Fruits and Vegetables & Nuts

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National Conference on Processed Foods and Beverages for Health: Beyond Basic Nutrition

(Session IV: Traditional Indian Functional Foods)

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No Comments on these terms here

Nutraceuticals

Nutriceuticals

Functional Foods

Dietary supplements

Many More Terms

FRUITS and VEGETABLES-- as functional foods

1. Fruits and vegetables are generally high in water and low in fat. And , in addition to vitamins and minerals, they contain significant amounts of dietary fiber and phytochemicals.

2. Consumption of whole foods such as fruits, vegetables is strongly associated with reduced risk of chronic diseases. Hence, a daily consumption of at least 400 g of fruits and vegetables is recommended by WHO.

Beneficial effects of fruits and vegetables:

- Reduced risk of cardiovascular diseases
- Reduced risk of cancer
- Reduced osteoporesis
- Improved memory and mental health
- Improved fetal health
- Quicker reaction time

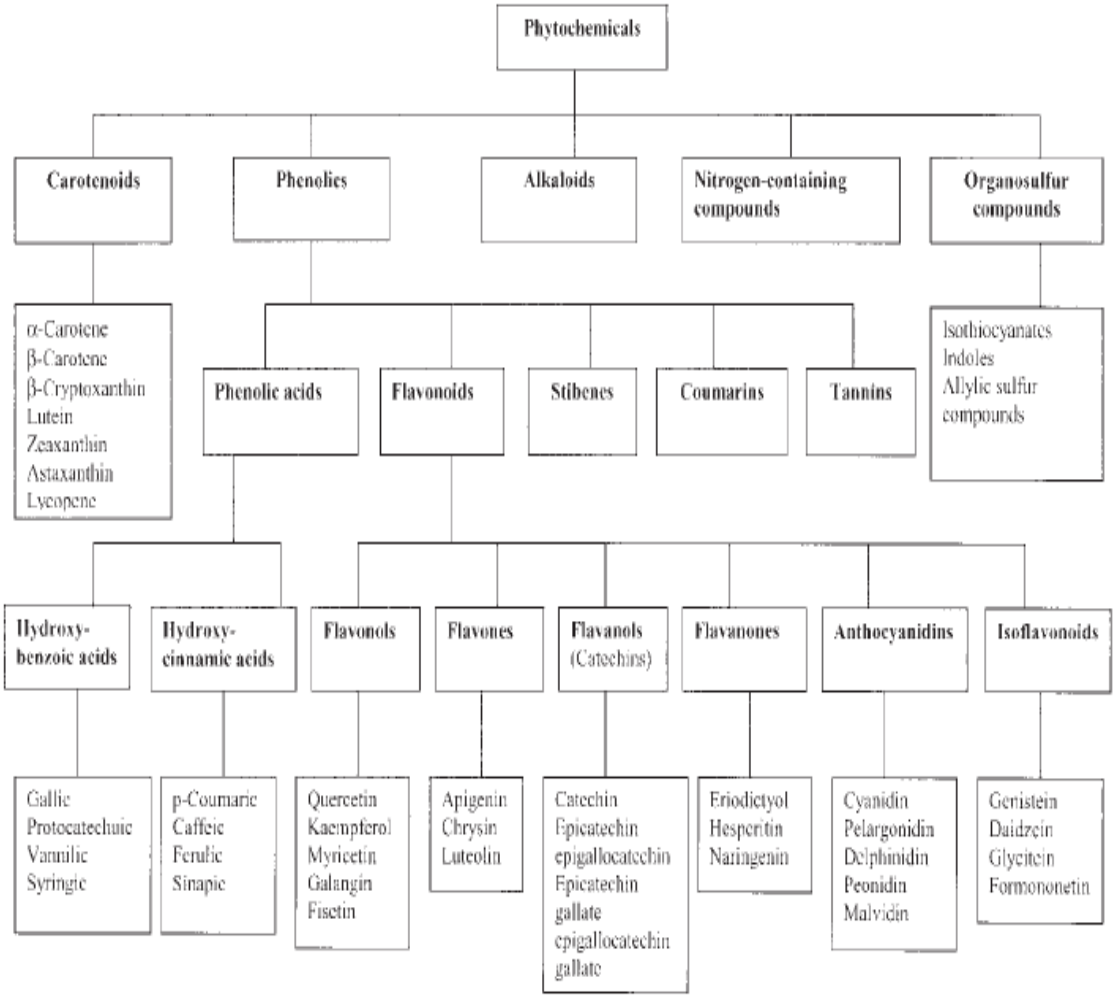
Phytochemicals present in Fruits and Vegetables

Class	Bioactive component	Source
Carotenoids	**Lycopene, Lutein, B-carotene**	**Carrots, tomatoes**
Flavonoids	**Querecetin, Apigenin, Naringenin, Catechin** **Proanthocyanindin**	**Onion, apple, broccoli**
Organosulphar	**Allyl sulfar, Diallyl sulfide**	**Onion, garlic**
Isothiocyanates	**Sulphoraphane**	**Broccoli, cauliflower, cabbage, Horseraddsh**
Phenolic acids	**Caffeic acid, Ferulic acid, Chlorogenic acid**	**Apple pears, citrus fruits, some vegetables**
Indoles	**Indole-3-carbinol**	**Cruciferous vegetables**
Chlorophyll	**Chlorophyllin**	**Green vegetables**
Sulfides/thiols	**Dithiolthiones**	**Cruciferous vegetables**
Phytosterol	**Sitosterol, stigmasterol, Campsterol**	**Nuts**
Monoterpenes	**D-limonene**	**Citrus fruits**

Role of Various Phytochemicals

Phyto-chemical	Source	Role
Carotenoids	Fruits & vegetables	Antioxidants, protects against uterine, prostate, colorectal, lung and digestive tract cancers, and protection to other antioxidants.
Limonoids	Citrus fruits	Inhibiting phase I enzymes & inducing phase II detoxification enzymes in liver, provide protection to lung tissue.
Phytosterols	Various plants	Exhibit anti-inflammatory, anti-neoplastic, anti-pyretic & immune-modulating activity, decrease cholesterol
Phenolic constituents	Various plants	Antioxidants, lowers the risk of CHD, diabetes, hypertension etc.
Flavonoids	Grapes, wines	Action against free radicals, free radicals mediated cellular signaling, inflammation, allergies, platelet aggregation, & hepatotoxins
Catechin & gallic acids	Grapes, berries, cocoa, green tea, acacia spp.	Antioxidants, free radical scavenging ability, inhibition of eicosanoid synthesis, reduces CHD
Anthocyanidins	Fruits & flowers	Antioxidants & anti-mutagenic properties
Glucosinolates	Cruciferous	Activators of liver detoxification enzymes, inhibit the neoplastic effect of various carcinogens
Fiber	Vegetables, fruits,	Protects against colorectal diseases,

Classification of dietary phytochemicals

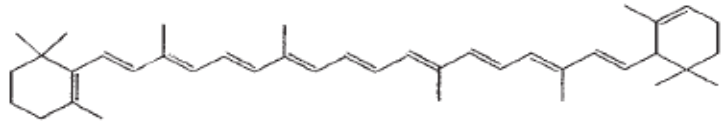


Health importance of fruits and vegetables

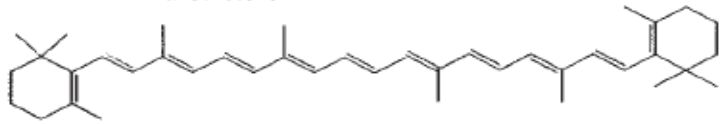
Disease	Effective Phytochemical/fruit/vegetable
Cancer	Quercetin, Chlorophyllin, Monoterpenes, Citrus Flavonoids, Cruciferous Vegetables
Cardiovascular disease	Lycopene, Avocado, Grapes, Berries
Diabetes Mellitus	Flavonoids (procyanidins)
Obesity	Dietary Fiber
Osteoporesis	Vitamin C, β-carotene
Asthma	Apples, pears
Birth defects	Folates

Nutraceuticals from fruits and vegetables available in market

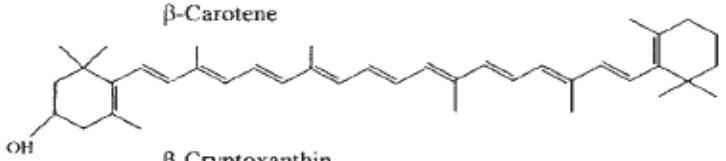
Brand name	Components	Function
Betatene	Carotenoids	Immune function
Xangold	Lutein esters	Eye health
Lipoec	α-lipoic acid	Potent antioxidant
Generol	Phytosterol	CHD reduction
Linumlife	Lignan extract flax	Prostate health
Fenulife	galactomannon	Control blood sugar
Marinol	ω 3 FAs	Heart health protection



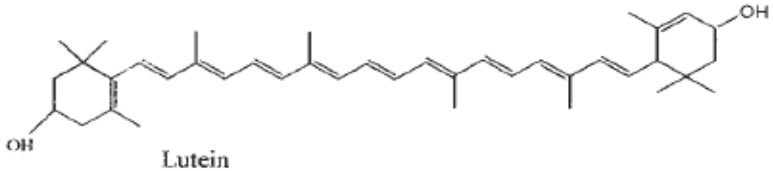
α-Carotene



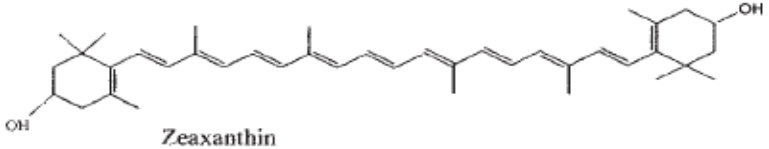
β-Carotene



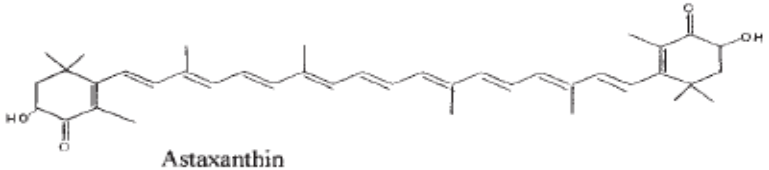
β-Cryptoxanthin



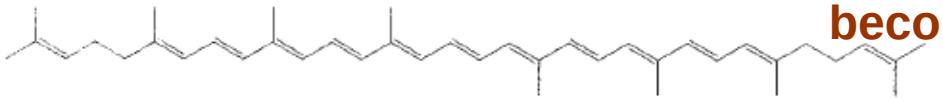
Lutein



Zeaxanthin



Astaxanthin



Lycopene

- Carotenoids have a 40-carbon skeleton of isoprene units.
  - Cyclized – β-carotene
    Acyclized – Lycopene
- Long series of conjugated double bonds forming the central part of molecule.

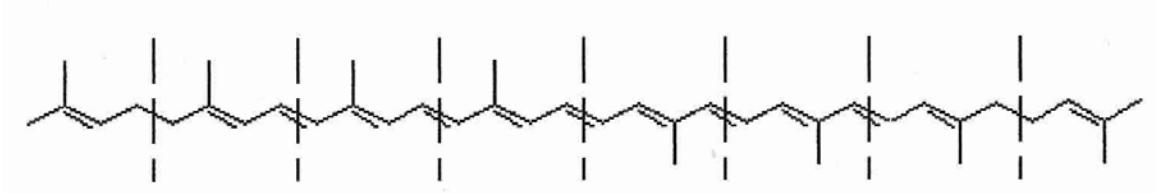
- they have ability to quench and inactivate reactive oxygen species especially singlet oxygen.

- they can react with free radicals and can become radicals themselves.

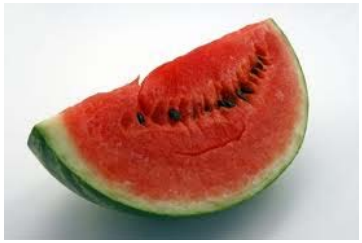
Chemical structures of “carotenoids” present in vegetables and fruits

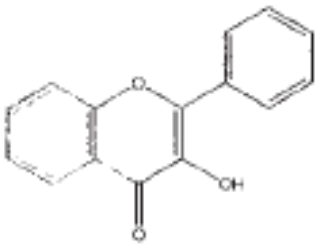
Lycopene

- Red color of tomatoes, watermelon, pink grapefruit, guava & papa
- Binds tightly to fibers, freed by high heat
- Powerful antioxidant which reduces damage to DNA and proteins
- Gives better skin protection against UV light than beta-carotene
- Concentrates in the skin, testes, adrenal and prostate where it protects against cancer
- Can reduce LDL cholesterol levels
- Suppresses Insulin-like Growth Factor (IGF-1) stimulation of tumor growth

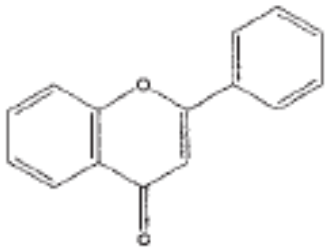


Lycopene

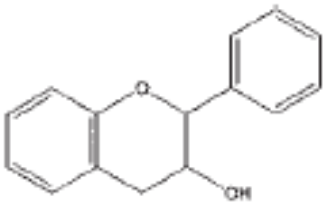




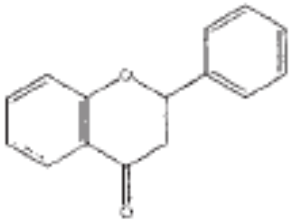
Flavonols



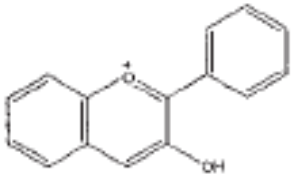
Flavones



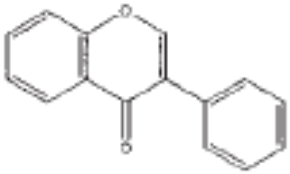
Flavanols (Catechins)



Flavanones



Anthocyanidins

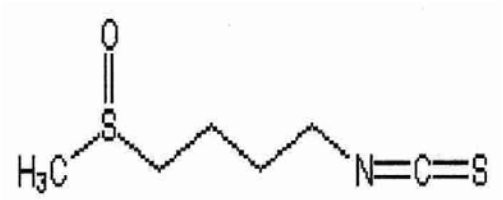


Isoflavonoids

Structure of main classes of flavonoids present in traditional Indian functional foods

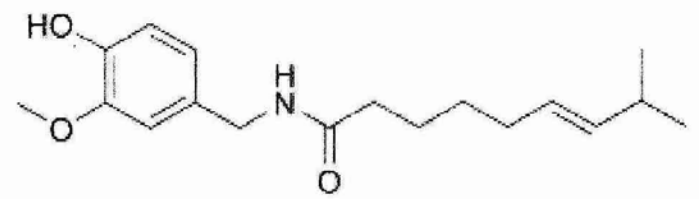
Flavonoids are mainly present in the glycosylated forms, and their bioavailability depends on the sugar moiety.

Sulforaphane



Sulforaphane

- Especially rich in broccoli
- Causes cell cycle arrest and apoptosis of cancer cells
- Produces D-glucarolactone, a significant inhibitor of breast cancer
- Kills *Helicobacter pylori* bacteria responsible for stomach ulcers and gastric cancer risk.



Capsaicin

Capsaicin

- Makes chilli peppers "hot"
- Stimulates neurons for burning and abrasion sensation
- Can cool mouth with cold milk, alcohol or ice cream
- Promotes apoptosis in pancreatic cancer cells
- May relieve chemotherapy-induced neuropathy
- Inhibits NF-κB transcription of proinflammatory and antiapoptotic (cancer-promoting) genes

Betaine

- Betaine = trimethylglycine
- Found in spinach and beets
- Capable of removing pro-atherosclerotic protein homocysteine from the body

Pectin

- Soluble fiber in apples (gives feeling of fullnes when eaten)
- Binds to sugars, releasing them slowly and keeping blood sugar levels steady
- Lowers cholesterol

Anthraquinones

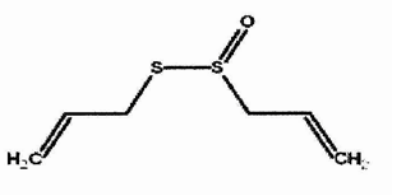
Senna

- Sennosides are dianthrones
- From dried leaves of leguminous herbs or shrubs of the pulse family
- Increases peristaltic movements in the colon
- Nauseating taste
- Contraindicated for **hemorrhoids** or inflammation

Barbaloin

- From Aloe vera plant (lily & onion family)
- Uterine stimulant (abortifacient)
- Heal skin burns & ulcers
- Antihelminthic
- Can cause gastritis, diarrhea & nephritis

Allicin



Thiosulfonates

- Organosulfur phytochemicals in garlic and onions
- Includes mercaptocysteines and allylic sulfides (an **allyl** is a hydrocarbon-sulfur bond)
- Allicin is toxic to insects and microorganisms
- Allicin protects against ulcers by inhibiting *Helicobacter pylori*
- Allicin inhibits mammary, endometrial and colon cell proliferation
- Garlic can induce nitric oxide synthetase activity
- Garlic inhibits platelet aggregation by arachidonic acid, epinephrine and other platelet agonists
- Propanethial-S-oxide released from cut onions converted to sulfuric acid in eyes (causes "burning")
- Cooking garlic & onions destroys the enzyme allinase, preventing formation of beneficial sulfur compounds

Inulin-type Fructans- common dietary sources are onion, garlic & banana

The term inulin-type fructans covers all β(2←1) linear fructans including native inulin (DP 2-60, DP_{av}=12) and oligofructose (DP 2-8, DP_{av}= 4).

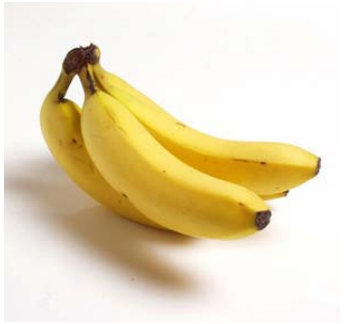
Act as prebiotics- increase and reduce the numbers of potentially health-promoting bacteria and potentially harmful species, respectively.

Enhance calcium and magnesium absorption.

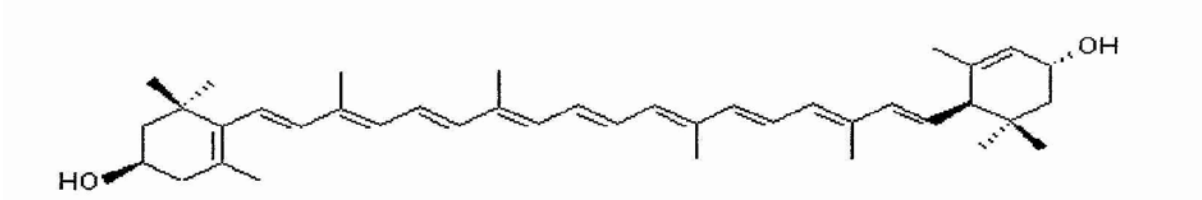
Modulate the secretion of gastrointestinal peptides involved in appetite regulation.

Reduce the risk of colon carcinogenesis and improve the management of inflammatory bowel diseases.

A "High performance"(HP) type of inulin has been made available recently to the market. This product is manufactured by removing the shorter-chain molecules.



Lutein



- Gives corn, avocado and egg yolk a yellow color
- Lutein and zeaxanthin constitute about half of all carotenoids in the retina
- Lutein and zeaxanthin are the only carotenoids in the macula of the eye
- Absorbs damaging blue light
- Protects the eye from macular degeneration and cataracts
- May protect against colon cancer
- Highest concentrations in kale, spinach, watercress and parsley (in that order)

II-A-5. Zeaxanthin

Dominant Phytochemical Pigments

COLOR	PIGMENT	FRUIT OR VEGETABLE
RED	Anthocyanins	Strawberries, Raspberries, Cherries, Cranberries, Pomegranates, Apples, Red Grapes
	Lycopene	Tomatoes, Pink Grapefruit, Watermelon
	Betacyanins	Beets
ORANGE	Beta-carotene	Carrots, Mangoes, Apricots, Cantelope, Pumpkin, Sweet Potatoes
	Beta-cryptoxanthin	Oranges, Tangerines
BLUE/PURPLE	Anthocyanins	Blueberries, Plums, Eggplant, Concord grapes
YELLOW	Lutein, Zeaxantin	Corn, Avocado
	Curcumin	Tumeric (Curry)
GREEN	Chlorophyll	Broccoli, Kale, Spinach, Cabbage, Asparagus, Green Tea
BLACK	Thearubigens	Black tea
	Anthocyanins	Blackberries

Dietary Fiber (DF):-Broccoli, spinach, pear and Guava are good source of DF

- **Plant polysaccharides and lignin which are resistant to hydrolysis by the digestive enzymes of man.**
- **plays important role in intestinal health, obesity, diabetes and cancer.**
- **the recommended daily intake of DF is 25-30 g/person.**
- **slow down gastric emptying & affect nutrient assimilation in the small intestine.**


Total dietary Fiber

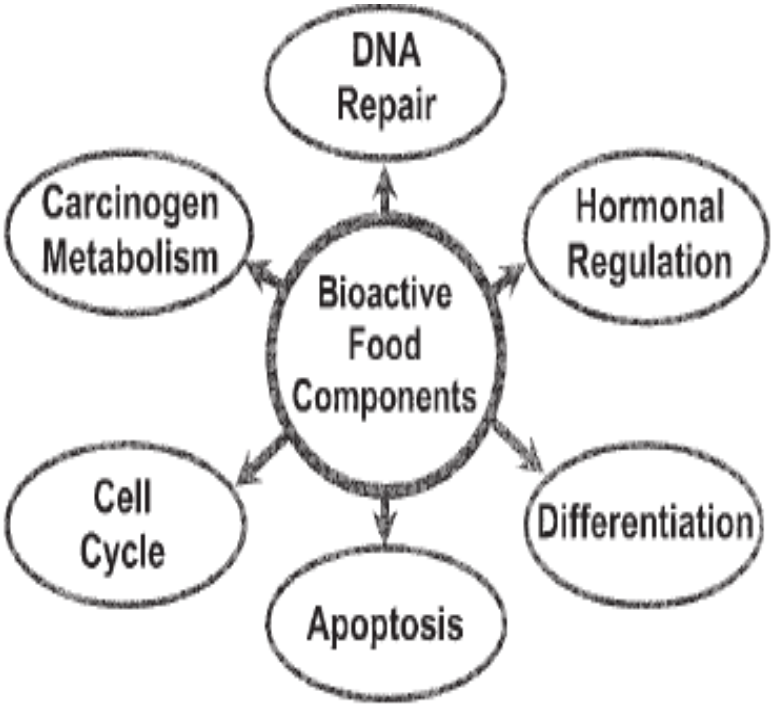

Insoluble dietary Fiber-IDF
(Cellulose, Lignin and Cutin)

Soluble dietary Fiber-SDF
(Pectins, β-glucans, arabinoxylans, galactomannans)

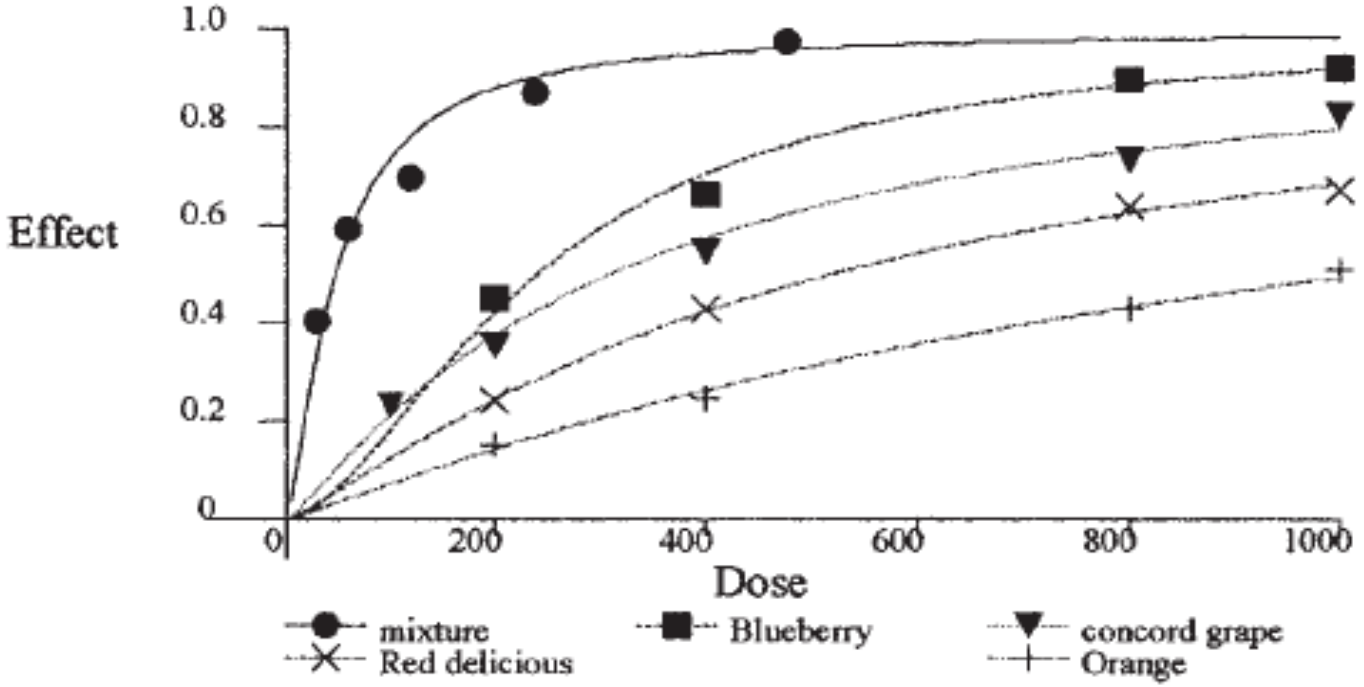
- Properties of DF in fruits and vegetables depend not only on the content, but also on the composition.
- DF of fruits and vegetables transports a significant amount of polyphenols and carotenoids linked to fiber matrix through the human gut.

Mechanism by which phytochemicals in Fruits & Vegetables may prevent diseases

- Antioxidant activity
- Enzyme induction and enhancing detoxification
- Inhibition of enzymes involved in the activation of carcinogens
- Enhancement of immune functions and surveillance
- Regulation of steroid hormone metabolism
- Antibacterial and antiviral effects
- Regulation of estrogen metabolism.
- Prevention of DNA binding

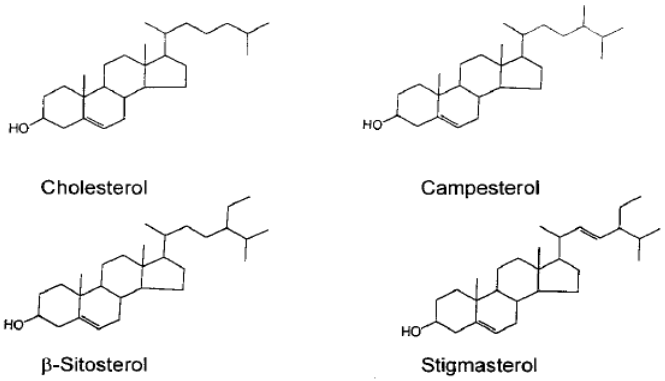


Synergistic effects of phytochemicals present in different fruits:



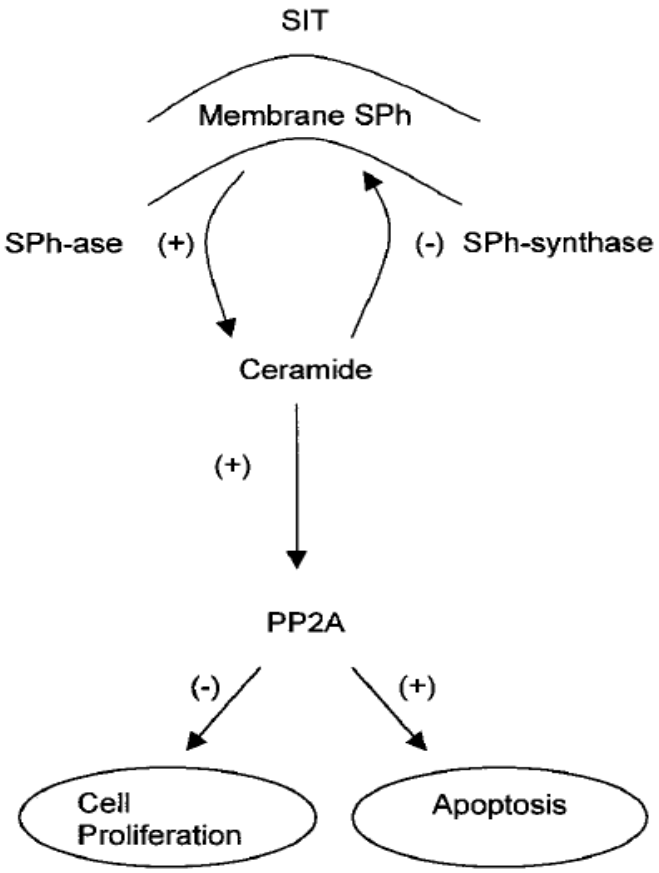
Consumers should obtain their phytochemicals from a wide variety of fruits, vegetables, and whole grains for optimal health benefits.

Nuts- a source of phytosterols



Chemical structures of phytosterols

- **Diet high in phytosterols lowers the level of *prostrate cancer.***
- **Incorporation of phytosterols in to membranes Changes the membrane fluidity/integrity and activities of Membrane-bound enzymes.**
- **Phytosterols have the ability to affect signal Transduction pathways such as protein kinase C pathway.**



Effect of Sitosterol on sphingomylein cycle

Medicinal Mushrooms

Trade: over $ 5 billion

Producers: China, Japan, Korea, Malaysia

Consumers: Above Countries + USA + Europe

Trade in India: over Rs. 500 crore

Commercially Important Medicinal Mushrooms

Reishi or Ling Zhi (*Ganoderma lucidum*)

Shiitake (*Lentinula edodes*)

(*Cordyceps sinense*)

(*Coriolus versicolor*)

(*Schizophyllum commune*)

Products in market

- **DXN-Chennai (220mg capsules) Rs. 360 for 30 Caps.**
- **Organotech - (USA) 100mg capsules Rs. 1250 for 100 Caps.**
- **Works out to Rs. 50000 to Rs. 1,25000 per kg of micronized and refined powder.**


DXN
REISHI GANO (RG)
100% GANODERMA
DXN
100% G. MYCELIUM


クレスチン
KRESTIN


A
抗悪性腫瘍剤
レンチナン〈味の素〉
1mg×10
B

3. Three mushrooms that developed the antitumor polysaccharide agent in Japan. (A) krestin (PSK) fro
versicolor (mycelium); (B) lentinan from *Lentinus edodes* (fruit body); and (C) schizophyllan from *Schizo*
ommune (medium product).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Phytochemicals from fruits and vegetables directly or from dietary supplements :

Whether a purified phytochemical has same health benefit as the compound when its source is a food or a mixture of food.

Isolated pure compound may lose its bioactivity or may not behave the same way as the compound in whole foods.

Natural combination of phytochemicals in fruits and vegetables is responsible for its potent antioxidant activity, it cannot simply be mimicked by pills or tablets.

Higher doses of phytochemicals in pure dietary supplement form may increase the risk of toxicity.

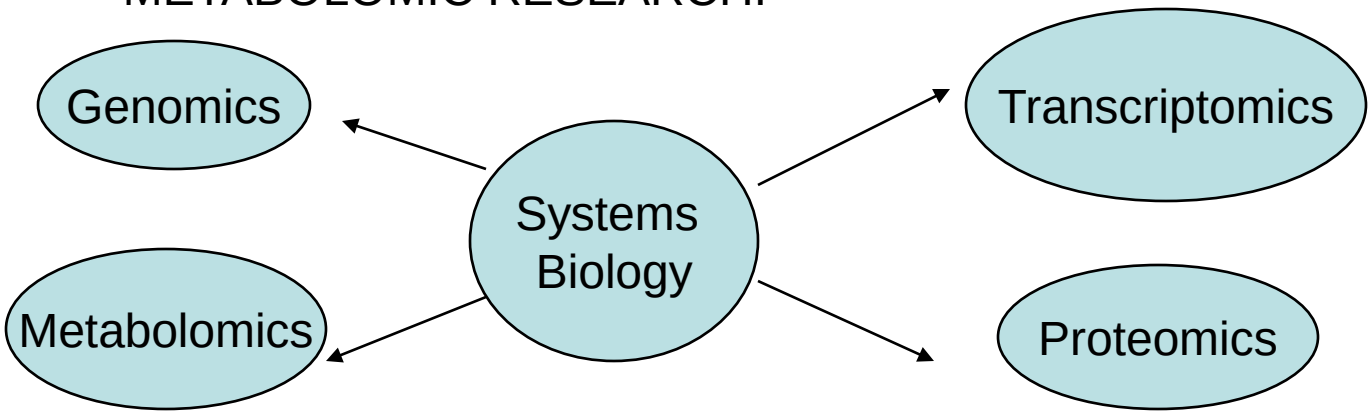
No single antioxidant can replace the combination of natural phytochemicals in fruits and vegetables in achieving the observed health benefits.

Functional foods in the Post-genomic Era:

- Alterations in gene expression in response to bioactive food components needs to be studied using microarray technology. Further, more information is needed to examine how genetic profile of an individual influences the ability of phytochemicals to bring about phenotypic changes.

- Since influence of food components is mainly at the translational or post-translational level (protein phosphorylation and glycosylation), PROTEOMIC-BASED studies are the need of the day.

- Ascorbic acid reduces the anticancer potential of Selenium while allyl sulphar compounds present in the garlic has enhancing effect on its anticancer potential.These interactions among the nutrients can be examined through METABOLOMIC RESEARCH.



ISSUES FOR CONSIDERATION:

- Modern scientific research on claims or empirical observation-- incentives
- Efficacy and safety issues
- Regulation (unscrupulous are everywhere)
- At times (often?) we over claim
- Create awareness among masses- gain credibility
- Standard practices; agricultural, storage and manufacturing

Thank you

Thank you