Apple Botany and History and Production

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Apples

- High diversity in cultivars (~20,000)
- High in vitamins, fiber, and antioxidants
- Intensively managed
- Can be picked ripe off the tree and eaten without any preparation
Botany and History

• Family: Rosaceae
• Genus: Malus
  – ~ 28-55 species
• Domesticated apple:
  – *Malus x domestica*
• Latest believed progenitor
  – Malus pumila
  – Malus sylversii

*Figure 4. On arrival in the Tian Shan, the neo-apple likely resembled the tiny, long-stalked, bitter apple *Malus baccata*, the Siberian crab. (Illustration courtesy of Rosemary Wise.)*
Botany and History

• Temperate zone tree fruit
  – In an area of the world \( \sim 30^0 \) north of the equator
  – Areas with cold winters
Botany and History

• Mechanisms for winter survival
  – Deciduous, lose their leaves in the fall
  – Dormancy
  – Chilling requirements
Botany and History

• Generally adapted for animal dispersal
  • Colorful fruit
    – Red is not the prominent color in the wild
  • High sugar content
  • It is believed the bear contributed much to its dispersal
Possible Center of Origin
• In the Tien Shan (Heavenly) Mountain range (Kazakhstan, Tajikistan, Kyrgyzstan)
Neolithic apple

Genetic diversity in the wild
Botany and History

- Much folklore and myth
- Cultivated by primitive man
- Evidence of domestication by 10\textsuperscript{th} century B.C.
- In 9\textsuperscript{th} B.C., in \textit{The Odyssey}, Homer wrote about apple trees
History

- **8,000 B.C.**—Nomadic hunter/gatherer societies invent agriculture and begin to "settle" in places throughout the "fertile crescent" from the Nile through the Tigris and Euphrates, the Indus, and Yellow River Valleys.

- As both trade and military expeditions begin among these earliest civilizations, **apples** quickly spread from the forests of their origin in the Tien Shan mountains of eastern Kazakhstan throughout the "civilized" world.
History

• **323 B.C.**—Theophrastos describes 6 varieties of apples and discusses why budding, grafting, and general tree care are required for optimum production and says seeds almost always produce trees of inferior quality fruit.
79 A.D.—Pliny the Elder in his *Natural History* describes 20 varieties of apples.

200 A.D.—Famous Greek physicians living in Rome, Galen and later Hippocrates, recommend *sweet apples* with meals as aids to digestion and sour apples only for fainting and constipation.
Legend

• In Greek mythology, Gaia, or Mother Earth, presented a tree with golden apples to Zeus and his bride Hera on their wedding day.

• Guarded by Ladon, a serpent who never slept, the apple tree was in the garden of the Hesperides, daughters of the Evening Star.
Legend

• These golden apples became involved with many tales of love, bribery and temptation ranging from the abduction of Helen of Troy to the defeat and marriage of Atlanta.
The Hesperides in the garden. Here the apples are on a tree, and the dragon Ladon looks more like a single-headed serpent.
London E 224, Attic red figure hydria, ca. 410-400 B.C.
Photograph courtesy of the Trustees of the British Museum, London
1470 A.D.—*The Fall of Man*, a painting by the popular and highly respected Hugo Van Der Goes, depicts an apple tree in the biblical Garden of Eden complete with Adam and Eve and the Devil. Thereafter artists everywhere choose apples for the Garden of Eden, even though the apples were no doubt borrowed from a similar creation story in Greek mythology, causing apple demand among illiterate Christians to plummet. Among learned Christians, e.g. in the monasteries and royal courts, apples continued to flourish.
Botany and History

• Brought into American continent by Canadian settlers
• First commercial orchard in the US~ 1600 in Maine
• Colonial: before 1800
  – called "pippins," prospered in New England, especially after the colonists imported honeybees to improve pollination.
• Cider-apple time - 1800-1875
  – In 1810:125 distillers/12,300 gal brandy in VT alone
• Farm orchards - 1875-1900
• Commercial - 1910-1940
• Specialized commercial - 1940-date
Old American Varieties

• Roxbury Russet

• Pippin:
  – Newton, Fall,
  – Cox Orange
"An apple a day keeps the doctor away" was an old adage, dating from the late 1904, that was updated into an advertising slogan, promoted by apple growers fearful that prohibition would cut sales.
Horticulturist but also, a smart and shrewd real estate agent!
Arkansas Production

• In 1900, there were 1,613,760 apple trees planted in Benton Co
• In 1907, the largest crop on record: over 5 million bushels
• Industry based on Ben Davis
• Industry began to decline
  – Pest control
  – Prohibition
  – “Hawkeye” Red Delicious: Introduced in 1894
Arkansas Apple Production

In Million Pounds

Years

Crop from unsprayed tree. Fourteen sound apples on left, 1,275 scabby apples on right. 1.9% sound
Arkansas Black

• Originated in Benton Co
• Bore its first fruit in 1870
• “It is one of the most beautiful apples. It is a good keeper and commands a good price…."
  (The Apples of New York, 1905)
Botany and History

• The domesticated apple is genetically very diverse.
• It does not ‘come true to seed’
Botany and History

• Most apple trees require cross pollination
  – You must have two different cultivars of apples in order to have fruit
Apple propagation

• Asexual propagation or cloning

  – When you take part of one plant, place it into another plant, and let them grow together as a new organism
Asexual propagation used in apples

• Grafting

• Budding
Fig. 3. Cleft Graft
Cultivars and Rootstocks

• All commercially sold apple trees consist of two parts
Cultivar and Rootstock

- What to look for in a cultivar
  - Appearance
  - Taste
  - Disease resistance
  - Insect resistance
  - Climatic adaptability
Cultivars and rootstocks

• What to look for in a rootstock
  – Climatic adaptability
  – Soil type adaptability
  – Pest resistance
  – Overall tree size
    • standard
    • semidwarf
    • dwarf
Apple cultivars or varieties

• Cato the Elder: 1st B.C.
  – 7 varieties
• 1st century A.D.
  – 36 varieties
• Today, there are approximately 20,000 different kinds of apple
• Where do these cultivars come from?
Origin of cultivars and varieties

- Wild seedlings
- Hawkeye- Red Delicious
Origin of cultivars and varieties

Mutations

Bud sport

Yellow Delicious
Origin of cultivars and varieties

Breeding programs where crosses are made

‘Liberty’
Disease Resistant Cultivars

• ‘Field immune’ to apple scab and have varying degrees of resistance to other diseases
  – Liberty
  – Williams Pride
  – Redfree
  – Jonafree
  – Pristine
  – CrimsonRed
  – GoldRush
Genetically engineered apples

• None to date commercially

• 1989 Researchers at Cornell University used a "gene gun" to successfully transfer an anti-bacterial gene from a Cecropia moth to a fire blight susceptible apple tree.

• This gene transfer from an animal to a plant enabled the tree to develop its own fire blight resistance and trees made from buds or graft wood from this tree also had blight resistance.

• Bio-tech as demonstrated could save the apple industry and consumers millions of dollars.
Genetically engineered apples

- Disease resistance
  - Fire blight resistant Gala

- Insect resistance
Apple Production Is Extremely Important To The Income Of U.S. Fruit Farmers

Source: USDA National Agricultural Statistics Service

Percentage share of the total value of U.S. fruit production during the period 1995/96-1998/99, which is estimated at $10 billion:

- Grapes 1%
- Oranges
- Apples: 16%
- Strawberries
- Peaches
- Pears
- Grapefruit
- Lemons
- Other Fruits 2%

1/ Includes grapes for fresh table, dried, and wine use.
2/ Major components in this category include cherries, blueberries, nectarines, and plums.
Apples are grown in every state in the continental United States, and are grown commercially in 36 states. Top-producing states include Washington, New York, Michigan, California, Pennsylvania and Virginia.

Six States Account For 85 Percent Of The U.S. Apple Crop

Source: USDA National Agricultural Statistics Service
U.S. Apple Production Is Slowly Shifting Away From The Traditional Delicious Varieties

Source: US Apple Association

Percent of Total Production

- Red Delicious: 43%, 34%
- Golden Delicious: 15%, 13%
- Fuji: 2%, 6%
- Gala: 7%

Marketing Years July-June:
- 1993/94
- 1994/95
- 1995/96
- 1996/97
- 1997/98
- 1998/99
- 1999/00
# Nutrition Facts

**Fresh Apples:**

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<th>Serving Size</th>
<th>1 medium apple (154g/5.5 oz.)</th>
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<tbody>
<tr>
<td><strong>Amount per Serving</strong></td>
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<tr>
<td><strong>Calories</strong></td>
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<tr>
<td>Calories from Fat</td>
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<tr>
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<tr>
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<tr>
<td>Calcium</td>
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<tr>
<td>Iron</td>
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*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.*

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<tr>
<th>Calories per gram:</th>
<th>Fat 9</th>
<th>Carbohydrate 4</th>
<th>Protein 4</th>
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What the Label does not Tell You

- Apples are a rich source of phytonutrient (plant-based) antioxidants.
- Apples and apple juice are two of the best sources of the mineral boron, which may promote bone health.
- Apples contain natural fruit sugars, mostly in the form of fructose.
- Because of apples' high fiber content, the fruit's natural sugars are slowly released into the bloodstream, helping maintain steady blood sugar levels.
Health Benefits

• Breast cancer
• Colon cancer
• Type II Diabetes
• Alzheimer's
• Heart disease
• Asthma

U.S. Apple Association
http://www.usapple.org/index-c.shtml
Thank You!