Nutritional Quality of Fresh-cut Products

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Fresh-cut Products

The success of these products is due to:
• Ready to eat
• Free of chemical preservatives
• Good sensorial and nutritional characteristics

Barrett D. et al., 2010; Beaulieu, 2006

Quality Attributes of Fresh-cut Products

• Color and appearance
• Flavor (taste and aroma)
• Texture
• Nutritional value

"Consumers often buy the first time based on appearance, but repeat purchases are driven by expected quality factors"

Nutritional Value of Fresh-cut Products

Dietary fiber
Vitamins
Minerals
Sugars and Organic acids
Phytochemicals
(Non-nutrients)
Antioxidants

Barrett D., et al., 2010

Table. Some nutrients and phytochemicals in some tropical and subtropical fruits (Yahia, 2011)

<table>
<thead>
<tr>
<th>Nutrient/Phytochemical</th>
<th>Source</th>
<th>Health benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin C (ascorbic acid)</td>
<td>Orange, pineapple, mango, papaya</td>
<td>Prevents scurvy, wound healing, healthy immune system, cardiovascular disease</td>
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<tr>
<td>Vitamin A (carotenoids)</td>
<td>Orange fleshed fruits such as papaya, mango, pineapple, citrus</td>
<td>Night blindness prevention, chronic fatigue, prostate, heart disease, stroke, cataracts</td>
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<tr>
<td>Potassium</td>
<td>Banana, plantain, cantaloupe</td>
<td>Hypertension, immune system</td>
</tr>
<tr>
<td>Flavan-3-ol: epicatechin, epigallocatechin, catechin, gallocatechin</td>
<td>Mango</td>
<td>Platelet aggregation, cancer</td>
</tr>
<tr>
<td>Flavonones: hesperidin</td>
<td>Citrus fruits</td>
<td>Cancer</td>
</tr>
<tr>
<td>Flavonoids: quercetin, kaempferol, myricetin, rutin</td>
<td>Papaya</td>
<td>Heart disease, cancer initiation, capillary protectant</td>
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<tr>
<td>Lycopene</td>
<td>Papaya, Brazilian guava</td>
<td>Cancer, heart disease, male infertility</td>
</tr>
<tr>
<td>β-Carotene</td>
<td>Mango, cantaloupe, papaya</td>
<td>Cancer</td>
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</tbody>
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Factors that contribute to the Nutritional Value of Fresh-Cut Products

• Genetics growing conditions (light, temperature, etc.)
• Production practices (fertilization, irrigation, etc.)
• Maturity at harvest
• Postharvest handling conditions
• Processing operations

Barrett D. et al., 2010
Postharvest Handling

Temperature, %RH, OP, PCO₂, PCD

Sugars, Organic acids, proteins

O₂

CO₂, C₂H₄

Water vapor

Harvest

The physical action of cutting and processing produce: stress of tissue
Depending on the control of the factors mentioned previously, this may lead to faster deterioration and loss of nutritional value.

Relationship Between the Main Processes of Deterioration of Fresh-cut Products

Release of nutrients, sugars, vitamin C, Increase loss of volatiles
Substrate-enzyme PPO-phenols exposition

Water loss

Microbial growth

Browning

Enhance Softening

Unpleasant odors

Quality loss

Economic losses

Microbiological Losses

Nutritional losses

- Vitamins
- Sugars
- Organic acids
- Phytochemicals
- Others

Mechanical cutting increased in higher extent the loss of nutrients
Some fruits such as mango is manually processed
Effect of temperature on the quality of papaya cubes stored at 5, 10 and 20 °C

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Days</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>10</th>
<th>14</th>
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UV Irradiation

UV Irradiation: Type of non-ionizing radiation with wavelengths from 100 to 400 nm.

- Stimulate beneficial reactions in biochemical systems (hormesis).
- Delay of senescence and fruit ripening, induction of natural defenses and elicitors against fungi and bacteria.
- Activate the plant defense mechanism and microbial DNA damage
- Preserve the quality of fresh-cut products

Reduce Vitamin C content, but increased Phenols content and AOC!!

Gonzalez-Aguilar et al., 2010
Controlled/modified Atmospheres

Active dynamic process that consists in altering the gases surrounding a commodity to produce a composition different from that of air.

- Delay senescence, thus extends storage life and maintain nutritional and sensory quality of fruit at different levels

Yahia, 2010; Caleb et al., 2012

High Pressure Processing

This method at refrigeration, ambient or moderate heating temperature allows inactivation of pathogenic and spoilage microorganisms, and it can play a key role in the extending of the shelf life.

- This technology acts uniformly throughout a food, regardless of size, shape and geometry, and also has minimal effects on the taste, flavor, texture, appearance, and nutritional values of food.

- Used for guacamole processing, release of bioactive compounds, make them more available for absorption

Norton and Sun, 2008

Edible Coatings

Thin layer of edible material applied to the surface of food products to extend its shelf life, by reducing moisture and solute migration, gas exchange, respiration and oxidative rates, as well as by reducing or even suppressing physiological disorders.

- Protecting aroma, texture and color throughout the storage
- Encapsulating matrices for many bioactive compounds

Norton and Sun, 2008

Active Packaging

Intelligent or smart system that involves interactions include oxygen scavengers, carbon dioxide emitter/absorbers, moisture absorbers, ethylene absorbers, ethanol emitters, flavor releasing/absorbing systems, time temperature indicators, and antimicrobial films.

- Designed to control deteriorative reactions, and to maintain the nutritional and sensory qualities of different foods.

Ayala-Zavala et al., 2008

Complexation of bioactive compounds with β-cyclodextrins

Ayala-Zavala et al., 2008

Aqueous solution
Release of Bioactive Compound

Microcapsules

Proposed Model

Fresh-cut tomato

Mode of action of complexes with high Content of Phenolic Compounds

Bioactive Compounds as Additives

Increase of nutritional value of mangos

Increase of nutritional value of mangos
In general, fresh-cut fruit visually spoil before any significant loss of nutrient occurs. But the question is, does these bioactive compounds are available?

A simple experiment that demonstrated the bioaccessibility of bioactive compounds of whole and fresh-cut mangos.

The antioxidant capacity increased in plasma from day 15th and was maintained constant afterwards. It appears that bioactive compounds are available in both tissues.

What about if we mix whole fruit and fruit juice? After ingestion the bioactive compounds are available???
Another important aspect that we have to consider is the individual contribution of bioactive compounds to the antioxidant capacity in tropical fruits.

The study of bioaccessibility and bioavailability of nutrients of fresh-cut after consumption and the pharmokinetics is of great interest.

Interaction of phenolic compounds with other molecules

There is a need to study the biological effects of fruit antioxidants after ingestion and its possible interactions with other molecules.

Interactions between antioxidants: ¿good or bad?
Hydrogen bridges hydrophobic interactions

Trapping and adsorption of phenols

Eastwood y Morris, 1982

Dietary fiber resist the different digestion steps

Nutrients in tropical fruits

50% of total phenolics are bioaccessible for absorption

Bioaccesibility of nutrients in tropical fruits

Interactions of phenols with dietary fiber

Release kinetics of phenolic compounds from avocado pulp

% release

Salivar step: 2.5

Gastric: 17.5-30

Intestinal: 32.5-20

Guacamole has 3-fold higher release

Health benefits of fresh-cut fruits

Fresh-cut Fruit antioxidants

Antioxidants and Functional Foods Laboratory
Hermosillo, Sonora, Mexico

Antioxidants and Functional Foods Laboratory
Hermosillo, Sonora, Mexico

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