Nutraceutical Bioactive compounds

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Nutrition to support well being

- Nutritional discoveries from the earliest days of history have had a positive effect on our health and well-being.

- 400 B.C. -- Hippocrates, the "Father of Medicine", said to his students, "Let thy food be thy medicine and thy medicine be thy food".  
  He also said “A wise man should consider that health is the greatest of human blessings.”
“YOU ARE WHAT YOU EAT”?

“Dis-moi ce que tu manges, je te dirai ce que tu es.”

Anthelme Brillat-Savarin, *Physiologie du Gout, ou Meditations de Gastronomie Transcendante*, 1826

He was simply stating that the food one eats has a bearing on what one’s state of mind and health.

What is Nutrition?

- The word *nutrition* itself means “The process of nourishing or being nourished, especially the process by which a living organism assimilates food and uses it for growth and replacement of tissues.”
- Today more than ever, obtaining nutritional knowledge can make a big difference in our lives.
Nutrition 1.0

BALANCED DIET

...needs to have a balance of macronutrients / energy (fats, proteins, and carbohydrates) and micronutrients to meet the needs for:

- support the growth,
- maintain body weight,
- prevent the development of dietary deficiency diseases such as rickets, goiter, anemia, scurvy, etc

Nutrition 2.0

OPTIMUM NUTRITION

...eating the right amounts of nutrients on a proper schedule to...

- achieve the best performance and the longest possible lifetime in good health,
- decrease the risk of chronic/ degenerative diseases
The era of Functional food and Nutraceutical

- Consumers are increasingly interested in the health benefits of foods and have begun to look beyond the basic nutritional benefits of food to the disease prevention and health enhancing compounds contained in many foods.
- This combined with a more widespread understanding of how diet affects disease, health-care costs and an aging population have created a market for functional foods and natural health products.

Functional Food

- a food can be regarded as “functional” if it is satisfactorily demonstrated to affect beneficially one or more target functions in the body, beyond adequate nutritional effects, in a way which is relevant to either the state of well-being and health or the reduction of the risk of a disease".
What is a Functional Food?

Functional Foods

Working Definition:
Foods that may provide a health benefit beyond basic nutrition.

Health care costs
Life span increase
Life style changes
Chronic/degenerative diseases

Scientific research
New technologies

Functional food

Health
Life quality
Ageing
The concept of functional foods was established in Japan in 1991. FOSHU must be approved by the Minister of Health and Welfare after the submission of comprehensive science-based evidence.
The European consensus document defines functional foods as:

- Conventional or every day food;
- Consumed as part of a normal diet;
- Composed of naturally occurring components;
- Having a positive effect on physiological function beyond nutritive value (basic nutrition);
- Having authorized and scientifically substantiated health claims.

### Scientific proof

<table>
<thead>
<tr>
<th>Biological Level</th>
<th>Main Type of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molecular</td>
<td>Biochemical &amp; Physiological</td>
</tr>
<tr>
<td></td>
<td>Mechanism in vitro</td>
</tr>
<tr>
<td>Sub-Cellular</td>
<td>ex vivo</td>
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<tr>
<td>Cellular</td>
<td>in vivo</td>
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<tr>
<td>Tissue</td>
<td>in situ</td>
</tr>
<tr>
<td>Organ</td>
<td></td>
</tr>
<tr>
<td>Whole Body</td>
<td><em>Practical &quot; Effect</em></td>
</tr>
<tr>
<td>Sub-Populations</td>
<td>Intervention Trials</td>
</tr>
<tr>
<td>Populations</td>
<td>Epidemiological</td>
</tr>
<tr>
<td>Nutrigenomics</td>
<td>Meta-analyses</td>
</tr>
<tr>
<td></td>
<td><em>Individual &quot; Effect</em></td>
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<td></td>
<td>*Analytical&quot;</td>
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Health Claims

• The EU Concerted Action supports the development of two types of health claims relevant to functional foods, which must always be valid in the context of the whole diet and must relate to the amounts of foods normally consumed.

Health Claims

• **TYPE A**: "Enhanced function" claims that refer to specific physiological, psychological functions and biological activities beyond their established role in growth, development and other normal functions of the body. This type of claim makes no reference to a disease or a pathological state.

• **TYPE B**: "Reduction of disease-risk" claims that relate to the consumption of a food or food component that might help reduce the risk of a specific disease (e.g. folate can reduce a woman’s risk of having a child with neural tube defects, and sufficient calcium intake may help to reduce the risk of osteoporosis in later life).
Nutraceuticals

- **Nutraceutical**, a term combining the words “nutrition” and “pharmaceutical”, is a food constituent that provides health and medical benefits, including the prevention and treatment of disease.
- The term nutraceutical was originally defined by Dr. Stephen L. DeFelice, founder and chairman of the Foundation of Innovation Medicine (FIM), Crawford, New Jersey (USA).

Nutraceuticals

- These food constituents are chemical components mainly present in plant food or of microbial sources, and provide medicinal benefits valuable to long-term health. Examples of these nutraceutical chemicals include **probiotics, antioxidants and phytochemicals**.

*The regular fruit and vegetable consumption is associated to a reduced risk of chronic/ degenerative diseases.*
Nutraceutical diet

Institutions like FAO and WHO recommend a daily intake of at least 400 grams of fruits and vegetables a day, if possible in 5 different servings.

World Health Organization

Eat the colours of life

To get the most benefits out of eating fruits and vegetable, you should eat at least one daily serving from each of the five color groups: blue/purple, green, white, yellow/orange red as the "Color Way" campaign suggests. This campaign is also known as "The Five Color Diet" or the "5 A Day" diet.
By eating fruits and vegetables of a variety of different colors, one can get the best all-around health benefits. Each different color fruit and vegetables contains unique health components that are essential to our health.

### Non nutrient components: Phytochemicals

Phytochemicals are non-nutritive plant chemicals that have protective or disease preventive properties. They are non-essential nutrients, meaning that they are not required by the human body for sustaining life.
**Classification of dietary phytochemicals**

Phytochemicals

- Carotenoids
- Phenolics
- Alkaloids
- Nitrogen-containing compounds
- Organosulfur compounds

**Sinergy of dietary phytochemicals**

Dose–response of antioxidant activity of orange, apple, grape, blueberry and 4-way combination.

The benefit of a diet rich in fruits and vegetables is attributed to the complex mixture of phytochemicals present in these and other whole foods. This partially explains why no single antioxidant can replace the combination of natural phytochemicals in fruits and vegetables in achieving the observed health benefits.
It is important to differentiate the pharmacological dose from the physiological (or nutritional) dose.

Pharmacological doses are used clinically to treat specific diseases in certain situations and require a doctor’s prescription; physiological (or nutritional) doses are used to improve or maintain optimal health, such as in foods.

The pharmacological dose is not equal to the physiological (or nutritional) dose and, in some cases, can be toxic for long-term use.

Currently, there are no recommended dietary allowances for phytochemicals. Therefore, it is not wise to take megadoses of purified phytochemicals as dietary supplements before the appearance of strong supporting scientific evidence.
Phytochemicals In the Spotlight

• Phytochemicals have been discovered within the past two decades.
• They are in the “Nutrition Spotlight” and are the “New Nutritional Frontier.”
• Research present in both in the private and public sectors.

So What are Phytochemicals?

• Phytochemicals are “plant chemicals.”
• They are naturally occurring compounds.
• However, most of their functions/roles in most plants are unknown.
• They provide healthier benefits and treat/prevent diseases.
• There are tens of thousands in the foods we eat (especially fruits, vegetables, and grains).
Phytochemicals: main actions

- **Detoxifiers**
  - helps body recognize and destroy toxins
- **Antioxidants**
  - removes cell-damaging molecules (free radicals)
- **Cell Regulators**
  - helps control growth of tumor cells
- **Hormone Modulators**
  - mimic hormones or prevent production

Allylic Sulfides

- **Garlic, onions, leeks, shallots, chives**
Allylic Sulfides (nutraceutical value)

- Stimulate enzymes that inhibit bacterial growth
- Lower blood pressure and cholesterol levels
- Strengthen immune and cardiovascular system
- Anti-growth activities for fungi and parasites
- Cancer preventive properties

The most abundant allylic sulphide in garlic is **allicin** which represent 70% of all the allylic sulphides in garlic, possessing antibacterial properties.

The immediate precursor of allicin is **alliin**, (+)-S-allyl-L-cysteine S-oxide.

Allicin is formed by action of the C-S lyase enzyme **alliinase** (released by cutting or crushing garlic cloves) on the stable precursor alliin in 10 s at room temperature!

Stereochemical structure of the most representative bioactive constituents from *Allium sativum* L.

**Allylic Sulfides**

Garlic and blood pressure

High blood pressure is an important risk factor for cardiovascular disease and is attributed to an estimated 70% of heart attacks, strokes, and chronic heart failure.

Garlic supplements have shown promise in lowering blood pressure in several meta-analyses.

Garlic contains a number of active sulfur compounds that modulate endothelium-relaxing and -constricting factors, leading to blood pressure reduction. Specifically, garlic has been shown to stimulate the production of NO and hydrogen sulphide (H2S), both gasotransmitters leading to vasorelaxation. In addition, garlic reduces the production of the vasoconstricting factors endothelin 1 and angiotensin II.

Moreover, garlic regulates slightly elevated cholesterol concentrations, and stimulates the immune system by increasing macrophage activity, natural killer cells, and the production of T and B cells.

Flavonoids

- Flavonoids (and bioflavonoids) are a class of plant secondary metabolites. The name is coming from the Latin word *flavus* (yellow).
- Most fruits and vegetables, some intensely colored (blue to red colors in fruits, flowers, leaves).
- **black and green tea, onions, red wine, and apples**

Representative natural flavonoids and their dietary sources

- (A) flavones,
- (B) flavonols,
- (C) flavanols,
- (D) flavanones,
- (E) isoflavones,
- (F) anthocyanidins.

Flavonoids (nutraceutical value)

- black and green tea, onions, red wine, and apples protect against cholesterol damage
- More than 3 cups of (green) tea a day protects against heart disease
- lower the death rate from heart disease
- help block carcinogenic effects of UVB radiation
- reduces risks of cancers

Peripheral vascular and cardiovascular effects of flavonoid rich foods

- Vasodilatation
- Blood pressure
- Insulin resistance
- Glucose tolerance
- Platelet reactivity
- Immune response

Anthocyanins

- Grapes, raspberries, blueberries, cherries, onions, blackberries, strawberries

- Red to purple pigments found in plants

Anthocyanins (from Greek ἀνθός (anthos) = flower and κυανός (kyanos) = blue) constitute the largest and probably the most important group of water-soluble plant pigments. They belong to the widespread flavonoid group of polyphenols, which are responsible for the blue, purple and red colour of many plant tissues. They are commonly glycosides at C3 position (esose and pentose).
Anthocyanins are rapidly absorbed in the stomach and small intestine and appear in the bloodstream within a few minutes (6 to 20 min).

Anthocyanins appear to have a high organotropism as can readily cross the blood–brain barrier. Anthocyanin accumulation has been demonstrated in the eyes, suggesting that these compounds also readily cross the blood–retinal barrier, which could justify the potential health effects of these substances to these areas.

Numerous in vitro and in vivo studies suggest that anthocyanins may be positively implicated in human health.

They exert different biological effects, and it seems that the consumption of foods such as juices or other formulations rich in these compounds may be correlated with antidiabetic and anti-obesity effects. These compounds may also be useful as neuroprotective agents, in reducing inflammation and exerting cardiovascular protection as well as in preventing and inhibiting cancer growth.

Anthocyanins (nutraceutical value)

- Also known as flavonols
- Provide bridges that connect and strengthen intertwined strands of collagen protein
  - soft tissue, tendons, ligaments, bone matrix
  - most abundant protein in the body

- Scavengers for free radicals
Blonde or Red?

Red oranges include three particular cultivars of oranges (Moro, Tarocco, Sanguinello) grown only in Sicily and the island of Malta.

With similar Vitamin C content with blond oranges, their nutraceutical value depends on the presence of anthocyanins, which are absent in other cultivars.

Blonde or Red?

The presence of anthocyanins in red oranges (Moro, Tarocco, Sanguinello) grown only in Sicily and the island of Malta can provide additional health benefits due to their potential anti-inflammatory properties.
**Glucosinolates**

- **Cruciferous vegetables**
  - scientific name for a group of plants whose four petals resemble a cross.
  - part of cabbage family (cabbage, broccoli, cauliflower, brussels sprouts)
  - release biological chemicals such as isothiocyanates, organic cyanides

**Broccoli and co...?**

- pH of intestinal tract
- Glucosinolate: Glucorafanine
- Isotiocyanate: Sulforaphane
Isothiocyanates (nutraceutical value)

- Activate liver detoxifying enzymes
- Block enzymes that promote tumor growth (liver, colon, lung, breast, stomach, esophagus)
- Increase enzyme activity involved in detoxifying carcinogens and other harmful substances
- Inhibit DNA damage that triggers cancer
“Eat Your Vegetables”

• Mother was right when she told you to “Eat your vegetables.”
• When phytochemicals are added to the diet, the capacity of human genes to protect and restore optimal health is far greater than previously recognized.

Your Diet Is Important

• People who consume little fat and eat plant-rich, high-fiber diets have a lower incidence of certain diseases, such as cancer, heart disease, and diabetes.
• 70% of preventable cancers and 33% of cancer deaths are attributed to dietary factors.
Diet Recommendations

• The Mediterranean food pyramid recommends at least 3-5 servings of vegetables a day and 2-4 servings of fruit a day.
• Eat around 5 different colored fruits and vegetables a day.
• Also, increase the amount of fiber you are getting.

Are There Alternatives?

• People who know they should eat more fruits and veggies, but have trouble doing so, question whether veggie pills and other supplements are beneficial.
• Are they none toxic?
  – So far, evidence for supplements is far less convincing than fresh fruits and vegetables.
Supplements, Less Than The Best

- Pills and powders try to mimic the components of food, but are far less successful.
  - Can never get all the known and unknown phytochemicals in a supplement.
  - Some nutrients and fibers can be lost when concentrated into pill form
  - Are more expensive.

Why Fruits and Veggies Win Over

- Nutraceuticals in fruits and vegetables overlap each other and possibly have interactive and sinergic effects.
- Fruits and vegetables help best to activate the body's own disease-fighting resources.
You have to take a lot of medicine if you want to become as big as your father. Can I hope for another alternative if I take less?

“If I’d known I was going to live this long, I would have taken better care of myself.”

Eubie Blake
American ragtime musician

The day of his 100th birthday
THANK YOU FOR YOUR ATTENTION