

Carotene Research Interest Group Meets in San Diego, California

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An audience of 200 students and professionals attended the annual conference of the Carotene Research Interest Group (CARIG), held in April, in conjunction with the gathering of the Experimental Biology 2008 meeting. For the first time in its history, CARIG had formally become part of the American Society of Nutrition, as a Research Interest Section (RIS).

Prof. John Landrum, of Florida International University, the CARIG Chair, welcomed those in attendance and turned the program over to Dr Elizabeth Johnson, of the Tufts University Human Nutrition Research Center on Aging in Boston, organizing coordinator for the 2008 conference. She gave a brief cumulative history of CARIG, including the roster of the first six presenters of the James Allen Olson Memorial Perspectives on Carotenoids lecture (named for one of CARIG's founding members). Dr Johnson introduced Dr Arun Barua, emeritus faculty member at the Iowa State University, to give the seventh annual lecture in this series, entitled *The Hidden Beauty of Carotenoids: From Brilliant Color to Human Health*, which stressed the importance of carotenoids for diverse life forms (*see article of the same name, p14*).

The memorial lecture was followed by two thematic blocks. The first block was a series of three talks on the

subject of carotenoids in early life. In the first, Dr Sherry Tanumihardjo, of the University of Wisconsin, spoke on the carotenoid content of human breast milk. Her discussion focused on the interface of vitamin A status assessment and the dietary importance of plant foods, highlighting as issues the content of carotene and the mechanism for its transport to the mammary gland and secretion into

the milk; its nutritional benefit to the infant, as human milk is also a source of preformed vitamin A; and its health benefits as an antioxidant or bioactive protective substance. Using survey data from various geographic settings, she demonstrated marked variation in maternal milk carotene concentrations; concentrations in milk were low in lactating Brazilian mothers, high in North American mothers, and variable in Irish mothers. Increasing dietary sources of carotenoids is reflected in increased concentrations in breast milk, but the concurrent circulating carotenoid concentration does not appear to influence mammary gland secretion. Breast milk produced by mothers of premature babies (premature milk) has low carotenoid content. Within this consideration, however, is a fact that full maturity of the intestinal enzyme system for bioconversion of provitamin A to active vitamin A is unlikely; hence, milk carotenes do not represent an important source of vitamin A. As other (non-vitamin) roles and functions for carotenoids have been widely described in adults, Dr Tanumihardjo noted the importance of following-up our knowledge of maternal milk carotenoid delivery with deeper understanding of the short- and long-term health implications.

John Landrum addressed the theme of macular pigments in the retina, summarizing data from neonatal monkeys, cats and humans. He used logical inference to describe and rationalize the specific pattern of accumulation of the oxygen-containing (xanthophyll) carotenoids in the macula (fovea) of the retina. The yellow color of the macular disk in the back of the globe of the eye attests to its content of these yellow pigments, lutein and zeaxanthin. Lutein dominates the zeaxanthin : lutein ratio early in life, which is <1.0 below the age of 3 years (or its age equivalence in experimental animals); beyond age 3 years (or its age equivalence in experimental animals), this ratio becomes >1.0. Carotenoids in



Student posters session

the eye tend to increase with age. A relative depletion of these pigments is associated with the blinding disease, macular degeneration of aging. Dr Landrum invoked an evolutionary biology paradigm to interpret the retinal xanthophyll pattern of early life. Since failing vision in later life would not have been a basis for reproductive selection, he concludes that the spatial and concentration features of the xanthophyll pigments have a distinct purpose in ocular function and health.

Dr B. Randy Hammond, of the University of Georgia at Athens, Georgia, gave a related talk on the role in early life of the aforementioned xanthophyll carotenes, in relation to long-term ocular health, especially macular degeneration and cataracts. Again, his arguments were based on logical connections between observed patterns of lutein and zeaxanthin and evolutionary assumptions. He provided evidence and inference supporting the proposition that lutein and zeaxanthin exert a critical role in visual development from early life, and that supplementation with these xanthophylls improves visual acuity in adults. The evidence for a role in maturation comes from studies in rhesus monkeys fed diets specifically deprived of lutein and zeaxanthin, resulting in distinct abnormal morphological changes, including increased cellular proliferation in some sectors of the retina with decreased cell density in others. Although these are ascribed as maturational changes, it was found in follow-up that these changes could be reversed by xanthophyll supplementation later in the monkeys' lives. Dr Hammond bases credibility for protection during vulnerable periods of retinal development on the need to have a filter to avoid damage from light in the blue wavelength, especially as the lens of an infant is more transparent and conducts greater light energy to the retina.



Emorn Wasantwisut in discussion with Rob Russell

The final thematic block of two presentations covered dermal and dermatological aspects of carotenoids. Dr Susan Mayne, of Yale University in New Haven, Connecticut, spoke on approaches to measurement of carotenoids in the skin, using non-invasive measurement methods. The need for exposure biomarkers for intake of nutrients in epidemiology comes from the errors seen in self-reporting of diets in surveys. Whereas blood sampling is needed to obtain serum or plasma, reflection of energy from the skin is totally non-invasive. Dr Mayne presented data from a longitudinal study following 75 persons of varying skin pigmentation designed to evaluate the validity and reproducibility of resonance Raman spectroscopy (RRS) for dermal

carotenoid status. The study revealed a high correlation between chemical HPLC measurements and the estimates provided by the RRS. Within-subject stability attests to the precision of the approach. In addition to the non-invasive nature of this approach, RRS provides immediate results. Moreover, the costs of HPLC analyses for blood specimens are much higher across survey populations than measurements with a portable probe apparatus. This approach portends wide utility as a biomarker in epidemiological studies relating dietary exposures to health outcomes.

Prof. Helmut Sies, of the Heinrich Heine University, Duesseldorf, Germany, concluded the program with his contribution on carotenoids and skin health. Among the points covered in his talk were: the necessity for both plants and animals in an oxygen-rich and sunlit environment to have protection from the solar radiation; the role of endogenous pigments such as melanin in animals and carotenoids in plants to reduce the effects on tissues of radiation; and the ability of certain plant compounds such as polyphenols, tocopherols and carotenoids to counteract free radical oxidation. Dr Sies presented the results of his group's experience with providing carotenoid-containing supplements to decrease the erythema formation of skin areas exposed to UV radiation. Subjects with extremely

fair skin complexions were recruited into five treatment groups: two were food sources (carrot juice and tomato paste), two were dietary supplements (tomato extracts) containing lycopene and other carotenoids (lycopene supplement; lycopene juice), and the final treatment was pure, isolated lycopene. The daily lycopene intakes ranged from 8.2 to 16 mg over the 10–12-week trial, with readings of skin protection efficacy made at baseline, at four weeks and at the end. Skin protection was found by all treatments, with the exception of

pure lycopene, by 12 weeks. This suggests that some interaction or cooperation among different carotenoids is more effective in reducing experimental erythema.

The customary VARIG-CARIG reception and poster competition was held on Saturday evening. Five graduate or post-doctoral students posted their original research findings for the competition. The jury awarded the prize to Youn-Kyung Kim, of Rutgers University, for her poster, entitled The Role of β -carotene 15-15' Oxygenase (CMO1) during Mammalian Embryonic Development. The next annual conference will be held in New Orleans in April 2009.