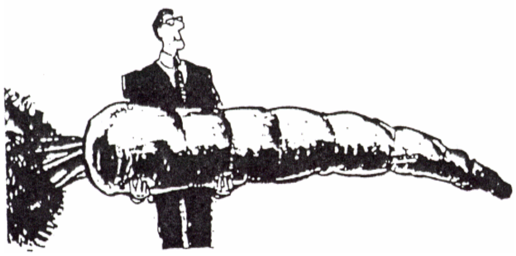


# Carotenoid News

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**August 2006**


## FROM THE EDITOR

*"However beautiful the strategy, you should occasionally look at the results"*

The venerable British statesman, Sir Winston Churchill, must have noticed that people tend to admire elegant approaches to solving problems, because of tradition, current fashion or logic, forgetting the most important criterion - the successful outcome. Scientific researchers often use particular methodology because it is widely accepted, and are satisfied with meager results, which do not answer the posed question and may discourage further investigation.

The Carotenoid Research Interactive Group (CARIG) is implementing a new strategy for electronic distribution of Carotenoid News. In April 2006, CARIG became a formal affiliate of the International Carotenoid Society (ICS). Among many benefits of our new affiliate status, is the opportunity to use the ICS listserve to communicate with our members. On a trial basis, the next issue of Carotenoid News (February 2007) will be electronically distributed through the ICS listserve. The ICS listserve will enable Carotenoid News to reach a larger, more international readership.

Carotenoid News subscribers, who are not members of the International Carotenoid Society, are encouraged to join via the ICS web site (http://www.carotenoidsociety.org). (Please see instructions below.) Membership in ICS is currently free and open to all with an interest in any aspect of carotenoid science. By joining ICS, Carotenoid News subscribers will be enrolled in the ICS listserve and will continue to receive future issues of Carotenoid News.

*Maria S. Sapuntzakis, Chicago, IL*
*Wendy White, Ames, IA*

### CARIG Implements New Procedure for Distribution of Carotenoid News

As highlighted in the Editor's column, future issues of Carotenoid News will be electronically distributed via the listserve of the International Carotenoid Society (ICS). Carotenoid News subscribers are urged to join ICS, if they have not already done so. By joining ICS, subscribers will be included in the ICS listserve and continue to receive Carotenoid News, as well as other important communications. ICS membership is currently free. The procedure to join ICS is outlined below:

### *International Carotenoid Society Membership Application Instructions*

Enter the website http://www.carotenoidsociety.org
Go to Members button on the left side.
Not a member? Click HERE to join ICS.
Choose a username and a password. Submit.
Next screen will inform you if the username, which you requested, is available. Continue to apply for membership.

After submitting your application, you will get the answer from the Secretary of ICS. You may view the current newsletter and past issues (**News** button), as well as literature lists (**Articles** button), and other interesting information anytime on this website, even if you are not a member.

### K. John Scott (1939 - 2006)

It is with great sadness that I relay to you the news of the death of my former supervisor and college K. John Scott on 6th April 2006. He was diagnosed with pancreatic cancer towards the end of 2005. John (his first Christian name was Keith) spent the last ten years of his career in the carotenoid research field, but when he retired in 1999 he had worked at the Institute of Food Research (in its various guises) for 42 years; initially at the National Institute for Research in Dairying (later to become IFR Reading) until 1989, then moving to IFR Norwich. John was quite a character and had many varied interests. He was a keen gardener and had a very beautiful garden; he was an active member of his local amateur dramatic society - and always had some good stories to tell when you met him. He was interested in wildlife and was active in the local naturalist society (the first thing he did after he retired was to spend three weeks bird watching in The Gambia). In his younger days he was a keen sportsman, playing rugby, football and cricket. He played the trumpet too! I worked only with him from 1992 to 1997, but I personally have two things to thank him for; teaching me the ways of an academic research lab, and leaving me unable to think of him without a smile on my face.

*David J. Hart, Institute of Food Research, Norfolk, UK.*

### News from the CARIG Steering Committee

The annual meeting of the CARIG Steering Committee was held during EB '06 in San Francisco, CA. The Steering Committee unanimously voted to accept the invitation to become a formal affiliate of the International Carotenoid Society (ICS). On a trial basis, CARIG will implement worldwide distribution of Carotenoid News via the ICS listserve. (Please see the editorial above.) The Committee thanked Elizabeth Johnson for her outstanding work as Chair of this year's CARIG Conference. (Please see report below.) The Committee also thanked outgoing members Alexandrine During and Cindy Schweitzer for their service. John Landrum was recognized for his successful fundraising campaign. Wendy White agreed to continue as Chair and John Landrum as Vice Chair in charge of fundraising. John will multi-task by also serving as Treasurer. The Steering Committee welcomes newly elected members Mario Ferruzzi and Lewis Rubin. The current membership of the CARIG Steering Committee includes:

Wendy White (Chair) – Iowa State University
John Landrum (Vice Chair, Treasurer) – Florida International University
Maria Stacewicz-Sapuntzakis (Newsletter Editor and member *ex officio*) – University of Illinois, Chicago
Julie Mares (Chair of CARIG Conference 2007) – University of Wisconsin, Madison
Mark Failla – Ohio State University
Mario Ferruzzi – Purdue University
Harold Furr – Craft Technologies, Inc
Elizabeth Johnson – Jean Mayer USDA Human Nutrition Research Center on Aging, Tufts University
Lewis Rubin – Cleveland Clinic
Sherry Tanumihardjo – University of Wisconsin, Madison

The next issue of Carotenoid News will include the agenda for the CARIG Conference at EB 2007 in Washington, DC.

## 2006 CARIG Conference Report

The Carotenoid Research Interactive Group (CARIG) annual conference was held on April 1, 2006 in conjunction with the Experimental Biology Meetings in San Francisco, CA. This year's conference was chaired by Elizabeth Johnson, Jean Mayer USDA Human Nutrition Research Center on Aging, Tufts University.

The James Allen Olson Memorial Lecture was presented by Dr. Barbara Underwood, adjunct professor of nutrition, Institute of Human Nutrition, Columbia University ("Reflections: Four Decades with Vitamin A and Carotenoids"). In the early 1960s, both Dr. Olson and Dr. Underwood were involved with assessing the existing knowledge of vitamin A status worldwide and developing programs to combat hypovitaminosis A, such as high-dose supplement capsules and fortification of staple foods. Dr. Underwood described the present efforts against hypovitaminosis A which include biofortification of staple crops for high content of provitamin A carotenoids.

The second lecture was presented by Dr. Earl Harrison, senior scientist at the USDA Human Nutrition Research Center at Beltsville, MD. He spoke on "Mechanisms involved in the intestinal absorption of dietary carotenoids". In collaboration with Dr. Alexandrine During, Dr. Harrison used the Caco-2 cell culture model to examine the mechanisms of intestinal absorption of dietary carotenoids. Kinetic experiments showing saturation kinetics provide evidence for a facilitated transport system and receptor involvement in carotenoid absorption. The investigators conducted a series of experiments using receptor inhibitors and knock-out mice to demonstrate partial dependency of carotene uptake on class B scavenger receptors, located in the apical membrane of intact enterocytes.

Professor John Erdman of the University of Illinois spoke on "Tomato, lycopene and the risk of prostate cancer". Dr. Erdman reviewed the epidemiologic data that points to a relationship between tomato and tomato products and the decreased risk of prostate cancer. The research from his laboratory explores the mechanisms behind this relationship. Using a prostatic cancer murine tumor model, the combination of broccoli and tomato proved to be better than tomato alone and both were better than supplemental lycopene in anti-cancer activity in mouse tumors, suggesting, components other than lycopene are protective. Other work presented dealt with the potential bioactivity of metabolic derivatives of lycopene, such as has been done with provitamin A carotenes. Apo-lycopenal, eccentric cleavage products of lycopene, have been detected by this laboratory in human plasma and breast milk, although concentrations were much lower than that of lycopene. Dr. Erdman concluded that research should not ignore compounds other than the major carotenoids that are found in fruits and vegetables.

Dr. Kathleen Ellwood, of the Division of Nutrition Programs and Labeling, Office of Nutritional Products Labeling and Dietary Supplements, Center for Food Safety and Applied Nutrition (CFSAN) of the Food and Drug Administration (FDA) spoke on the topic "Reviewing the Scientific Evidence for Health Claims". Dr. Ellwood outlined the process by with the U.S. government oversees and regulates food labeling and health claims. This need grew from the various research that provided evidence for bioactive food components, thus leading to producers and marketers making health claims regarding the consumption of certain foods or food products. The process by which the FDA evaluates a health claim has a defined procedure that regards the existing research literature in terms of relevancy and study design. Dr. Elwood concluded that the scientific community has a role in designing scientifically sound studies that evaluate relationship between dietary substances and health benefits.

The CARIG annual meeting also included awards presentations. Francesca Alvarez-Calderon, Florida International University, was given the graduate student travel award for her abstract entitled "A computational study of end-group conformational barriers in carotenoids". In recognition of research by young trainees, Heather Mernitz, USDA Human Nutrition Research Center on Aging, Tufts University, won the poster competition for her research on "Inhibition of lung carcinogenesis by 9-cis retinoic acid and 1,25 dihydroxyvitamin D3 in the A/J mouse model". Finally, in recognition of her continuous efforts as the editor of Carotenoid News, Maria Stacewicz-Sapuntzakis was awarded a recognition-of merit plaque by the CARIG Steering Committee.

The Conference Organizing Committee (Alexandrine During, Mark Failla, Elizabeth Johnson, Julie Mares, and Wendy White) would like to thank our sponsors: Chrysantis, Inc., Cognis Corp., Craft Technologies, Inc., DSM Nutritional Products, Inc., General Mills, Inc., International Food Policy Research Institute (IFPRI), Kemin Health, L.C., LycoRed Corp., and Sight and Life. The full text of the James Allen Olson memorial lecture and an expanded summary of CARIG 2006 can be found in the Sight and Life Newsletter 2/2006 (www.sightandlife.org).

*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 2007. 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'07, 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 2007 issue of Carotenoid News. No advance registration is required to participate in the poster competition. Contact: Wendy S. White, Ph.D., Iowa State University, Ames, IA Phone: 515 294-3447; E-mail: wswhite@iastate.edu.

## UPCOMING EVENTS

**September 21-24, 2006**
**3rd International Conference on Oxidative Stress, Skin Biology & Medicine, Andros Island, Greece.** Contact: Michail Rallis, tel: 30-210-727-4027, **E-mail**: rallis@pharm.uoa.gr, **website**: www.pharm.uoa.gr/oxstress/index.htm

**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.pigmentsinfood 2006.uni-hohenheim.de

**January 7-12, 2007**
**The 6th Gordon Research Conference on Carotenoids**, **Ventura, CA**. [see program below]. To apply, contact www.grc.org/programs/2007/carot.htm

**April 16-18, 2007**
**Micronutrient Forum, Istanbul, Turkey**. Consequences and Control of Micronutrient Deficiencies: Science, Policy, and Programs—Defining the Issues. Contact: Micronutrient Forum Secretariat at the ILSI Research Foundation, One Thomas Circle, NW, Ninth Floor, Washington, DC 20005-5802, US, **tel**: 202-659-9024, **fax**: 202-659-3617, **E-mail**: mnforum@iilsi.org.

**April 28-May 2, 2007**
**Experimental Biology 2007**, **Washington, DC**. Contact: EB2007, FASEB Office of Scientific Meetings & Conferences, 9650 Rockville Pike, Bethesda MD 20814-3998, **website**: www.eb2007.org

**Gordon Research Conference on Carotenoids**
**January 7-12, 2007, Ventura Beach Marriott, Ventura, CA**
**Chair: John T. Landrum, Vice Chair: Susan T. Mayne**

**TOPICS & SPEAKERS** *(discussion leaders in italics)*

**A 3-Dimensional Basis for Chemistry and Biochemistry** (*Hans-Georg Ernst* / Madeleine Helliwell / TBA)

**Analysis, Chemistry and Properties** (*Synnøve Liaaen Jensen* / Richard van Breemen / Klaus Albert / C. Caris-Veyrat / Harry Klee / *George Truscott*)

**Electronic States, Photochemistry, and Photosynthesis** (*Ana Moore* / Tomas Polivka / Hideki Hashimoto / Bruno Robert / *Richard Cogdell*)

**Human Health I: Metabolites, Gene Regulation, and Cancer** *(Helmut Sies* / X.-D. Wang / Olaf Sommerburg / John Erdman, Jr. / *Adrian Wyss*)

**Human Health II: Nutrition & Bioavailability, an International Perspective** (*Rob Russell* / Keith West / Richard Semba / Guangwen Tang / *Machteld van Lieshout*)

**Human Health III: Carotenoids in the Eye** (*Erik van Kuijk* / Julie Mares / Malgorzata Rozanowska / Paul Bernstein / Emily Chew / *Wolfgang Schalch*)

**Human Health IV: Metabolites, Gene Regulation, and Cancer** (*Yoav Sharoni* / Peter Gann / Margaret Wright / Joseph Levy)

**Carotenoids in Nature: Biosynthesis and Occurrence in Animals** (*Jonathan Blount* / Claudia Schmidt-Dannert / Eleanore Wurtzel / Kevin McGraw / Kozo Tsuchida)

**Keynote Lecture: Carotenoid Oxidases** (*George Britton* / Johannes von Lintig)

**RECENT / FORTHCOMING PUBLICATIONS**

**SIGHT AND LIFE Newsletter 1 & 2/2006,** PO Box 2116, 4002 Basel, Switzerland, **web:** www.sightandlife.org, **tel:** 41-61-688-7494, **fax**: 41-61-688-1910, See especially:

Ford NA, Erdman JW. Lycopene intake and prostate cancer risk (1/2006)

Underwood BA. Reflections: four decades with vitamin A and carotenoids (2/2006)

Solomons NW. CARIG Annual Conference 2006, San Francisco (2/2006)

## Alphabetical Listing of Recent Publications

Prepared by Dr. Harold Furr, Craft Technologies, Inc.
More extensive list may found at www.carotenoidsociety.org


Alija, A. J., Bresgen, N., Sommerburg, O., Langhans, C. D., Siems, W. & Eckl, P. M. (2005) Cyto- and genotoxic potential of β-carotene and cleavage products under oxidative stress. Biofactors. 24: 159-163.

Alos, E., Cercos, M., Rodrigo, M. J., Zacarias, L. & Talon, M. (2006) Regulation of color break in citrus fruits. Changes in pigment profiling and gene expression induced by gibberellins and nitrate, two ripening retardants. J. Agric. Food Chem. 54: 4888-4895.

Aman, R., Biehl, J., Carle, J., Beifuss, U. & Schieber, A. (2005) Application of HPLC coupled with DAD, APcI-MS and NMR to the analysis of lutein and zeaxanthin stereoisomers in thermally processed vegetables. Food Chem. 92: 753-763.

Austin, J., Singhal, N., Voigt, R., Smaill, F., Gill, M. J., Walmsley, S., Salit, I., Gilmour, J., Schlech, W. F. et al. (2006) A community randomized controlled clinical trial of mixed carotenoids and micronutrient supplementation of patients with AIDS. Eur. J. Clin. Nutr. (in press).

Barclay, M. C., Irvin, S. J., Williams, K. C. & Smith, D. M. (2006) Comparison of diets for the tropical spiny lobster Panulirus ornatus: astaxanthin-supplemented feeds and mussel flesh. Aquaculture Nutrition 12: 117-125.

Bernhardt, S. & Schlich, E. (2006) Impact of different cooking methods on food quality: Retention of lipophilic vitamins in fresh and frozen vegetables. J. Food Engineering 77: 327-333.

Boudries, H., Kefalas, P. & Hornero-Mendez, D. (2006) Carotenoid composition of Algerian date varieties (Phoenix dactylifera) at different edible maturation stages. Food Chem. (in press).

Breithaupt, D. E. & Schlatterer, J. (2005) Lutein and zeaxanthin in new dietary supplements—analysis and quantification. Eur. Food Res. Technol. 220: 648-652.

Caballero-Ortega, H., Pereda-Miranda, R. & Abdullaev, F. I. (2007) HPLC quantification of major active components from 11 different saffron (*Crocus sativus L.*) sources. Food Chem. 100: 1126-1131.

Caldwell, C. R. & Britz, S. J. (2006) Effect of supplemental ultraviolet radiation on the carotenoid and chlorophyll composition of green house-grown leaf lettuce (*Lactuca sativa L.*) cultivars. J. Food Composition and Analysis 19: 637-644.

Calvo, M. M., Dado, D. & Santa-Maria, G. (2006) Influence of extraction with ethanol or ethyl acetate on the yield of lycopene, β-carotene, phytoene and phytofluene from tomato peel powder. Eur. Food Res. Technol. 223 (in press)

Carmona, M., Zalacain, A., Sanchez, A. M., Novella, J. L. & Alonso, G. L. (2006) Crocetin esters, picrocrocin and its related compounds present in *Crocus sativus* stigmas and *Gardenia jasminoides* fruits. Tentative identification of 7 new compounds by LC-ESI-MS. J. Agric. Food Chem. 54: 973-979.

Cenkowski, S., Yakimishen, R., Przybylski, R. & Muir, W. E. (2006) Quality of extracted sea buckthorn seed and pulp oil. Canadian Biosystems Engineering 48: 3.9-3.16.

Chitchumroonchokchai, C. & Failla, M. L. (2006) Hydrolysis of zeaxanthin esters by carboxyl ester lipase during digestion facilitates micellarization and uptake of the xanthophyll by Caco-2 human intestinal cells. J. Nutr. 136: 588-594.

Clark, R. M., Herron, K. L., Waters, D. & Fernandez, M. L. (2006) Hypo- and hyperresponse to egg cholesterol predicts plasma lutein and β-carotene concentrations in men and women. J. Nutr. 136: 601-607.

Collera-Zuniga, O., Garcia Jimenez, F. & Melendez Gordillo, R. (2005) Comparative study of carotenoid composition in three Mexican varieties of *Capsicum annuum L*. Food Chem. 90: 109-114.

Cortes, C., Esteve, M. J. & Torregrosa, F. (2005) Changes in carotenoids including geometrical isomers and ascorbic acid content in orange–carrot juice during frozen storage. Eur. Food Res. Technol. 221: 125-131.

Criado, M. N., Motilva, M. J., Goni, M. & Romero, M. P. (2006) Comparative study of the effect of the maturation process of the olive fruit on the chlorophyll and carotenoid fractions of drupes and virgin oils from Arbequina and Farga cultivars. Food Chem. 100: 748-755.

de Moura, F. F., Ho, C. C., Getachew, G., Hickenbottom, S. & Clifford, A. J. (2005) Kinetics of 14C distribution after tracer dose of 14C-lutein in an adult woman. Lipids. 40: 1069-1073.

Deepa, N., Kaur, C., Singh, B. & Kapoor, H. C. (2006) Antioxidant activity in some red sweet pepper cultivars. J. Food Composition and Analysis 19: 572-578.

Delcourt, C., Carriere, I., Delage, M., Barberger-Gateau, P. & Schalch, W. (2006) Plasma lutein and zeaxanthin and other carotenoids as modifiable risk factors for age-related maculopathy and cataract: the POLA Study. Invest Ophthalmol. Vis. Sci. 47: 2329-2335.

Englberger, L., Aalbersberg, W., Schierle, J., Marks, G. C., Fitzgerald, M. H., Muller, F., Jekkein, A., Alfred, J. & Vander Velde, N. (2006) Carotenoid content of different edible pandanus fruit cultivars of the republic of the Marshall Islands. J. Food Composition and Analysis 19: 484-494.

Fanasca, S., Colla, G., Maiani, G., Venneria, E., Rouphael, Y., Azzini, E. & Saccardo, F. (2006) Changes in antioxidant content of tomato fruits in response to cultivar and nutrient solution composition. J. Agric. Food Chem. 54: 4319-4325.

Fanciullino, A. L., Dhuique-Mayer, C., Luro, F., Casanova, J., Morillon, R. & Ollitrault, P. (2006) Carotenoid diversity in cultivated citrus is highly influenced by genetic factors. J. Agric. Food Chem. 54: 4397-4406.

Faure, H., Preziosi, P., Roussel, A. M., Bertrais, S., Galan, P., Hercberg, S. & Favier, A. (2006) Factors influencing blood concentration of retinol, α-tocopherol, vitamin C, and β-carotene in the French participants of the SU.VI.MAX trial. Eu. J. Clin. Nutr. 60: 706-717.

Ferruzzi, M. G., Lumpkin, J. L., Schwartz, S. J. & Failla, M. (2006) Digestive stability, micellarization, and uptake of β-carotene isomers by Caco-2 human intestinal cells. J. Agric. Food Chem. 54: 2780-2785.

Frederiksson, S., Elwinger, K. & Pickova, J. (2006) Fatty acid and carotenoid composition of egg yolk as an effect of microalgae addition to feed formula for laying hens. Food Chem. 99: 530-537.

Gajic, M., Zaripheh, S., Sun, F. & Erdman, J. W., Jr. (2006) Apo-8'-lycopenal and apo-12'-lycopenal are metabolic products of lycopene in rat liver. J. Nutr. 136: 1552-1557.

Goff, S. A. & Klee, H. J. (2006) Plant volatile compounds: sensory cues for health and nutritional value? Science. 311: 815-819.

Goni, I., Serrano, J. & Saura-Calixto, F. (2006) Bioaccessibility of β-carotene, lutein, and lycopene from fruits and vegetables. J. Agric. Food Chem. 54: 5382-5387.

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Herrero, M., Jaime, L., Martin-Alvarez, P. J., Cifuentes, A. & Ibanez, E. (2006) Optimization of the extraction of antioxidants from *Dunaliella salina* microalga by pressurized liquids. J. Agric. Food Chem. 54: 5597-5603.

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Lenucci, M. S., Cadinu, D., Taurino, M., Piro, G. & Dalessandro, G. (2006) Antioxidant composition in cherry and high-pigment tomato cultivars. J. Agric. Food Chem. 54: 2606-2613.

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## Technical Note

### EVALUATION OF A LASER SYSTEM DESIGNED TO MEASURE IN VIVO HUMAN OXIDATIVE STRESS

The detection of carotenoids in human skin and retina by Raman spectroscopic laser measurement has been debated in the Carotenoid News[1, 2]. At a recent FASEB annual conference, the Pharmanex BioPhotonic Scanner was the subject of a new presentation supporting the claims made for the scanner technology and generalizing the correlation of scores to overall systemic antioxidant status[3,4,5]. Pharmanex antioxidant supplements are sold based on the prospective before-and–after results of their use, as measured by the BioPhotonic Scanner; however, controversy remains about the relative efficacy of such supplementation to raise antioxidant status, versus the ingestion of whole foods[6]. We report a case study testing the biophotonic laser, comprising 22 measures of a single subject over 14 months, the results of which cause us to question the measurement system's precision and consistency. We examined the BioPhotonic system measurement consistency, as instanced within any one machine-operator setup, and between various such setups. We define the system as "all instances of the company's standardized BioPhotonic protocol of hardware, software, and operator". Two crucial premises of the system's usefulness are that the scanner machines are identical for measuring purposes and produce commensurable scores, and that the scores cannot be inadvertently altered or deliberately manipulated by short-term dietary or normal, minor environmental and health variations. This latter feature of the BioPhotonic system results, it is said, in distinguishing it from more transitory serum, urinary and other oxidative measures, because of the system's presumptive ability to measure reliably those stable tissue carotenoids that can only be accrued and maintained over several months or longer, and which thereby indicate persistent systemic dietary carotenoids. The licensee company, Pharmanex Corporation, reports the short-term (hours to days to weeks) intra-system or inter-system total score variability in the early versions (S1) of the software was 5-6%. Later, for software version 3.0, and the multiple series of software upgrades of the original S1 (2005) system, the company states the score variability as an absolute number: "… like many biological measurements, [they] may vary within a narrow range (+ or – 3,000 units)"[4]. Operators of the S2 system (the current upgrade of the hardware from S1) claim software version 4.0 (and multiple software 4.0 versions, 2006) have diminished the variation to ~ 1,000 Raman units.

A male, non-smoker, non-alcohol drinker, in good health, was measured 22 times through the course of 14 months. The measurements were performed by the trained equipment operators following the defined protocol, with their system's lasers directed to the same spot on the subject's right palm. Throughout the experiment, the subject followed his typical dietary, nutritional supplementation, work and recreational patterns, with minor variations. Seasonally, the experiment encompassed the highest and lowest UV periods of the year.
Lipid and serum profiles [MDS Metro Labs], and standard physical exam measures were taken during the experiment, with no significant changes. The subject's vital signs were normal throughout the experiment, and weight, BMI, body fat percentage, and total body hydration levels remained stable throughout the 14-month test period.

Figure 1 (rotate to view) shows the scanner scores chronologically, numbers them for reference, and identifies by our code (A, B, C, etc. etc.) the individual systems (operator-hardware-software) used. The mean and standard deviation for this set of scores were 78,810 ± 9,000 Raman units. The subject's scores fall in the high range, as classified by the company, whose diagrams show a possible score range of 0 – 100,000 Raman signal units. Our first concern is the standard deviation of 9000 Raman units, which seems much greater than the variation stated to be expected by the company. Secondly, the changes between some sets of scores related to the amount of elapsed time between those sets of scores are unexpected. The initial transition, which we question, happened between score #4 and # 5, when a decline occurred in one day of 6,000 Raman units. Between score #13 and #14 a decline of 8,000 units occurred after only four days. Between score #14 and #15 an increase of 16,000 units occurred in one day. On February 16 a total of three scores were registered: score #17 increased by 10,000 in 3 hr after #16, then #18 declined by 11,000 units in another 4.5 hr. Thus many scores appear to us as erratic, i.e. exceptionally volatile, given the elapsed periods between scans, compared to expectations of system performance stated by the company.

The range of the sample set of scores is 31,000 units (from 61,000 to 92,000), and changes within 24 hours were recorded as high as 16,000 units within 24 hr, and 11,000 units within 3 hr. We conclude that in the range we examined the measuring system may be imprecise, and yields inconsistent scores at short intervals. What criteria are to be used to distinguish which subset(s) of that series is (most) accurate? Do the erratic measures point to a measuring device problem, or to unknown factors relevant to the experiment?

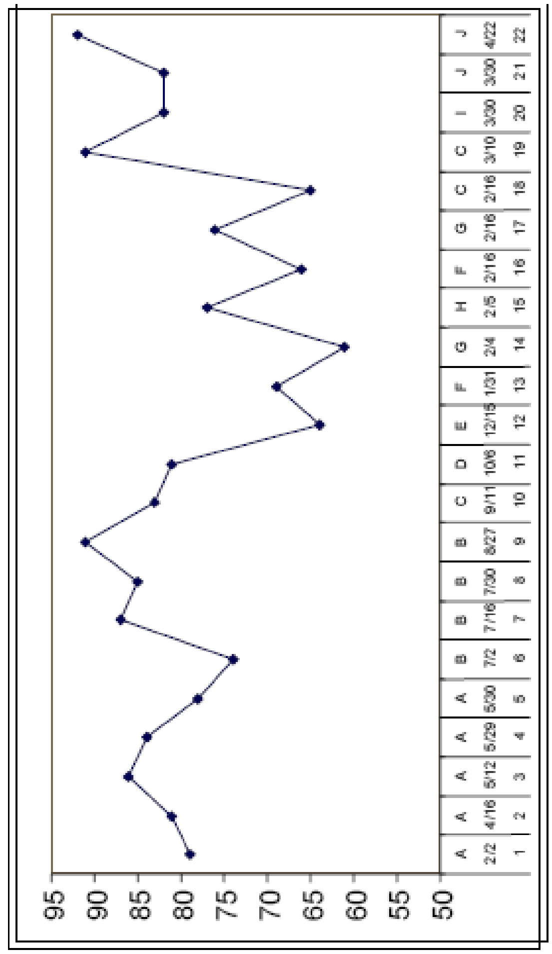

Figure 1. Pharmanex Biophotonic Scanner results (x $10^3$ Raman Units)

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## NEWS AND VIEWS

### Natural Tomato Color Beats Synthetic or Insect-derived Red

Just a few months after its approval in the US, a natural tomato food colorant claims to have attracted strong interest as food and beverage manufacturers look to clean up their labels. The use of synthetic colorants in general appears to be declining in favor of natural colorants. The market for natural and synthetic food colorings together is estimated at $1 billion. The natural food colorant market is estimated at $250 million, with red accounting for $30 to $40 million. The insect-derived red food color is obtained from prickly pear parasite, cochineal, which is rich in carminic acid (an anthraquinone). Tomat-O-Red, derived from tomato lycopene, claims to provide health advantages along with its function as a colorant. The product is available as a liquid dispersion or a cold-water dispersible powder. It can be used to color a variety of products, including beverages, dairy products, confectionery products and baked goods.

*www.nutraingredients-usa.com, April 26, 2006*

### Carotenoids Linked to Lower Risk of Non-Hodgkin Lymphoma

High daily intakes of lutein and zeaxanthin, as well as vegetables in general, could reduce the risk of non-Hodgkin lymphoma by almost 50%, says a new study. Non-Hodgkin lymphoma is a cancer that starts in the lymphatic system and encompasses about 29 different forms of lymphoma. According to the American Cancer Society, over 50,000 new cases are diagnosed in the US every year. The new epidemiological study, published in the June issue of the American Journal of Clinical Nutrition (Vol. 83, 1401-10), compared the dietary intake of 466 people with non-Hodgkin lymphoma (NHL) and 391 matched controls. Carotenoid intakes were estimated using the USDA nutrient databases. The researchers, led by Linda Kelemen from the Mayo Clinic College of Medicine, found that people with a higher number of weekly servings of all vegetables was linked to an lower risk of NHL (42% lower risk than those with the lowest intake). Green leafy vegetable and cruciferous vegetable intake was also associated with a reduced risk of NHL, with the highest intake reducing the risk by about 40% for both vegetable types, compared to the lowest intake. People with the highest intake of lutein and zeaxanthin, were associated with a 46% lower risk of NHL, compared to people in the lowest intake group, while zinc intake was also linked to a lower risk (42%). “Higher intakes of vegetables, lutein and zeaxanthin, and zinc, are associated with a lower non-Hodgkin lymphoma risk,” concluded the researchers. Although this was an epidemiological study, the researchers propose that the mechanism behind this protective effect is linked to the antioxidant effects of the carotenoids. One of the risk factors for NHL maybe DNA damage caused by oxidative stress from reactive oxygen species (ROS), and this is reduced by an antioxidant-rich diet.

*www.nutraingredients-usa.com, June 16, 2006*

### Risk Assessments for Lutein and Lycopene

The Council for Responsible Nutrition’s (CRN) has authored risk assessments for the carotenoids lutein and lycopene – giving both industry and consumers vital information on safe dosage levels that was previously non-existent. More than 30 peer-reviewed, published human randomized clinical trials (RCT) were assessed for lutein with doses ranging from 8 to 40 mg/d. Neither animal or human studies showed any adverse effects at any dose, but based on the data from the RCTs, an USL (safe upper level for supplements) of 20 mg/d was proposed. For all-trans lutein, based on extrapolation from animal studies, an USL of 38mg/d was proposed. Sixteen RCTs were assessed to establish safe doses for lycopene. The data was sufficient to propose an USL of 75 mg/d (extrapolation from animal studies yielded an USL of 270 mg/d). The risk assessments are available online from the peer-reviewed journal, Regulatory Toxicology and Pharmacology.

*www.nutraingredients-usa.com, July 7, 2006*

### Low Lutein, Zeaxanthin Levels Linked to Artery Disease

Researchers from Sweden have reported that people suffering from coronary artery disease (CAD) have low levels of the oxycarotenoids, lutein and zeaxanthin, and could respond to supplementation. A debate has been raging concerning the role of carotenoids and heart health with various intervention trials reporting that supplementation with β-carotene failed to have the effects suggested by epidemiological studies. These disappointments, suggest the researchers from the University Hospital in Linkoping, may be due to the lack of focus on other carotenoids, such as lutein and zeaxanthin. Alpha- and β-carotene, as well as lycopene, are so-called hydrocarbon carotenoids, meaning they contain only hydrogen and carbon atoms, while lutein, zeaxanthin and beta-cryptoxanthin are oxycarotenoids, meaning they contain oxygen atoms in addition to the hydrocarbon skeleton. The new study recruited 89 patients with CAD (50 with stable angina, 39 with acute coronary syndrome), as well as 50 healthy control subjects. Interestingly, the researchers found that the healthy controls had significantly higher plasma levels of lutein plus zeaxanthin (037μM) and β-cryptoxanthin (0.17μM) than the CAD patients (0.27 and 0.10μM, respectively). There were no significant differences between controls and CAD patients for the other carotenoids studied. Lower levels of the oxycarotenoids was also linked to smoking, higher BMI, and lower HDL-cholesterol levels. However, when the researchers accounted for these other factors, there was still a significant link between lutein, zeaxanthin and β-cryptoxanthin levels and artery health. In other words, the results of this study suggest that higher levels of these carotenoids may be linked to improved cardiovascular health, which is in line with the findings from the Los Angeles atherosclerosis study (Circulation, 2001, Vol 103, 2922-27). It was also found that lutein and zeaxanthin levels were associated with levels of the natural killer cells (NK cells), which form a major component of the human immune response system. The mechanism behind potential protective effects of the carotenoids follows this link: the antioxidants reduce the oxidative stress in the body, and therefore benefit NK cell numbers which can then aid immune system response of the individual.

*www.nutraingredients-usa.com, July 26, 2006*

### More Support for Lutein, Zeaxanthin Protection from Macular Degeneration

A stable intake of lutein and zeaxanthin could reduce the risk of age related macular degeneration in women under 75, says a new cohort study. AMD affects the central part of the retina called the macula, which controls fine vision, leaving sufferers with only limited sight. AMD affects over 30 million people worldwide, and is the leading cause of blindness in people over 50. Previous studies have reported a link between AMD and lutein and zeaxanthin, found in leafy green vegetables, corn, egg yolks, squash, broccoli and peas. The carotenoids are proposed to reduce the risk of AMD by absorbing blue light that could damage the macula, by preventing free radicals from damaging eye cells and by strengthening eye cell membranes.

The Carotenoids in Age-Related Eye Disease Study (CAREDS), published in the Archives of Ophthalmology (Vol. 124, 1151-62), used a cohort of 1787 women aged between 50 and 79. Dietary assessments were performed by means of a semi-quantitative food frequency questionnaire (FFQ) at the start of the study. A FFQ also assessed dietary intake over the 15 years before the start of the study. Blood samples were taken to assess levels of carotenoids and color photographs of the retina were used to determine the presence and progression of AMD. While no significant difference in the risk of AMD was observed for the overall sample population, the researchers found that women under 75 with a high and stable intake of lutein + zeaxanthin (2.9 mg/day) had a 43% lower risk of intermediate-stage AMD and a 74% lower risk of late-stage AMD, compared to those with low lutein + zeaxanthin intake (0.8 mg/day). These results did not include women with diet instability. Women over 75 with high intakes of lutein + zeaxanthin did not have reduced risks of AMD, compared to the lower intake group of the same age. Blood levels of these carotenoids were not associated with a decreased or increased risk of AMD, said the researchers. The lack of a link between intake of carotenoids and AMD in the overall study group could be due to several factors, including the fact that the older women who participated in the study may have been more likely to have consumed higher levels of fruits and vegetables during their lifetimes than other older adults who have already died.

*www.nutraingredients-usa.com, August 17, 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. International Carotenoid Society (ICS) Webpage: www.carotenoidsociety.org.

4. 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.

5. Reference library prepared by LycoRed Natural Product; www.lycopene.com-references

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