FOOD QUALITY and WHY IT MATTERS

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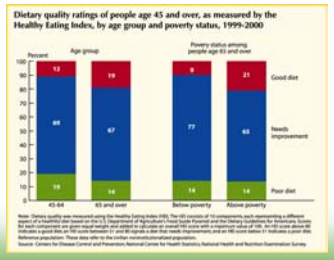
Why Food Quality Matters

- Americans are *"overfed and undernourished"* – phrase coined in "What We Eat in America" – major USDA report released in September 2005.
- Epidemics of obesity and diabetes have displaced AIDS and lung cancer as the nation's foremost public health problems

Why Food Quality Matters

Only 15% of Americans have a healthy diet based on USDA's "Healthy Eating Index"



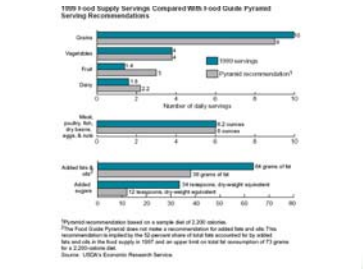
Why Food Quality Matters

- Treating disease prolongs life but at high costs
- Experts agree that changes in dietary choices and food quality must play a role in health promotion and disease prevention
- Changes in diet needed to support graceful aging

What's Wrong with the American Diet?

- Too many calories and too much added sugar, salt and fat
- Inadequate intakes of fiber and on average 2.5 essential nutrients/day
- Intake of about one-half of the recommended servings of fruit and vegetables per day
- Intake of about one-third of the optimal intake of antioxidants per day (best estimate)

What's Wrong with the American Diet?



What's Needed to Fix the American Diet?

- Dietary choices driven by individual needs according to age and health status
- Access to more whole and minimally processed foods
- Access to more nutrient and antioxidant dense foods

Antioxidant Capacity of Foods

Varies greatly per serving and per calorie

Food Group	Values	Average H-ORAC	Average H-ORAC
	H-ORAC units per serving	Units per Serving	Units per Calorie
Very High	2,000-14,000	6,063	84.5
High	1,000 – 1,999	1,535	40.4
Moderate	500 – 999	724	31.6
Low	0-499	325	16

Antioxidant Capacity of Foods

Foods High in H-ORAC Units per Calorie Deliver Thirty-Five More ORAC Units per Calorie Than Foods Low in ORAC Units

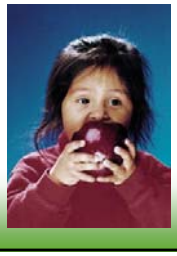
Antioxidant Category and Fresh Food	H-ORAC Units per Calorie	Antioxidant Category and Fresh Food	H-ORAC Units per Calorie
VERY HIGH		LOW	
Blueberry, Wild	247	Cucumber, with peel	6
Artichoke, Cooked	186	Granola, Low-fat	6
Plums, Black	161	Toasted Oatmeal Cereal	5
Asparagus, Raw	150	Oats, Quick (Oatmeal)	5
Broccoli Raab, Raw	126	Corn, Canned	5
Blackberry	122	Oatmeal Raisin Cookie	4
Strawberry	111	Watermelon	4
Blueberry, Cultivated	108	Life Cereal	4
Cabbage, Red, Cooked	107	Low-fat Chewy Granola Bar	4
Lettuce, Red Leaf	102	Lima Bean, Canned	1
AVERAGE TOP 10 FOODS	**142**	AVERAGE BOTTOM 10 FOODS	**4**

Meeting Antioxidant Needs

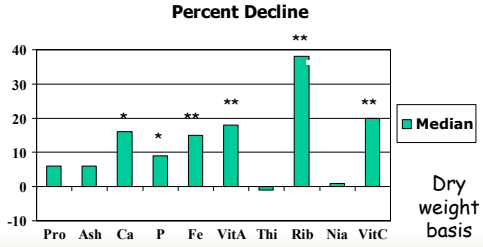
- Tufts researchers recommend a diet delivering 3,000 – 5,000 ORAC units per day; also called "Anti-Aging Points"
- "Moderate" foods = average 32 ORAC units/calorie
- Only about 160 calories of "Moderate" ORAC level foods are needed to reach 5,000 ORAC units per day (only about 8% of daily calorie intake based on a 2000 kcal diet)

Quality Food

- Delivers maximum nutrients per calorie consumed
- Is free of chemical, drug, mycotoxin and microbial contaminants
- Tastes good and stores well



Nutrient Density in 43 Garden Crops: 1950 to 1999



Dry weight basis

* P < 0.05
** P < 0.01

(Davis, Epp & Riordan, J Am Coll Nutr, 2004; 23:669)

Organic Farming Impacts on Food Quality

- Often enhances nutrient density a few percent to 30% or more
- Avoids most chemicals and animal drug contaminants
- Has potential to – and may already – reduce prevalence of mycotoxin and bacteria contaminants
- Often improves taste and organoleptic quality, although many factors must be taken into account

The Organic Center's Food Quality Index

- An enormous task that will take years and much investment
- Many institutions, labs and companies will need to lend a hand in developing methods and essential data

The Organic Center's Food Quality Index

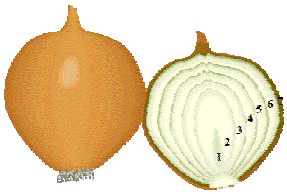
Positive attributes:

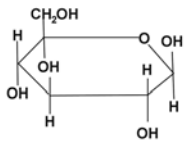
- Nutrient density – including protein levels and quality
- Taste and sensory attributes
- Antibiotic susceptibility status of bacteria present in food
- CLA and omega-3 levels, and omega-3:omega-6 ratio in animal products

The Organic Center's Food Quality Index

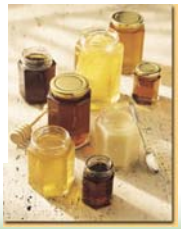
Negative attributes:

- Presence of added fats, salt and sugar
- Pesticide residues and risks
- Mycotoxin levels and risks
- Microbiological contamination





GLUCOSE



Biological Functions of Glucose in Humans

- Basic form of energy (fuel) in the form of CARBOHYDRATE
- Precursor of a variety of substances including Vitamin C and glycogen (stored energy)

Glucose (sugar) metabolism is regulated by insulin

Glycosylation in Humans

- Is the process or result of adding a sugar molecule or molecules to proteins and peptides
- Usually an enzymatic reaction -- can help protect regulatory proteins and hormones from metabolic breakdown

Glycosylation in Humans

- Can also decrease bio-availability of vitamins, minerals, antioxidants and other substances
- Excessive levels of glucose in the blood leads to abnormally high glycosylation of proteins, altering their normal functions

Diabetes Mellitus

Type 1 – IDDM, or Insulin Dependent Diabetes Mellitus

- Characterized by a lack of pancreatic production of insulin
- Exogenous insulin is essential

Type 2 – NIDDM, or Noninsulin-Dependent Diabetes Mellitus

- Pancreatic production of insulin continues, but there is a lack of action or resistance to insulin action

Diabetes Mellitus

Gestational Diabetes

- Occurs during pregnancy as a result of hormonal influences causing insulin resistance

Diabetes Mellitus

Diabetes is rapidly increasing in the U.S. and has serious consequences including blindness, loss of limbs, kidney disease, and premature death

Management of Diabetes

Diet – Prescribed to promote health

- the reduction of excessive weight
- the 'normalization' of circulating glucose levels

Exercise - Improves the natural control of blood glucose levels

Blood Glucose Measurement

- average glucose levels are measured by evaluating glycosylated hemoglobin values

Medication (if necessary)

Biological Functions of Glucose in Plants

- Glucose is the major product of photosynthesis
- Glucose is the plant's major energy source and is the structural carbohydrate for plant cell walls

Plant Sugars

The form of sugar in plants varies:

- glucose – 0.74 times as sweet as sucrose
- galactose – found in fruits, vegetables and dairy products
- fructose – primarily found in fruits, vegetables and honey
- sucrose – a disaccharide (breaks down into glucose and fructose) found in sugar cane, sugar beet and maple sugar

Plant Sugars

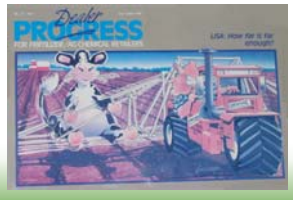
- Foundation of cellulose (cell walls)
- Stored in the plant as cellulose and starch
- Are moved by the plant to where they are needed
- Excesses are moved out of the plant via root exudates and leaf tissues
  - sugar exudates play a role in rhizosphere microbial ecology – and food safety

Glycosylation in Plants

- Plant proteins, peptides, and phytochemicals are routinely glycosylated
- Impacts the movement and stability of phyochemicals within plants
- Alters the bio-availability and activity of phytochemicals – including vitamins and antioxidants in the mammalian (human) digestive system

Impacts of High Nitrogen

Excess N in farming systems leads to extra production of sugars and nitrates – both tend to be higher in conventional crops

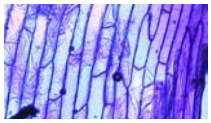


More High 'N' Impacts ….

- Higher yields
- Larger fruits and vegetables
- Larger average cell size
- Decreases in nutrient density
- Greater yield variability when plants are stressed
- Less intense flavor

Impacts of Larger Average Cell Size in Plants

- Dilution of nutrients
- Stretched cell walls that may be more easily penetrated by viruses, bacteria and fungi



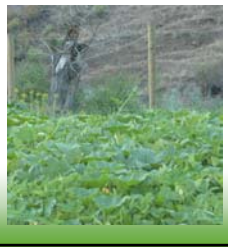
More Impacts of Larger Cells

Heightened vulnerability to certain pathogens

- thinner cell walls plus….
- more readily available "fuel" for pathogens that invade cells
- lower density of phytochemicals needed for plant "immune response"

Diabetes in Plants?

Excess sugar in plants triggers changes in plant physiology, regulation and the ability to combat pathogens that have some similarities to diabetes in humans



Diabetes in Plants and Humans

- Fundamentally rooted in sugar metabolism
- Complications arise as a consequence of how plants and people deal (or are unable to deal) with excess circulating sugar

Is There a Connection Between Plants with a Diabetes-Like Syndrome and the Risk of Human Diabetes?

Diabetes Connections?

- Extra sugars in plants/human blood may alter the integrity of cells and mute responses to stress and pathogens
- Nutrient dilution in food crops clearly impacts adequacy of human nutrient intake

Diabetes Connections?

- More sugars and less antioxidants in human diets are risk factors for inflammation, proliferation and free-radical and oxidative cell damage
- Glycosylation patterns and biochemistry play key roles in plant and human nutrition and health

Organic Center Research 2007 Priority Areas

- Healthy children and human reproduction
- Nutrient content and antioxidant capacity of food
- Physiological factors and mechanisms leading to changes in nutrient density and food quality
- Development of a "Food Quality Index" to measure and compare the nutritional quality and safety
- Enhancing environmental quality and biodiversity through organic management

Ongoing Organic Center Research Activities

- Pesticides
- Antioxidants
- *E. coli* O157 prevention
- Wine quality
- Nutrient content
- Soil quality
- Cow health and milk quality
- Impacts of organic milk reaching 10% market share

Organic Center Research Priorities

Please share your thoughts and suggestions regarding:

- The Organic Center's areas of focus
- Individuals who can help advance our ongoing research
- Companies or organizations with an interest and commitment to promote food quality that may be willing to work with the Organic Center

Sources of Information

Antioxidant State of Science Review (SSR)
January 2004

Obesity and Diabetes Critical Issue Report (CIR)
To be released early December

"Do Organic Fruits and Vegetables Taste Better than Conventional Fruits and Vegetables?"
SSR to be released late November

www.organic-center.org

Sources of Information

E. coli FAQ Critical Issue Report (CIR)

"Successes and Lost Opportunities to Reduce Children's Exposure to Pesticides Since the mid-1990s, CIR, August 2006

Mycotoxin SSR