(167) Carotenoid Accumulation Among the Diploid and Amphidiploid *Brassica* Species

Dean A. Kopsell*[1], Scott McElroy[1], Carl Sams[1], David Kopsell[2]

[1]The University of Tennessee, Plant Sciences, Knoxville, TN, 37996; [2]The University of Wisconsin–Platteville, School of Agriculture, Platteville, WI, 53818

Vegetable crops can be significant sources of nutritionally important dietary carotenoids and *Brassica* vegetables are sources that also exhibit antioxidant and anticarcinogenic activity. The family *Brassicaceae* contains a diverse group of plant species commercially important in many parts of the world. The six economically important *Brassica* species are closely related genetically. Three diploid species (*B. nigra, B. rapa,* and *B. oleracea*) are the natural progenitors of the allotetraploid species (*B. juncea, B. napus,* and *B. carinata*). The objective of this study was to characterize the accumulation of important dietary carotenoid pigments among the genetically related *Brassica* species. The HPLC quantification revealed significant differences in carotenoid and chlorophyll pigment accumulation among the *Brassica* species. *Brassica nigra* accumulated the highest concentrations of lutein, 5,6-epoxy lutein, violaxanthin, and neoxanthin. The highest concentrations of beta-carotene and total chlorophyll were found in *B. juncea. Brassica rapa* accumulated the highest concentrations of zeaxanthin and antheraxanthin. For each of the pigments analyzed, the diploid *Brassica* species accumulated higher concentrations, on average, than the amphidiploid species. *Brassicas* convey unique health attributes when consumed in the diet. Identification of genetic relationships among the *Brassica* species would be beneficial information for improvement programs designed to increase carotenoid values.

(168) Phospholipase Dα and Lipoxygenase Gene Expression in Fruit, Floral, and Vegetative Tissues of 'Honey Brew' Hybrid Honeydew Melon

Bruce D. Whitaker[1], Gene E. Lester*[2]

[1]USDA–ARS Beltsville Agricultural Research Center, Produce Quality & Safety Laboratory, Beltsville, MD, 20705-2350; [2]USDA, Agricultural Research Service, Kika de la Garza Subtropical Agricultural Research Center, Weslaco, TX, 78596

Increases in phospholipase D (PLD) and lipoxygenase (LOX) activities are thought to play a key role in senescence of mesocarp tissues in muskmelon fruit. We have cloned and characterized two full-length cDNAs, CmPLDα and CmLOX1, encoding PLDα and LOX proteins in honeydew melon (*Cucumis melo* L. Inodorus Group). Levels of expression of the corresponding genes were determined by semi-quantitative RT-PCR in developing and mature fruit mesocarp tissues (20–60 d after pollination; DAP), and in roots, leaves, and stems from 4-week-old and flowers from 6-week-old plants. The coding regions of CmPLDα1 and CmLOX1 cDNAs are, respectively, 2427 and 2634 nucleotides long, encoding proteins 808 and 877 amino acids in length. CmPLDα1 is most similar to PLDα genes in castor bean, cowpea, strawberry, and tomato (77% nucleotide identity), and is the first cucurbit PLD gene cloned. CmLOX1 has 94% nucleotide identity to a cucumber LOX gene expressed in roots and 80% identity to cucumber cotyledon lipid body LOX. Transcript of CmPLDα1 was much more abundant than that of CmLOX1, but relative levels of transcript in the various organs and tissues were similar for the two genes. Expression was highest in roots, flowers, and fruit mesocarp tissues. CmPLDα1 expression in fruit was high throughout development, although maximum levels occurred at 50 and 55 DAP, respectively, in middle and hypodermal mesocarp. CmLOX1 expression was generally higher in middle than in hypodermal mesocarp with maximum transcript levels at 55 and 50 DAP, respectively. Overall, the patterns of expression of CmPLDα1 and CmLOX1 are consistent with a model in which their encoded enzymes act in tandem to promote or accelerate senescence in fruit mesocarp tissues.

(169) Antioxidant Levels in Frozen and Processed Lingonberries and Bog Blueberries

Patricia S. Holloway*[1], Roxie Rodgers Dinstel[2]

[1]Univ. of Alaska Fairbanks, Dept. of Plant, Animal & Soil Sciences, Fairbanks, AK, 99775; [2]Univ. of Alaska Fairbanks, Cooperative Extension Service, Fairbanks, AK, 99775

Frozen lingonberries (*Vaccinium vitis-idaea* subsp. *minus*) and bog blueberries (*V. uliginosum*) were processed using recipes of the Alaska Cooperative Extension Service. Overall antioxidant activity (H-ORAC) was 71 $\mu mol \cdot g^{-1}$ of TE for frozen bog blueberries and for lingonberries, 160–165 $\mu mol \cdot g^{-1}$ of TE. Processing into fruit leather and drying increased levels in bog blueberries to 260–430 $\mu mol \cdot g^{-1}$ of TE and lingonberries to 457–939 $\mu mol \cdot g^{-1}$ of TE. Leathers and dried fruit had significantly higher levels of total anthocyanins (frozen bog blueberries: 2.1 $\mu g \cdot g^{-1}$, leather: 8.0 $\mu g \cdot g^{-1}$, dried: 9.8 $\mu g \cdot g^{-1}$; frozen lingonberries 1.4 $\mu g \cdot g^{-1}$, leather: 4 $\mu g \cdot g^{-1}$, dried: 5.2 $\mu g \cdot g^{-1}$); total phenolics (frozen bog blueberries: 4.8 $\mu g \cdot g^{-1}$, leather: 19 $\mu g \cdot g^{-1}$, dried: 26 $\mu g \cdot g^{-1}$; frozen lingonberries 7.7 $\mu g \cdot g^{-1}$, leather 24 $\mu g \cdot g^{-1}$, dried: 38 $\mu g \cdot g^{-1}$); and quercetin (frozen bog blueberries: 6.7 $\mu g \cdot g^{-1}$, leather: 86 $\mu g \cdot g^{-1}$, dried: 150 $\mu g \cdot g^{-1}$; frozen lingonberries 7.7 $\mu g \cdot g^{-1}$, leather 110 $\mu g \cdot g^{-1}$, dried: 430 $\mu g \cdot g^{-1}$). Bog blueberries did not have detectible levels of p-coumeric acid or benzoic acid, but lingonberries showed a significant increase in dried fruit and leather (frozen fruit p-coumeric: 0.18 $\mu g \cdot g^{-1}$g, leather: 0.45 $\mu g \cdot g^{-1}$, dried: 1.4 $\mu g \cdot g^{-1}$; frozen fruit benzoic: 0.41 $\mu g \cdot g^{-1}$, leather: 0.84 $\mu g \cdot g^{-1}$, dried: 0.71 $\mu g \cdot g^{-1}$). Frozen and processed lingonberries had little or no vitamin C. Bog blueberries had detectible levels in all treatments [highest in leather (440 $\mu g \cdot g^{-1}$), frozen berries (220 $\mu g \cdot g^{-1}$)]. ORAC, total anthocyanins, total phenolics, and quercetin were detected in all other processing methods (canned fruit, syrup, canned juice, jam, sauce, frozen j uice, and freezer jam). Levels were similar to or lower than frozen fruit.

(170) Reduction of Natural Microbial Population with Antimicrobial Agents and Subsequent Washing Treatments of Fresh-cut Vegetables

Hidemi Izumi*, Takeshi Yamashita, Maki Inada

Kinki University, School of Biology-Oriented Science and Technolgy, 930 Nishimitani, Kinokawa, Wakayama, 649-6493, Japan

Ferulic acid agent (2% of ferulic acid), fumaric acid agent (20% of fumaric acid), mustard extract agent (10% of allyl isothiocyanate), and calcined calcium agent (91% of calcium) were assessed for reduction of endogenous microbial population on fresh-cut lettuce, cabbage, and cucumber in the preliminary study. In seeking effective minimum concentration, a 0.5% ferulic acid agent or 1.0% fumaric acid agent applied on lettuce, 0.1% mustard extract agent on cabbage, and 0.05% calcined calcium agent on cucumber reduced mesophilic aerobic bacteria (MAB) and coliform group (coliforms) by about 0.5 to 1.5 logs relative to water-dipped control. The efficacy of these antimicrobial agents with subsequent washing treatments with electrolyzed water (13 ppm of available chlorine) or ozonated water (5 ppm of ozone) on endogenous microorganism were evaluated with fresh-cut vegetables stored in MA package for 4 days at 10 °C. With lettuce, the fumaric acid agent followed by electrolyzed water treatment was the most effective in reducing counts of MAB, coliforms, and psychrotrophic aerobic bacteria (PAB) for the first 2 days of storage. This treatment eliminated gram-positive bacteria such as the genus *Curtobacterium* and gram-negative bacteria such as the genus *Stenotrophomonas*. With cucumber, fumaric acid agent or calcined calcium agent with sequential washing with electrolyzed water reduced counts of MAB, coliforms, PAB and lactic acid bacteria during 4 days of storage, with the reduction being greater with fumaric acid agent than with calcined calcium agent. With cabbage, the combinations of the agents and washing treatments had no pronounced effect when compared with water treatment.