Nutritional Properties of Underutilized Fruits

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Seminar for the Fruit Week – 2018
Fruit Research Center, DOA, Horana
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What to expect?

- Introduction
- Diet and health
- Fruit consumption
- The role of fruits
- Nutrients in fruits
- Bioactives in fruits
- Fruit consumption and diseases
Nutrient Deficiencies

- Iron
- Folic acid
- Vitamin A
- Vitamin D

- Iron deficiency anemia – school children, women, pregnant women
- Low birth weight
- Stunting and wasting
Fruits and Vegetable Consumption

- How much do we eat?
- University study
- Recommended – 400 g per day excluding tubers
- USA – 700 g per day
- Daily fruit consumption – 200 g minimum
What nutrients do fruits provide?
Nutrients in fruits

- Rich in minerals
- Rich in vitamins
- Rich in phytochemicals
- Rich in dietary fiber
- Low in fat
- Low in sodium
Vitamins

- Vitamin C
- Vitamin A
- Vitamin E
- Vitamin B complex
- Vitamin K
Minerals

- Ca
- Cr
- Cu
- Se
- Fe
- Mg
- Mn
- Mo
Fruit versus cereals

- More sugar
- Less starch
- Dietary fiber
- Less protein
- Less fat
- Vitamins A, E, C
- More phytonutrients

Less sugar
More starch
Less dietary fiber
More protein
More fat
Vitamin B
Less phytonutrients
Dietary Fiber
- **Reduces**
  - Plasma cholesterol levels (TC)
  - Some toxicants and carcinogens
  - DM
- **Promotes GI health**
  - Speeds up transit
  - Promotes gut microflora
  - Reduces pressure in lower bowel
  - Reduces incidences of appendicitis
  - Reduces incidences of diverticulitis
Dietary Fiber

- **Soluble DF**
  - Pectins
  - Gums
  - Mucilages and some hemicelluloses

- **Insoluble DF**
  - Cellulose
  - Most hemicelluloses
  - Lignins
Soluble DF

- Slows GI transit
- Slows glucose absorption
- Lowers glycemic load
- Lowers plasma cholesterol
Postprandial hyperglycemia results in

- DM
- Atherosclerosis (a risk factor)
- Renal diseases?
- Cancer?
Insoluble DF

- Speeds up GI transit
- Increase fecal weight
- Lowers starch hydrolysis
- Delays glucose absorption
Fruits Rich in DF

- Bale fruit
- Mango
- Nelli
- Guava
- Jack fruit
- Durian
- Mangosteen
- Anona
How much should be consumed?

- 25-35 g DF per day
- 6-8 g per meal is recommended
Prebiotic Effects of Fruits
INTESTINAL MICROFLORA

$10^{14}$ micro-organisms, >500 differentes species

- Lactobacilli
  - Stomach: $10^2$ to $10^3$
  - Duodenum: $<10^{4-5}$
  - Jejunum
  - Ileum: $10^3$ to $10^7$
  - Colon with appendix: $10^9$ to $10^{12}$
- Streptococci
- Lactobacilli

and....
There is clinical evidence that probiotics helps

- Reducing the incidents of diarrheal illnesses
- Enhancing immune function
- Reducing the degree of severity of lactose intolerance
- Reduce the population of harmful MOs
- Reduce the incidences of colon cancer
- Lower serum cholesterol levels
- Lower blood pressure
- Improve mineral absorption
Evaluation of Prebiotic Effect of Selected Fruits Grown in Sri Lanka

Thilini Mahaarachchi and Terrence Madhujith
- Matured, ripe fruits from home gardens

Annona squamosa

Aegle marmelos

Durio zibethinus

Artocarpus heterophyllus
Table 1. Variation of cell count of the media containing different fruit extracts during the storage period

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Day</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>7</td>
<td>14</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td>Annona</td>
<td>9.7b ± 0.03</td>
<td>9.6b ± 0.07</td>
<td>8.5d ± 0.05</td>
<td>7.0d ± 0.05</td>
<td>6.8e ± 0.06</td>
</tr>
<tr>
<td>Bale fruit</td>
<td>9.9b ± 0.03</td>
<td>9.9c ± 0.05</td>
<td>9.2a ± 0.01</td>
<td>8.6a ± 0.07</td>
<td>8.0a ± 0.04</td>
</tr>
<tr>
<td>Jack fruit</td>
<td>9.8b ± 0.04</td>
<td>9.8b ± 0.02</td>
<td>8.8c ± 0.05</td>
<td>8.1bc ± 0.03</td>
<td>7.2c ± 0.02</td>
</tr>
<tr>
<td>Duriyan</td>
<td>9.8b ± 0.03</td>
<td>9.7b ± 0.02</td>
<td>9.0b ± 0.05</td>
<td>8.0b ± 0.03</td>
<td>7.1d ± 0.01</td>
</tr>
<tr>
<td>FOS</td>
<td>9.9b ± 0.04</td>
<td>9.9c ± 0.04</td>
<td>9.2a ± 0.01</td>
<td>8.2b ± 0.03</td>
<td>7.6b ± 0.03</td>
</tr>
<tr>
<td>Control</td>
<td>8.6a ± 0.03</td>
<td>8.1a ± 0.03</td>
<td>6.4e ± 0.04</td>
<td>6.4e ± 0.07</td>
<td>5.9f ± 0.03</td>
</tr>
</tbody>
</table>
Change of *S. thermophilus* population in media enriched with four fruit derived prebiotics at 4 °C after 21 days.
Anona showed the **lowest** performances throughout the storage period
- Intermediate performances throughout the storage period
Intermediate performances throughout the storage period correspond to the standard prebiotic.
- Bale fruit maintained standard count of greater than $10^8$ CFU/mL with *S. thermophilus* throughout the 28 days of storage.

- Duriyan and jack fruit maintained standard counts up to 21 days.

- This target was achieved by annona added sample only up to 14 days.

- The control showed the standard microbial count only up to 1 week.
Why do we need antioxidants?
FREE RADICALS

- Any species capable of independent existence that carries one or more unpaired electrons
WHAT FREE RADICALS CAN DO?

Vitamins
Proteins
Enzymes
Lipids & other biomolecules
How do antioxidants protect body?

- Scavenging FR
- Reducing LDL oxidation
- Reducing lipid oxidation
- Breaking down oxidative products
- Removing initiators
- Protecting DNA/RNA and other biomolecules
Nutritive antioxidants
Non-nutritive antioxidants
Fruits are rich in both
Nutritive Antioxidants

- vitamin C
- vitamin E
- carotenoids- lycopene, lutein and zeaxanthin
Alpha-carotene

- Passion fruit
- Tangerines
- Oranges
Beta-carotene

- Orange
- Tomato
- Lavalu

Lycopene
Tomato
Non-nutritive Antioxidants

Polyphenolic compounds

- Flavonoids
- Anthocyanins
Other Bioactives

- Terpenoids and saponins
- Enzyme inhibitors
- Glucosinolates
- Essential fatty acids
- Lignans and related compounds
Anthocyanins

Colorful compounds
Powerful antioxidants
Found in
grapes
berries
Anthocyanins are
- Powerful antioxidants
- Some possess anticancer activity
- Leach into water
- Destroyed at high temperatures
Fruits and CVD
Fruits and CVD

- Association between F&V consumption and CVD – American Nurses’ Health Study (2004)
- Cardioprotective agents in fruits
  - Carotenoids
  - Folate
  - Polyphenols
  - Fiber
  - Other vitamins
Cardiovascular Risk Markers

- Platelet function
- Vascular function
- Hypertension
- Lipid profile
Regular consumption of grapes, berries and pomegranate has reduced platelet aggregation potential
- Peak concentration after 1-3 hours
- Excreted within 8-12 hours
- Fruits containing polyphenols reduce BP
- Pomegranate and berries have shown the best results
- Vascular activity
- Vascular endothelium dependent vasodilation
- Pomegranate, apple and grape seeds have shown positive results
- Cinnamic acid, anthocyanins, proanthocyanindns and tannins are responsible
Blood Lipids

- Fruits rich in anthocyanins, proanthocyanidins
- Grapefruit and oranges are the most contributing fruits
- Reduction of BP by 5 mm/Hg brings about reduction of stroke by 40% and CHD by 20-25%

- 45% of CHD is due to abnormal lipid profile
Fruits and cancer
## Fruits and Cancer

<table>
<thead>
<tr>
<th>Site of cancer</th>
<th>Relationship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mouth and pharynx</td>
<td>weak</td>
</tr>
<tr>
<td>Esophagus</td>
<td>Strong</td>
</tr>
<tr>
<td>Lung</td>
<td>Moderately consistent</td>
</tr>
<tr>
<td>Stomach</td>
<td>Moderately consistent</td>
</tr>
<tr>
<td>Pancreas</td>
<td>Very strong – limited data</td>
</tr>
<tr>
<td>Liver</td>
<td>Possible for Vegetables Not with fruit</td>
</tr>
<tr>
<td>Tissue</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Colon and rectum</td>
<td>Possible for vegetables.</td>
</tr>
<tr>
<td>Breast</td>
<td>Moderately consistent with vegetable – not with fruits</td>
</tr>
<tr>
<td>Cervix</td>
<td>Strong with fruits – limited data</td>
</tr>
<tr>
<td>Bladder</td>
<td>Moderately consistent – limited data</td>
</tr>
</tbody>
</table>
Suppression of oxidation using natural plant extracts


Anticancer effects of ELA from bitter gourd and pomegranate
What do fruits do?

- Detoxifying carcinogens
- Cell apoptosis
- Changes in cell signaling
- Changing hormone profile
- Protecting DNA
- Increased DNA repair
- Stimulation of immune system
- Anti inflammatory effects
- Reducing serum cholesterol
- Antimicrobial activity
Antimicrobial properties
<table>
<thead>
<tr>
<th>Bioactive</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terpenoids &amp; saponins</td>
<td>Hypolipidemic and hypocholesterolemic</td>
</tr>
<tr>
<td>(sesquiterpenes, triterpenes, tetraterpenes)</td>
<td></td>
</tr>
<tr>
<td>Enzyme inhibitors (protease &amp; amylase) – Bowman –Birk type</td>
<td>Prevent development of chemically induced cancer of liver, lungs, colon, esophagus</td>
</tr>
<tr>
<td>Glucosnolates and breakdown products</td>
<td>Block tumors induced by chemicals</td>
</tr>
<tr>
<td>Phenolics/polyphenolics</td>
<td>Cehmopreventive, modulation of key signal transduction pathways, modulation of arachidonic acid metabolism, antioxidant and hormonal effects</td>
</tr>
<tr>
<td>Carotenoids</td>
<td>Antioxidant</td>
</tr>
<tr>
<td>Lignans</td>
<td>Antioxidant</td>
</tr>
</tbody>
</table>
Summary

- Our fruit consumption is not satisfactory
- Diet is important for health
- Fruits are very important functional foods
  Fruits help reduce many diseases
- More efforts are required to popularize fruits among Sri Lankans
Thank You