Food Science and Economic Adulteration

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The Problem of Economic Adulteration

A serious, but not a new problem:

“They make olive-oil out of cottonseed-oil, now a days, so that you can’t tell them apart.”

- Mark Twain  *Life on the Mississippi* (1883)
The Problem of Economic Adulteration

- There is a financial incentive to dilute or substitute a high value product with a less expensive substitute.
- Such substitutions are sometimes difficult to detect by consumers or commercial traders.
- It is the job of the food science analyst to develop and utilize appropriate technical means for the detection of economic frauds.
Example: Fruit Juice

• Fruit juice can be diluted with less expensive sugars:
  ▪ $1.00 + per pound fruit solids vs. $0.20 for sugar and HFCS

• Premium juice types can be extended with less costly juice types

• Juices can be “enhanced” with improper additives such as colors or acids
Adulteration with Sugars

- Sugar and Invert Sugar
- High Fructose Corn Sweetener
- Specialty Sweeteners such as Inulin Syrups and Rice Syrup
Substitution of Cheaper Juices

• Apple, White Grape and Pear Juices
• Deionized Grape, Pearl and Pineapple Sugars
• By-products such as pomace extract or peel juice
• Almost anything in high priced specialties like berry juices and pomegranate
Undeclared Enhancement with Food Additives

- Acidulants – Malic Acid, Citric Acid etc.
- Artificial Colors
- Artificial Flavors
- Vitamin C and other Nutrients
The Sad History of Juice Adulteration

Some Major Adulteration Scandals in the US:

- Apple Juice in late 1970’s
- Orange Juice – U.S. Midwest in late 1980’s, Canada, UK, Australia in early 1990’s
- Cranberry Juice in 1995-6
- Apple Juice again in the mid 1990’s
- Pomegranate Juice from 2006 to date
- Lemon Juice 2011 to date
Approaches to Analysis

- Determine levels of natural or components
  - minerals, acids, sugars
- Determine markers of particular adulterants
  - Trace oligosaccharides – invert sugar
  - Sorbitol – apple and pear juice
- Characteristic ratios
  - Carbon Isotope Ratio – cane and corn
  - Anthocyanin and Phenolic Fingerprints
Current Authenticity Issues

- Pomegranate Juice
- Lemon Juice
- Coconut Water
Pomegranate Juice
Current Issues: Pomegranate Juice

![Graph showing the relationship between potassium (mg/L) and mannitol (g/100mL).]
Current Issues: Pomegranate Juice
Lemon Juice
Current Issues: Lemon Juice
Current Issues: Lemon Juice

![Graph showing the relationship between Formol Value (meg/100mL) and Potassium (mg/L).]
Cider Vinegar
Isotopic Analysis of Vinegars

- PETROCHEMICAL VINEGAR AND ACETIC ACID
- WINE AND CIDER VINEGARS
- CORN VINEGAR

14C Activity (% of Modern Standard Activity)

13C/12C Ratio (‰ PDB)
Isotopic Analysis of Commercial Cider Vinegars
Tools For Coping
Know Your Suppliers

- Provide Clear Specifications
- Make Plant Visits and Audits
- Require Traceability of Supplies
- Periodic Qualification Analyses
Attend Scientific and Trade Association Meetings

• Participate in Technical Committees
• Personal networking – Go out to dinner or have a drink in the bar with your industry colleagues
• This is where some of the best information about what is really happening can be obtained
AIJN Code of Practice

- The AIJN Code of Practice Committee has compiled compositional and quality data ranges and guide values for more than 20 fruit juices.
- The Code of Practice also contains texts of EU regulations and identity standards.
- [WWW.AIJN.ORG](http://WWW.AIJN.ORG)
IFU Analyses

• Compendium of Fruit Juice Analytical Methods Compiled by the IFU Commission on Methods of Analysis
• Contains 80 Validated Test Methods and 10 Method Recommendations
• http://www.ifu-fruitjuice.com/ifu-methods