated with a 68% and 65% reduction in the risk of ER-PR breast cancer among smokers, respectively. The researchers note that it is biologically plausible that carotenoids may reduce the risk of breast cancer. *"If the potential protective effect of α -carotene and β -carotene against breast cancer is mediated through their antioxidant properties, an association may be stronger or limited to women who do not obtain other antioxidants from dietary supplements. A protective effect of carotenoids may also be more pronounced among smokers because tobacco smoke induces oxidative stress. The risk of breast cancer also decreased with increasing intakes of α -carotene and β -carotene among women who did not use dietary supplements. Further studies are needed to clarify whether carotenoids confer more protection among non-users of supplements and smokers, and whether the association varies by hormone-receptor status".* (Larsson SC, et al, Eur J Cancer, Jan 27, 2010, epub)

www.nutraingredients-usa.com (2/8/2010)

Carotenoids Improve Reproduction in Birds

Carotenoids can confer somatic and reproductive benefits, but most evidence is from captive animal experimentation, or single time-point sampling. Another, perhaps more informative means by which to assess physiological contributions to animal performance is by tracking an individual's ability to increase or sustain carotenoids over time. In a field study of North American barn swallows (*Hirundo rustica erythrogaster*), we analyzed within-individual changes in carotenoid concentrations by repeatedly sampling the carotenoid profiles of individuals over the course of the breeding season. Three carotenoid pigments were detected in plasma – lutein,

zeaxanthin, and β -cryptoxanthin – all of which we previously reported in the egg yolks of barn swallows. We summed levels of all three carotenoids to obtain total plasma carotenoid concentration. In our longitudinal field study of carotenoid circulation and breeding in barn swallows, we found that single-time-point estimates were not significantly correlated with reproductive performance. Instead, we found that males and females, who maintained high concentrations of carotenoids over time, had greater body mass and better seasonal reproductive success, compared to individuals whose carotenoid concentrations declined during the breeding season. Some individuals are both better at maintaining feather coloration and acquiring carotenoids via diet – possibly due to abilities to dedicate time both for preening and efficient foraging. Our results demonstrate that carotenoid concentrations of individuals are temporally dynamic, and that season-long balance, rather than single time-point samples, predicts reproductive performance.

Safran R, et al, PLoS ONE 5(2):e9420 Feb 2010

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.

Published twice a year, in February and August by
CAROTENOID RESEARCH INTERACTIVE GROUP (CARIG), a Research Interest Section of the American Society for Nutrition and an Affiliate of the International Carotenoid Society

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