

A still life painting of various vegetables including a head of lettuce, a bunch of green onions, a tomato, and some potatoes, set against a warm, textured background.

Ingredientes de productos vegetales. Nuevas fuentes para Alimentos Funcionales

F.A. Tomás-Barberán, CEBAS (CSIC)
Zaragoza, 4 Abril 2006



Experimental
Field



The Institute





Food constituents

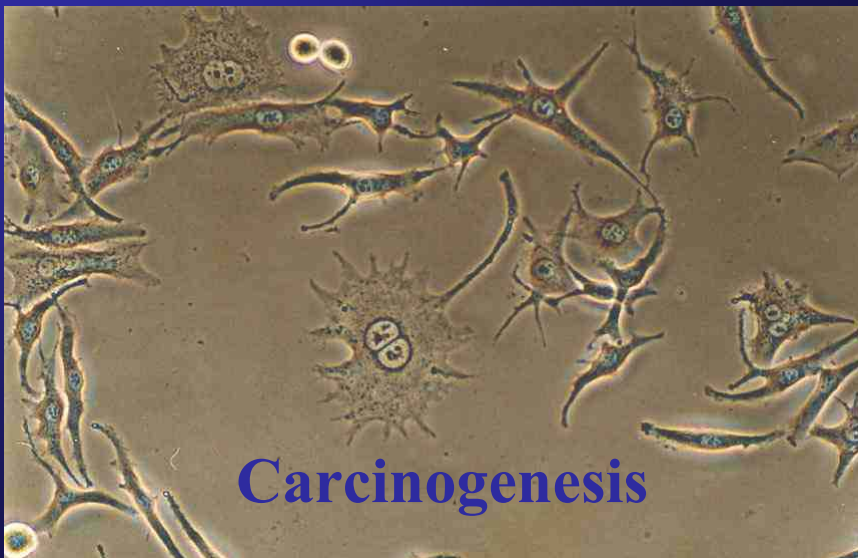
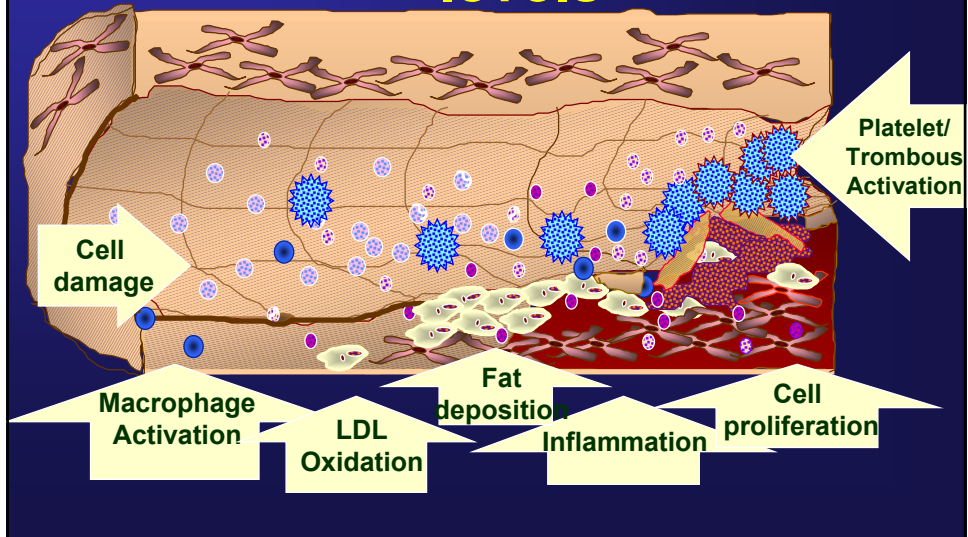
- Nutrients
 - macronutrients (lipids, carbohydrates, proteins)
 - micronutrients (vitamins)
- Non-nutrients
 - Other constituents with biological activity beyond nutrition

Diet and Disease Risk

- **A)** Cardiovascular diseases
 - Miocardial infarct
 - Vascular accidents
- **B)** Cancer
 - Digestive tract
 - Other
- **C)** Neurodegenerative diseases

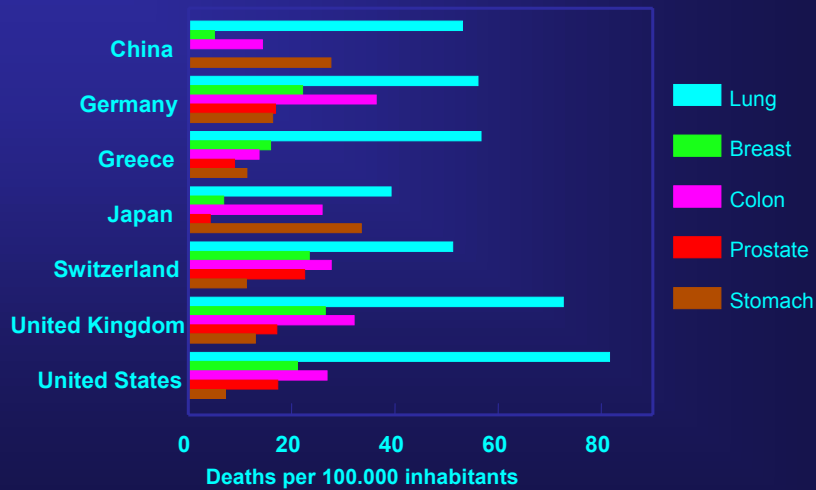
Cardiovascular Diseases

Oxidants act at different levels



Cancer deaths

1992-1995



Epidemiological evidence: Fruit & Vegetables *Protection Against Cancer*

Cancer
Types

No. studies showing
protective effect

Total

127 / 162

Stomach

28 / 30

Colon

15 / 19

Esophagous

12 / 14

Lung

11 / 13

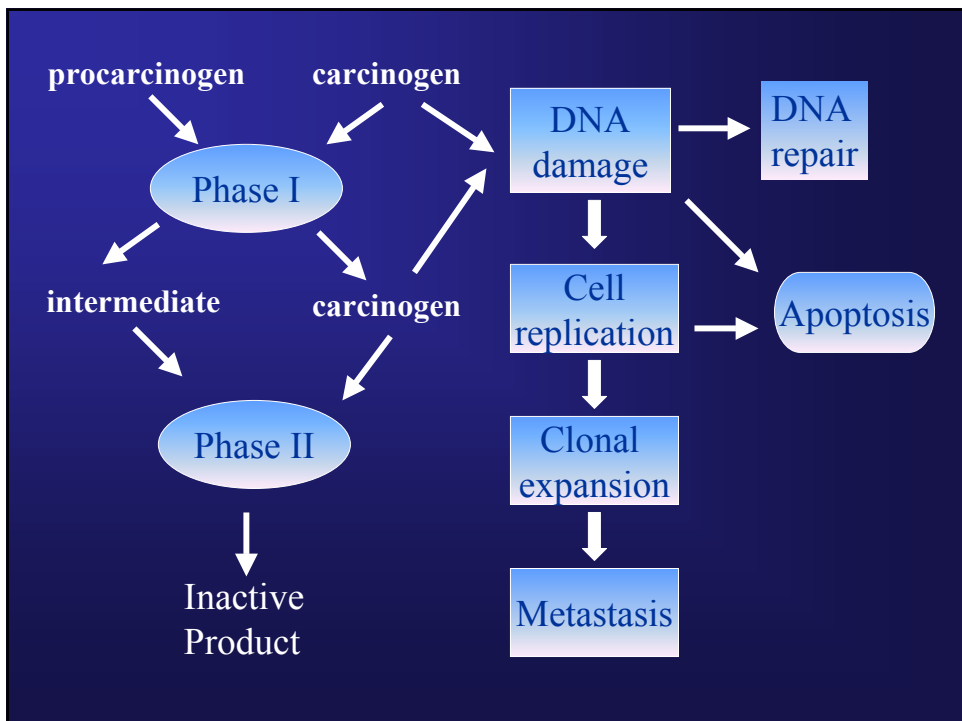
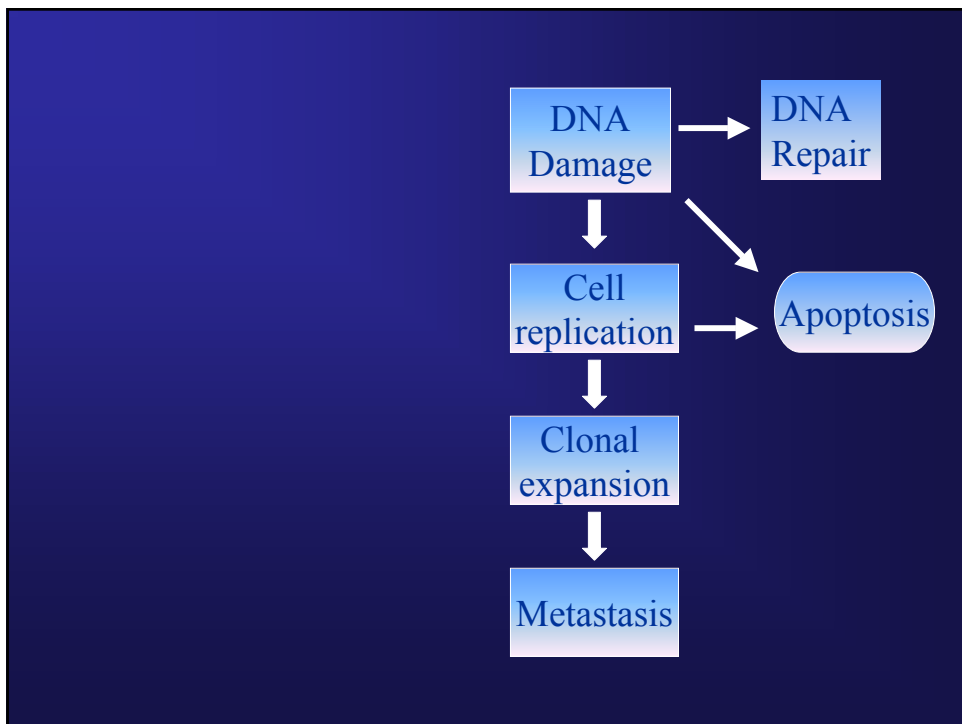
Rectum

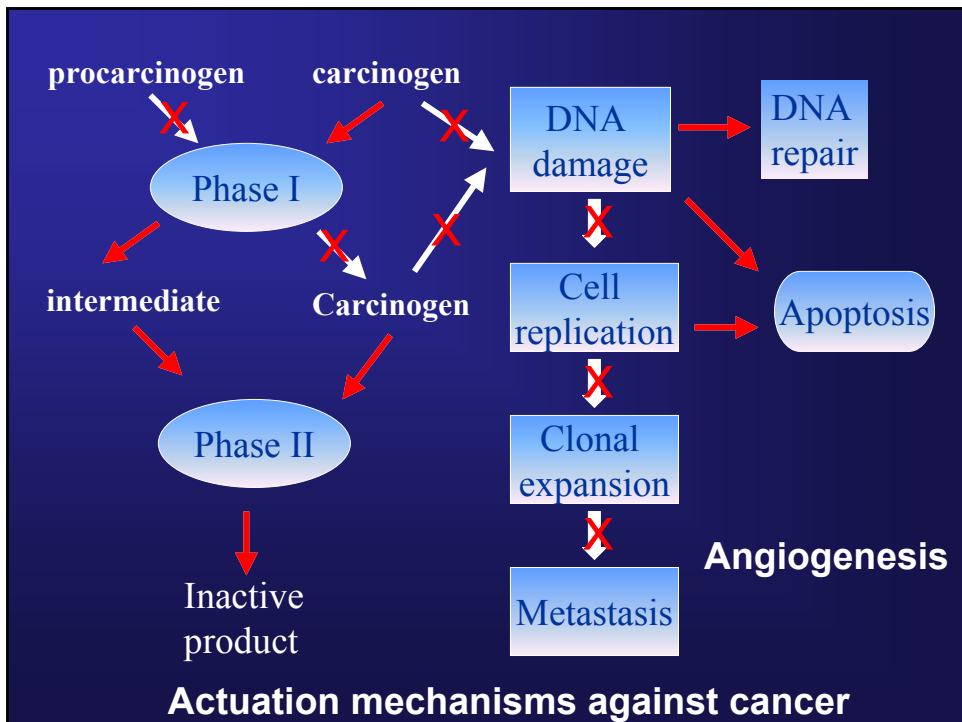
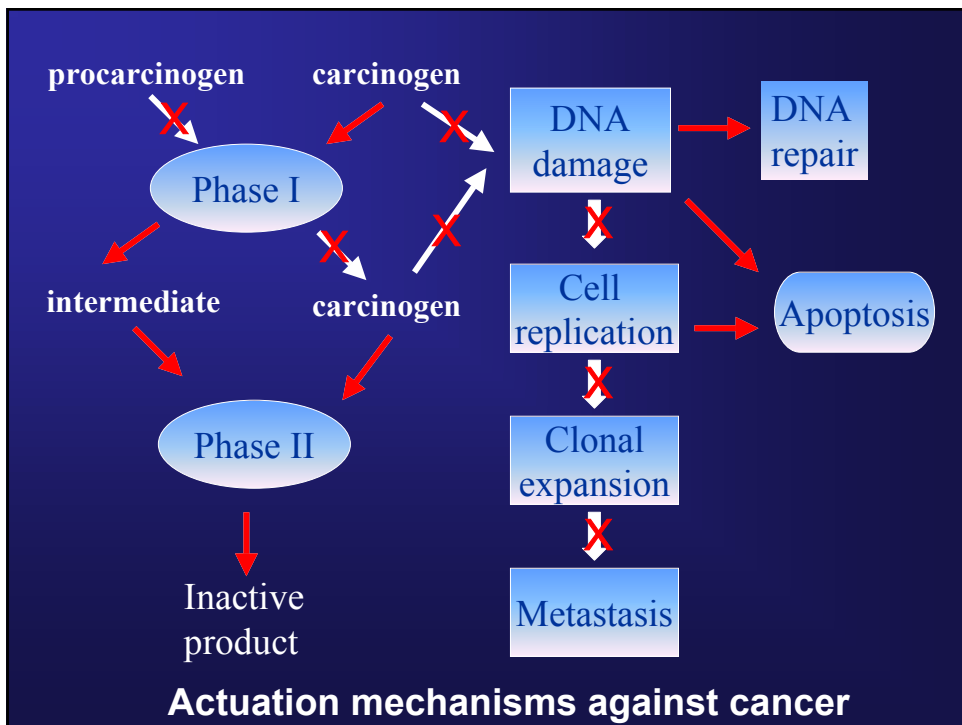
8 / 10

Breast

9 / 13

(Steinmetz & Potter, 1996, *JADA* 96:1027-1039)

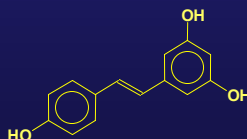
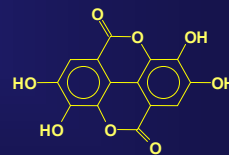
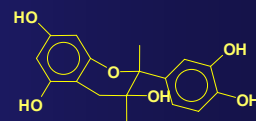
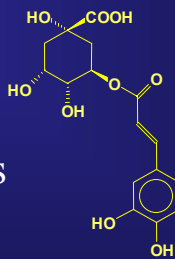
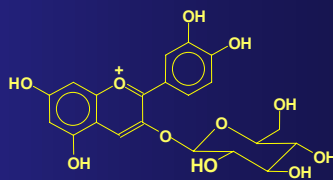
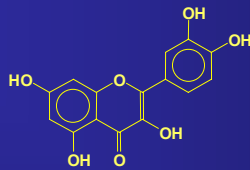


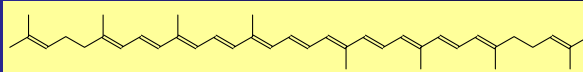


Bioactive constituents

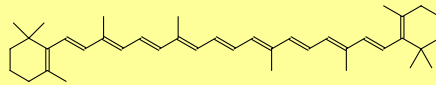
Phytochemicals

- Flavonols
- Anthocyanins
- Flavan-3-ols
- Hydroxycinnamates
- Phenolic acids
- Stilbenoids

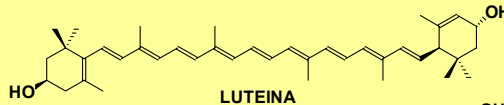




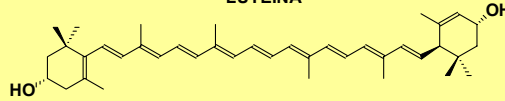
LICOPENO tomate



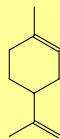
BETA CAROTENO
zanahoria



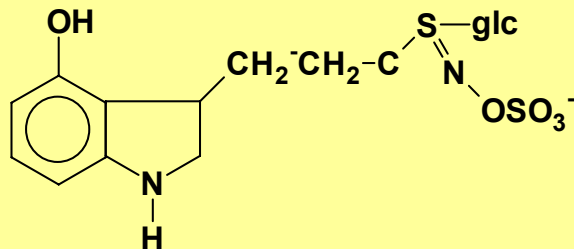
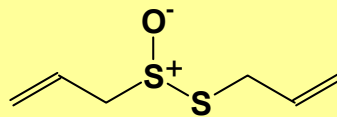
LUTEINA



LACTUCAXANTINA
lechuga



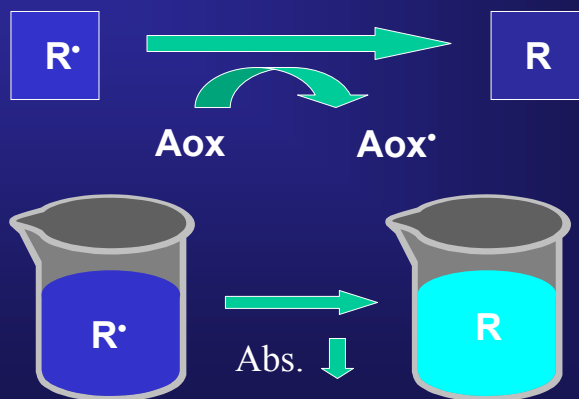
LIMONENO
cítricos



Health = Antioxidant

- Relationship with diseases and ageing
- Consumer's demands
- Marketing opportunities for industries

Antioxidant activity 'in vitro'



Raise Your Antioxidant I.Q.

What are antioxidants? What can they do for me?

Antioxidants are special compounds that neutralize the damaging effects of oxidation, which is thought to play a role in the aging process and the development of cancer, heart and lung diseases, and cataract formation.

In what foods are antioxidants found?

Antioxidants are found in a variety of foods—especially fruit. In a recent study, U.S. Department of Agriculture scientists at Tufts University have ranked fruits by their level of antioxidant power. Following is the result:

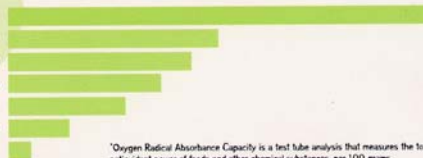
What is oxidation?

Oxidation is cellular damage caused by free radicals—highly reactive molecules that are normally produced in the body as a byproduct of metabolism in cells. Common examples of oxidation in everyday life include the rusting of metal, the browning of fruit and the rancidity of oils.

Prunes Score Highest in Antioxidants

Fruit antioxidant score*

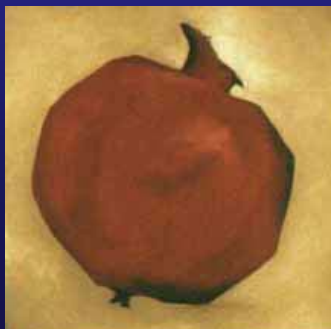
Prunes	5770
Raisins	2830
Blueberries	2400
Blackberries	2036
Strawberries	1540
Oranges	750
Apples	218



*Oxygen Radical Absorbance Capacity is a test tube analysis that measures the total antioxidant power of foods and other chemical substances, per 100 grams.

Source: U.S. Department of Agriculture

©1999 California Prune Board

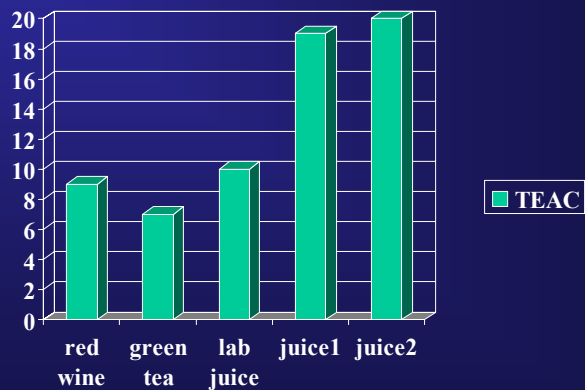


Pomegranate Juice



Murcia, 1995

Pomegranate juice antioxidant activity



Davis, August 1999 (Gil et al., 2000)

MORE POWERFUL ANTIOXIDANTS

Product	Antioxidant Power (%)
POM Wonderful	71%
Red Wine	46%
Blueberry Juice	33%
Cranberry Cocktail	20%
Orange Juice	12%
Green Tea	10%

www.pomwonderful.com

Chart compares ability of various juices to eliminate harmful free radicals; units are % of free radicals eliminated. Source: Avron, M., Technion Faculty of Medicine. Data on file.

Printed in Korea

Drink it daily. Feel it forever.

POM WONDERFUL

POM WONDERFUL
100% POMEGRANATE JUICE

Los Angeles, July 2004

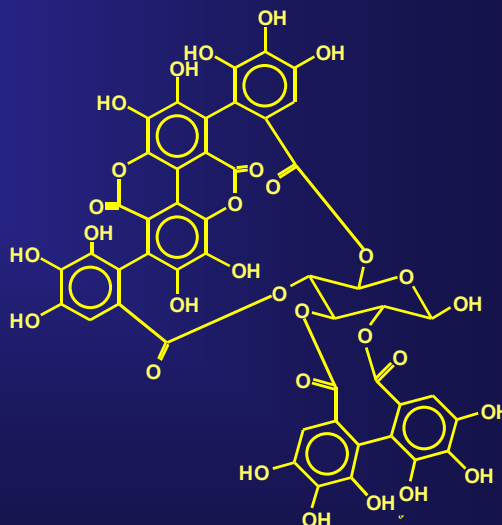
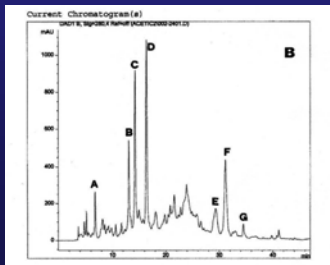
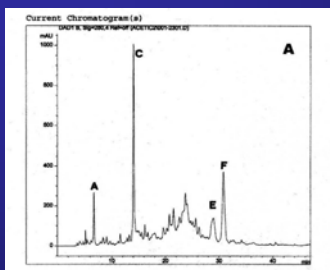
The Antioxidant Superpower.

POM WONDERFUL
100% POMEGRANATE JUICE

The power of pomegranate juice.

San Francisco, October 2005

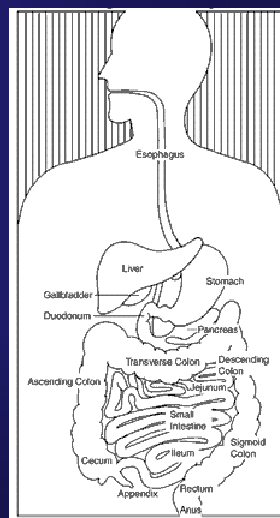
Pomegranate juice polyphenols



Clinical Studies

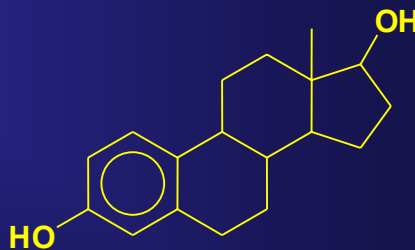
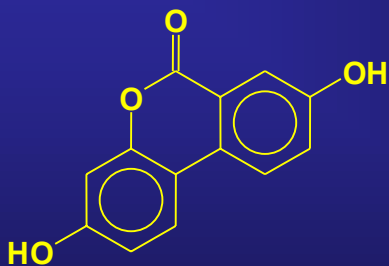
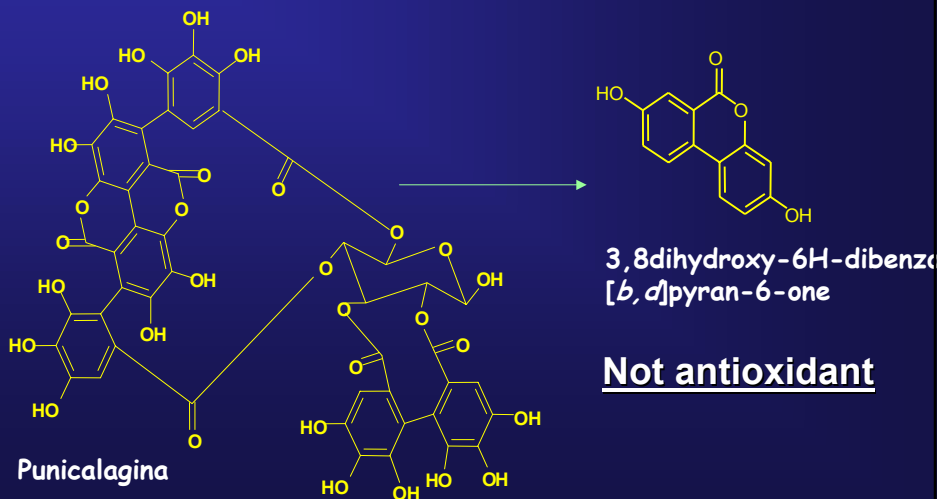


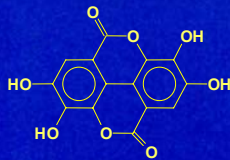
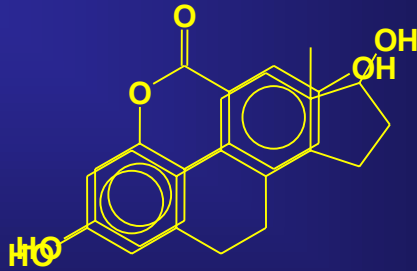
- Effect biomarkers
- Exposition biomarkers
- Bioavailability
- Final effect biomarkers



Gastrointestinal metabolism of punicalagin

Cerdá et al, Eur J. Nutr. 2003



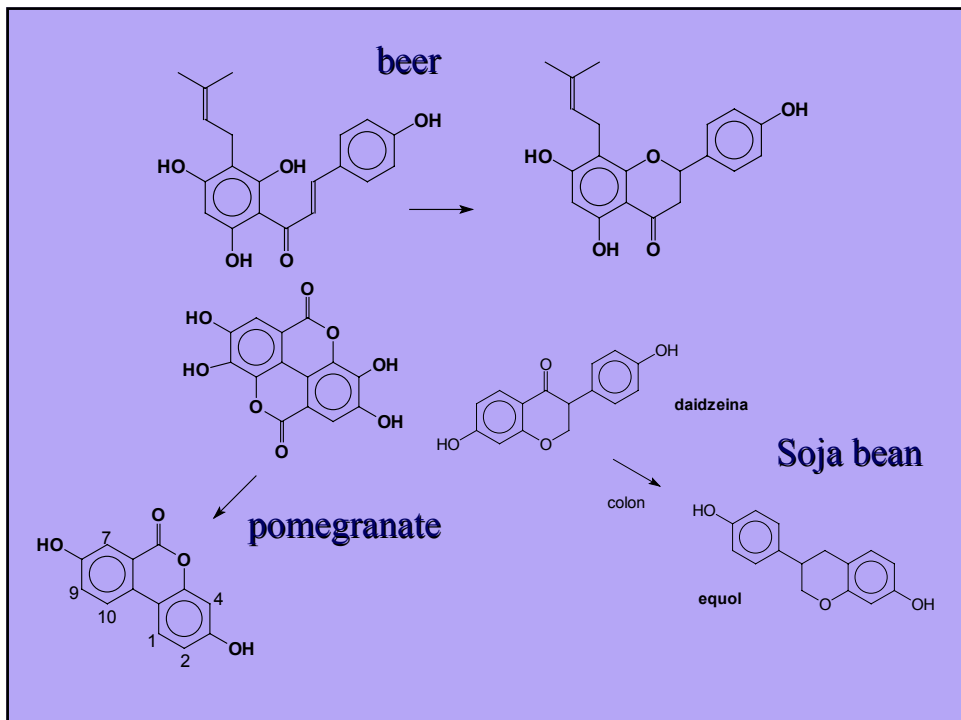


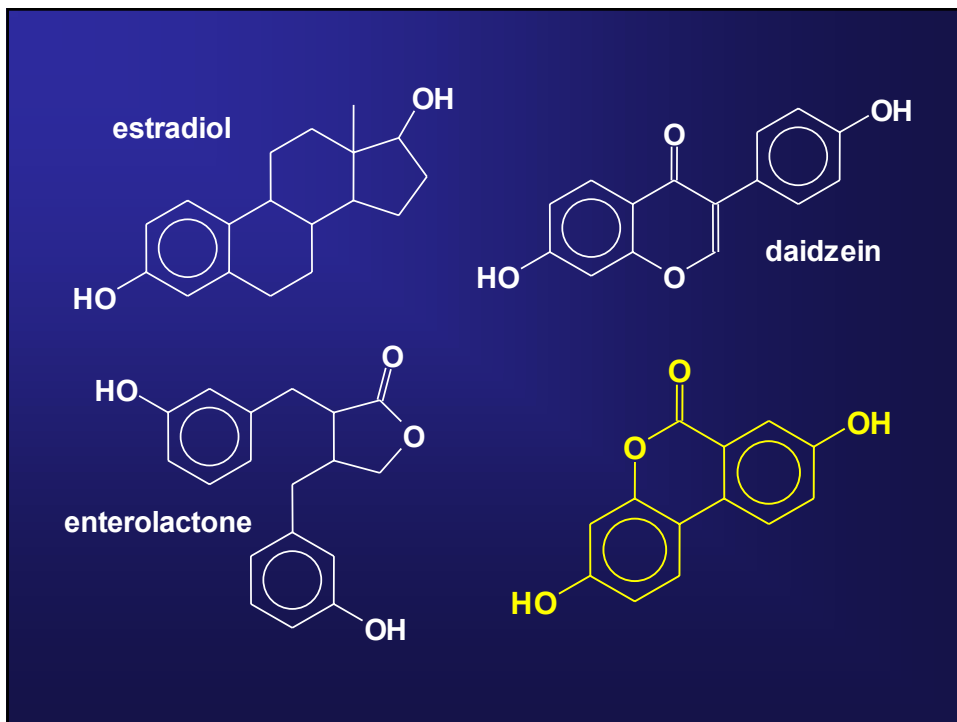
Apoptosis in colon cancer

Colon microflora

- **Strict Anaerobics**
 - *Bacteroides*
 - *Bifidobacterium*
 - *Eubacterium*
 - *Clostridium*
 - *Peptococcus*
 - *Peptostreptococcus*
 - *Ruminococcus*
- **Anaerobics fac.**
 - *Escherichia*
 - *Enterobacter*
 - *Enterococcus*
 - *Klebsiella*
 - *Lactobacillus*
 - *Proteus*

Large variability among individuals





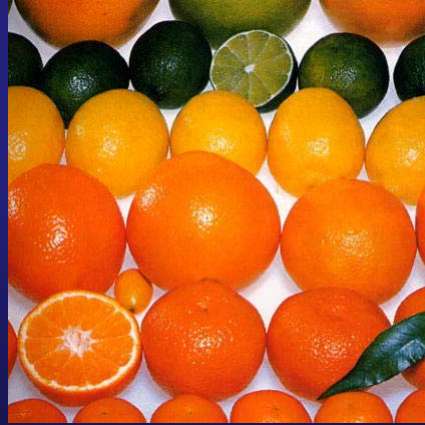
New Sources of Ingredients

- Mediterranean diet
- Ethnobotany
- Ethnopharmacology
- Traditional cultivars
- Byproducts
- Technological treatments
- Biotechnological treatments



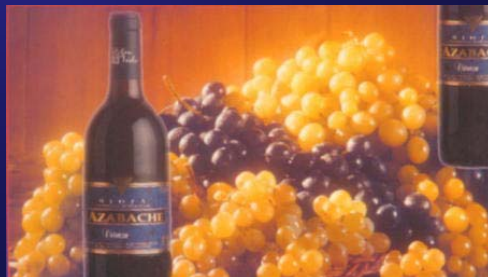
Citrus products

- Phenolic substances
 - flavanones
 - coumarins
 - flavones
- Terpenes
 - limonene
 - limonoids
 - carotenoids
- Dietary Fibre
- Folates



Grape products

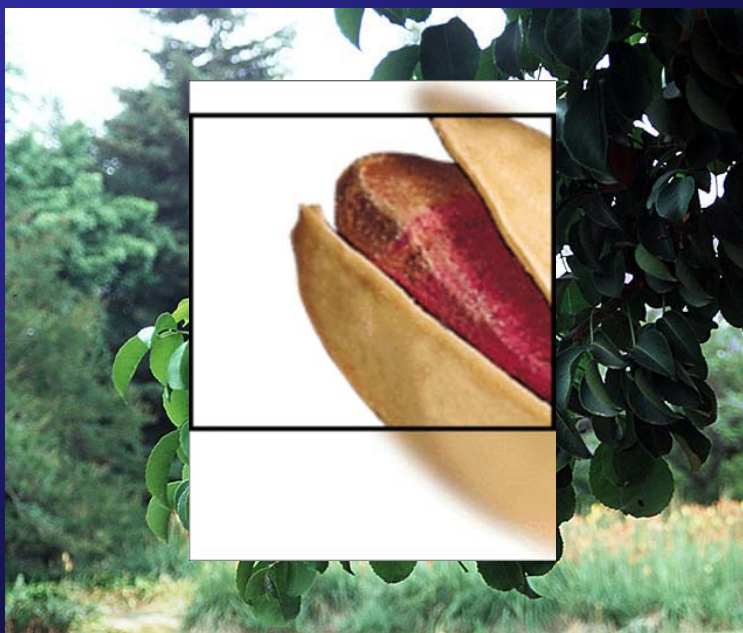
- Antioxidant dietary fibre
- Phenolic substances
 - anthocyanins
 - tannins
 - resveratrol
 - flavonols





© The Thyssen-Bornemisza Collection, 1992.





Copyright © Professor David H. Byrne
Department of Horticultural Sciences
Texas A&M University



Olives



Vegetables



Vegetable products

- Crucifers
 - Isothiocyanates
 - Indols
 - Dithiolthiones
- Onions and garlic
 - Sulfur compounds
- Other
 - Dietetic fibre



Oils



Herbs



Propolis





Cyperus







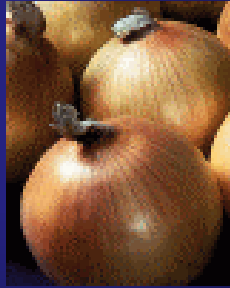




Byproducts and Wastes

- Environmental problem
- Industrial problem
- Good source of phytochemicals

Tissue location of phytochemicals



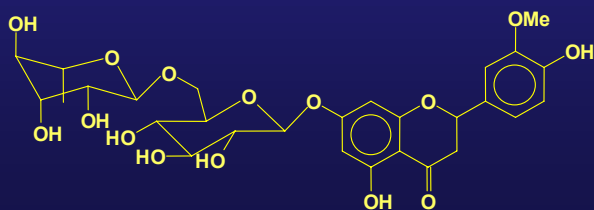
Sources of waste production

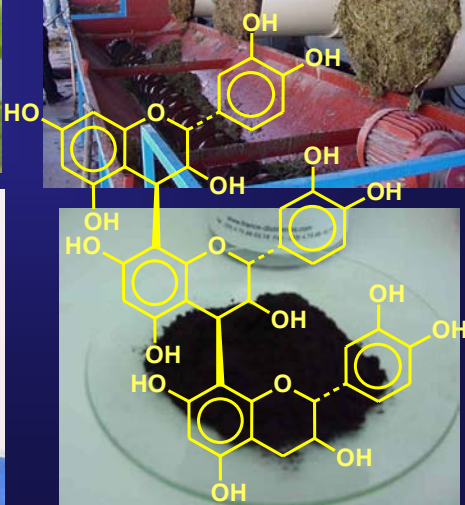
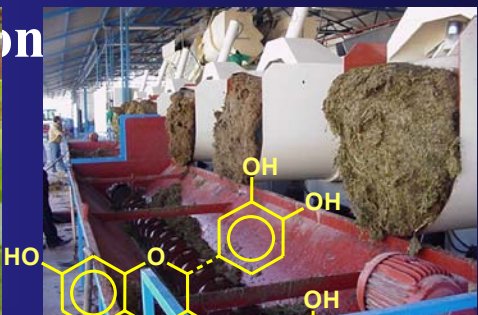
- Handling. Packing houses
- Processing
 - Minimal processing (fresh-cut products)
 - Extraction industries
 - Press residues (pomaces)
 - Other wastes (peels)
 - Thermal processing
 - Plant residues
 - Water effluents

Packing Houses

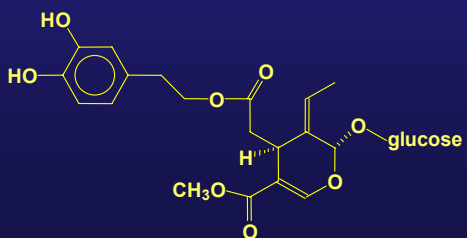


Extraction Industries





This photomicrograph shows a sharp boundary between two distinct materials. On the left is a blue, crystalline material, and on the right is a brown, granular material. The boundary is irregular and jagged, suggesting a fracture or a change in mineral composition.



Extraction industries



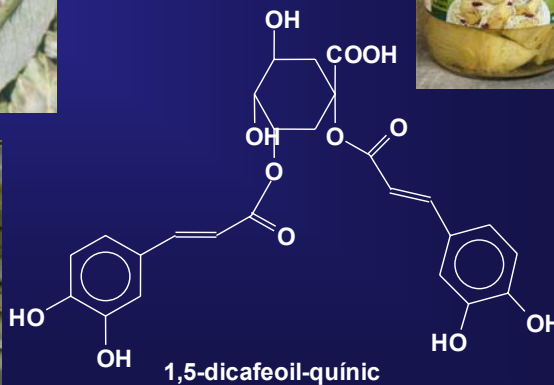
Extraction industries



Extraction industries



Canning industries



Experimental wastes



Technological processes

- Not very sophisticated (unexpensive)
- Sample preparation
- Extraction
 - Use of vacuum or pressure
 - Use of Temperature
 - Use of enzymes
- Concentration (drying)
- Handling of residues (fibre?)



Technological processes

- Not very sophisticated (unexpensive)
- Sample preparation
- Extraction
 - Use of vacuum or pressure
 - Use of Temperature
 - Use of enzymes
- Concentration (drying)
- Handling of residues (fibre?)



Some requirements

- Use fresh raw materials (drying expensive)
- Food compatible solvents
- Thermal treatment sometimes needed
- Extract concentration (freeze-drying, spray drying)
- Extract purification (non-ionic resins)
- Extract disposition

Experimental extracts



Potential Uses

- Pils (supplements)
- Ingredients for other food
 - Juices (have to be compatible)
 - Soups



Larrosa et al., 2002 Lebensm. Wiss Technol. 35: 532.
Llorach et al., 2002, J. Agric. Food Chem. 50: 3458.



Concerns

- Market
- Safety
 - Pesticides and other residues
 - Risk-Benefit balance
- Content of phytochemicals (analysis)
 - The case of resveratrol
- Biological activity
 - Need in vivo experiments (bioavailability)

Conclusions

- Interesting source of high value products
- Importance of safety
- Technologically feasible
- Bioactivity of extracts needs further research
- Objective: Recover the health promoting compounds from horticultural products that are lost during processing.