USDA-ARS Grape & Wine Workshop

David Klurfeld
National Program Leader, Human Nutrition
Beltsville, MD
Health and Nutrition

- Components of grapes/wine that can enhance human health and provide for the nutritional needs of the American public
  - Compounds may need to be delivered as a package to derive maximal benefit

- Health and nutrition concerns will be strong drivers for the market of both traditional and innovative products
Established Health Attributes

- Antioxidants
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- Red wine – heart disease
  - Still controversial – AHA says no specific link
- Grape/wine reduction of blood clotting
  - Ethanol has similar effect
Grapes & Health in ARS

- Analysis of grapes – 3 locations
- Metabolism of grape constituents
- Animal models for human diseases
  - Aging
  - Cholesterol-lowering
  - Prevention of diabetes, cancer, Alzheimer’s disease, Parkinson’s disease
- Vision study in humans
Antioxidants in Muscadines

• Selection of muscadine germplasm with increased phenolics/anthocyanins
• NP306 – Quality & Utilization of Agricultural Products
• Penny Perkins-Veazie, South Central Agricultural Research Lab, Lane OK
  – Grape breeders in Davis, CA and Poplarville, MS
• 16 varieties tested, grown in 2 locations; found 2 with unusually high total phenolics
Antioxidants in Fruits

• Health consequences of phytochemical intake
• NP107 – Human Nutrition
• Ron Prior – Arkansas Children’s Nutrition Center
  – Another chemist at ACNC
  – Adapted ORAC assay for routine use
  – Special nutrient database -- proanthocyanins
Organic Chemistry Lesson

Anthocyanins
4 biological mechanisms to inhibit cancer, heart disease

Genistein
>10 biological mechanisms to inhibit cancer, heart disease, osteoporosis

Estradiol

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Antioxidants in Fruits

- 25 fruits screened for anthocyanin content
  - 14 contained compounds
  - Range was 2 in peaches to 31 in Concord grapes
    - 4 more than in blueberries
    - 11 in red grapes
    - 13 in cranberries
    - 7 in strawberries
  - Many anthocyanins identified for the first time
Antioxidant Method Development

• NP107– Human Nutrition
• Food Composition Lab – Beltsville, MD
• Dave Luthrie and Jim Harnly
• Improving methods for extraction and measurement of phenolics, including polymeric tannins
  – Have method to measure 13 at once
Food Composition Lab

- Flavonoid database
  - Released 2003
  - Determined 27 flavonoids (19 published)
    - Grapes – black, red, white
    - Grape juice
    - Raisins
    - Wine – red, white
  - Industry support of analysis for chocolate, blueberries, plums, tea
- www.nal.usda.gov/fnic/foodcomp
Metabolism of Grape Compounds

- NP107 – Human Nutrition
- Michael Grusak, Children’s Nutrition Research Center, Houston
  - Two other ARS scientists
- Growth chambers to label suspension cultures of grape and berry cells with radioactive carbon
- Feed to animals for tissue distribution studies
Benefits of Pterostilbenes

• NP302 – Plant Biol & Molec Processes
• Agnes Rimando, Natural Products Utilization Research Unit, University, MS
  – Chemist from WRRC, Albany, CA & others
• Pterostilbene is a much more active analog of resveratrol
  – Lowers LDL cholesterol by 29% in hamsters
  – Induces PPAR-α 8-14-fold
Cancer Prevention

- Collaboration with Univ. of Illinois
- Fed 3 levels of Concord grape juice to rats
  - Juice/Water – 1:3, 1:2, 2:1
- Reduction in breast cancers in rats
- Freeze-dried grape color extract reduced growth of cancer cells in culture
Diabetes Prevention

• NP107 – Human Nutrition
• Susan Zunino and Charles Stephensen, WHNRC, Davis, CA
• Feeding NOD mice 1% grape powder
  – At 28 weeks, 71% of controls have diabetes
  – 33% of grape-fed mice have diabetes
• Plan to increase grape powder, study individual antioxidants, identify specific grape varieties
Neurological Functions

• NP107 – Human Nutrition
• James Joseph, HNRCA, Boston, MA
  – Research increased demand for blueberries
  – Doing similar studies with grape juice
• Grape juice/extract studies
  – Functional improvements in memory & behavior during aging
  – Muscarinic (acetylcholine) receptor sensitivity increases – relevant to AD and PD
**ROTAROD TEST**

**REVERSAL AGE DIET STUDY**

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**LACTENCY TO FALL (sec)**

- CONTROL
- STRAWBERRY
- SPINACH
- BLUEBERRY

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**Diet Group**

- **a**
- **b**

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**J. Joseph, HNRCA at Tufts**

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BENEFICIAL EFFECTS OF HIGH ANTIOXIDANT FRUITS ON BRAIN AGING

Senescent rats drank Concord Grape Juice for two months:

- Improved coordination, strength and memory
- Improved dopamine release from brain tissue

J. Joseph, HNRCA at Tufts
Wine and Cataracts

• NP107 – Human Nutrition
• Allen Taylor, HNRCA, Boston, MA
  – 4 other scientists at HNRCA
• Nurses Health Study - Harvard
  – 556 women aged 53-74 years
  – Moderate wine intake
    • 17% more nuclear cataracts (~20% of total)
    • 12% fewer cortical cataracts (~60% of total)
“Not much ... just flushing out my arteries.”