Title: Phytochemicals and Health benefits

Dear Students, in to-day's lecture, we will discuss about "**Phytochemicals and Health benefits".**This episode deals with different types of **Phytochemicals, sources. Colour pigments, Health benefits" ect**. The fallowing points are highlighted;

Introduction:

Phyto means plants in greek, the substances in plants that may prevent diseases like cancer and heart disease. The bioactive non nutrient plant compounds in fruit, vegetables, grains, and other plant foods—have been linked to reductions in the risk of major chronic diseases. Carotenoids are a class of more than 600 naturally occurring pigments synthesized by plants, algae, and photosynthetic bacteria. These richly colored molecules are the sources of the yellow, orange, and red colors of many plants . Fruit and vegetables provide most of the carotenoids in the human diet. Nutraceutical - specific chemical compounds in food, including vitamins and additives, that may aid in preventing disease. Lycopene is a bright red carotene and carotenoid pigment and phytochemical found in tomatoes and other red fruits and vegetables, such as red carrots.

1. Phytochemicals
2. Eat colors Wheel to become fit
3. Carotenoids , lycopens and Anthocyanins
4. Antioxidents
5. Conclusion:

1:Phytochemicals:

There are 3,000 different phytochemicals with possible health benefits were reported

- Phytochemicals are certain organic components of plants which scientists have isolated as being beneficial to human health in a different way from traditional antioxidants.

- They are sometimes referred to as phytonutrients, but unlike the traditional nutrients (protein, fat, vitamins, minerals), they are not "essential" for life so the term phytochemical is more accurate.
- Biologically active chemical compounds found in plants.They are not nutrients like vitamins or minerals.Believed to have health benefits especially related to heart disease and cancer.
- They may serve as antioxidants in a bodily system when required; for example, the phytochemical beta-carotene can metabolize to create vitamin A, a powerful antioxidant
- Additionally, phytochemicals may enhance immune response and cell-to-cell communication, allowing for the body's built-in defenses to work more efficiently.
- Phytochemicals may even alter estrogen metabolism, cause cancer cells to die (apoptosis), repair DNA damage caused by smoking and other toxic exposure, and detoxify carcinogen..

Some of the important food sources

- Soy
- Tomato
- Broccoli
- Garlic
- Flax seeds
- Citrus fruits
- Melons: cantaloupe, watermelon
- Pink grapefruit and Blueberries
- Chili peppers
- Legumes: beans, and lentils

2: Eat colors Wheel for better health:

The colourful pigments are very important, they contain phytochemicals and vitamins,eg

1. Red pigments : Lycopene, phytoene, phytofluene, vitamin E- eg,Tomatoes, tomato sauce, vegetable juice, tomato soup, watermelon.

2. Green pigments: Glucosinolates, Isothiocyanates, Indole-3 Carbinol, and Folic Acid,eg Broccoli, Brussel Sprouts, Bok Choy, Cauliflower , Cabbage
3. Green/Yellow- Lutein, Zeaxanthin
4. Spinach, Avocado, Kale , Green Beans, Green Peppers, Kiwi, Collard Greens, Mustard Greens
5. Orange pigments : Alpha and Beta Carotene,eg Carrots Pumpkins, Squash, Mangos, Apricots, Cantaloupe
6. Orange/Yellow: Vitamin C, Flavonoids eg,Oranges, Orange Juice, Tangerines, Peaches, lemons, Limes, Pineapple.
7. Red-Purple pigments :Anthocyanins, Ellagic Acid, Flavonoids,eg,Grapes and grape juice, cherries, red wine, strawberries, raisins
8. White/ Green : Allyl Sulfides,eg, Garlic, Onion, and Chives

3:Carotenoids , lycopens and Anthocyanins

Carotenoids:

Carotenoids are a class of more than 600 naturally occurring pigments synthesized by plants, algae, and photosynthetic bacteria. These richly colored molecules are the sources of the yellow, orange, and red colors of many plants Fruit and vegetables provide most of the carotenoids in the human diet.There are several dozen carotenoids in the foods and most of these carotenoids have antioxidant activity.

There are over 600 known carotenoids; they are split into two classes, xanthphylls and cartonoids.Probably the most well-known carotenoid is the one that gives this second group its name,carotene, found in carrots and are responsible for their bright orange color. Crude palm oil, however, is the richest source of carotenoids in nature.Their color, ranging from pale yellow through bright orange to deep red, is directly linked to their structure. Xanthophylls are often yellow, hence their class name.

Humans and animals are mostly incapable of synthesizing carotenoids and must obtain them through their diet. Carotenoids are also actively concentrated in the corpus luteum of the ovaries, where they impart the characteristic color, and may act as general antioxidants.

Lycopene:

Lycopene is the natural substance responsible for the deep red color in many foods, most particularly in tomatoes. It is familiar with lycopene because of of the many health benefits it provides such as a cancer fighting agent and a powerful antioxidant. Found in red carrots, is a type of carotene also found in tomatoes. It is believed to help prevent heart disease and, in conjunction with other phytochemicals, reduce the risk of certain cancers, including prostate cancer. The lycopene content of tomatoes depends on species and increases as the fruit ripens.

.**Health Benefits**

Lycopene is well known specifically to help prevent many forms of cancer as well as the prevention and treatments of many illnesses and diseases such as:

- Heart diseases-Lycopene stops LDL cholesterol from being oxidized by free radicals and in turn cannot be deposited in the plaques which narrows and hardens the arteries
- Infertility-Research suggests that lycopene may help in the treatment of infertility. Results from tests showed that lycopene can boost sperm concentration in men
- Helps prevent diabetes
- Prevents age-related macular degeneration and cataracts
- Prevents the aging of skin and keeps it younger looking
- Acts as an internal sunscreen and protects your skin from sunburn
- Lycopene is also been known to help prevent osteoporosis.

Anthocyanins:

More than 500 different anthocyanins have been described in the literature. Anthocyanins are water-soluble phytochemicals with a typical red to blue color. Anthocyanins belong to the group of flavonoids They are food bioactive compounds implication on cardiovascular disease risk protection. Anthocyanins and pigments of the flavonoid class are found in purple carrots. They occur in all tissuse of higher plants they are clear, white to yellow counterparts of anthocyanins occurring in plants.

They can be found in tissues of plants, including leaves, stems, roots, flowers and fruits of blackcurrant, blueberry, bilberry, cherry, red grape and purple corn. They occur mainly as glycosides of anthocyanidins such as cyanidin, delphinidin, peonidin, pelargonidin, petunidin and malvidin.

Health Benefits : Although anthocyanins are powerful antioxidants in vitro, their real biological activity will be low because of their low stability and poor absorption. Most studies on the potential health benefits of anthocyanins have been focused on its effect on cardiovascular health, its anti-cancer activity and anti-inflammatory properties. In the human body these pigments act as powerful antioxidants, immobilizing harmful free radicals. Anthocyanins can also help to reduce the risk of heart disease by slowing blood clotting.

Cardiovascular health

The beneficial biological effects of anthocyanins on cardiovascular health may be driven by their affinity for proteins and their antioxidant activity. Anthocyanins can act on different cells involved in the development of arthrosclerosis.

Anticancer

Studies have shown that anthocyanins may act as anti-cancer agents by inhibit promotion and progression of tumor cells by stopping the growth of pre-malignant cells, increasing the apoptosis of cancer cells and inhibiting the growth of new blood vessels that nourish tumors.

Anti-inflammatory

The anti-inflsmmatory action of anthocyanins may be attributed to its direct and strong antioxidant action but also its regulatory effect on the expression of genes involved in the inflammatory response..They are also protect the plant cells against damage caused by UV radiation.

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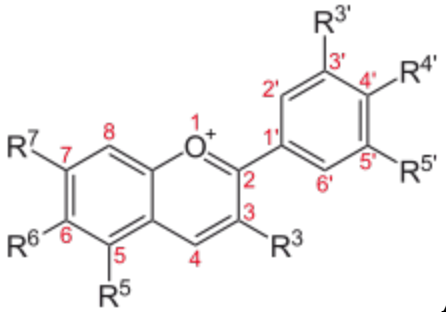


Anthocyanin

Use

Anthocyanins are water soluble strong colours and have been used to colour food since historical times. Extracts of berries have been used to colour drinks, pastries and other foods.

The colour is also susceptible towards temperature, oxygen, UV-light and different co-factors. Temperature may destroy the flavylium ion, and thus causes loss of colour. Oxygen may destroy the anthocyanins, as do other oxidizing reagents, such as peroxides and vitamin C. Many other components in plants and foods may interact with the anthocyanins and either destroy, change or increase the colour. Quinones in apples, for example, enhance the degradation of anthocyanins

Flavonoids are also commonly considered phenols, although the term "flavonoids" can refer to many phytonutrients. Isoflavones are usually categorized as members of this family. They are found in soy, kudzu, red clover, flax and rye, and have been researched extensively for their ability to protect against hormone-dependent cancers, such as breast cancer

Xanthophylls, similar to beta-carotene, give yellow carrots their golden colours; they are linked to eye health and may reduce the incidence of lung and other cancers.

Geraniol

Geraniol is acyclic monoterpene-alcohol. Pure geraniol is a colourless oily liquid, with a sweet rose-like scent. When oxidized, geraniol becomes geranial or citral.It is

present in Bergamot, carrot, coriander, lavender, lemon, lime, nutmeg, orange, rose, blueberry and blackberry

Health benefits: Geraniol is a natural antioxidant and prevent cancer as well as Geraniol inhibits DNA synthesis.

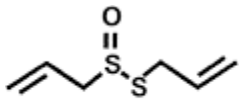
Limonene:

Pure limonene is a clear liquid. Limonene is a monoterpene, made up of two isoprene units. Limonene occurs in two optically active forms, l-limonene and d-limonen. Both isomers have different odours: l-limonene smells piney and turpentine like and d-limonene has a pleasing orange scent.

Distribution: Limonene is found in the essential oils of citrus fruits and many other plant species. Industrial limonene is produced by by alkali extraction of citrus residues and steam distillation. This distillate contains more than 90% d-limonene. It is a colourless liquid hydrocarbon classified as a cyclic terpene. The more common d-isomer possesses a strong smell of oranges.

Health benefits: Studies have shown that limonene have anti- cancer effects. It increase the levels of liver enzymes involved in detoxifying carcinogens. The Glutathione S-transferase (GST) is a system which eliminates carcinogens. Limonene seems to promote the GST system in the liver and small bowel, thereby decreasing the damaging effects of carcinogens.

Allicin:



Allicin

Allicin is an organosulfur compound obtained from garlic, a species in the family Alliaceae. It was first isolated and studied in the laboratory by Chester J. Cavallito and

John Hays Bailey in 1944. Allicin is garlic's defence mechanism against attacks by pests. When the garlic plant is attacked or injured it produces allicin by an enzymatic reaction. Allicin, one of the active principles of freshly crushed garlic homogenates, has a variety of antimicrobial properties.

Health benefits: The main antimicrobial effect of allicin is due to its chemical reaction with thiol groups of enzymes, e.g. alcohol dehydrogenase, thioredoxin reductase, and RNA polymerase.

Many clinical studies have showed that garlic/allicin has the ability to lower total cholesterol, LDL, or "bad cholesterol" and triglycerides, and increase HDL cholesterol. This in turn prevention of heart-related conditions such as heart attack, atherosclerosis, and stroke. In addition, garlic/allicin may support the overall health of the circulatory system, which may helps in lowering the risk of heart attack and strokes, anti-blood coagulation, anti-hypertension, anti-cancer, antioxidant and anti-microbial effects.

Silymarin :

Silymarin is a unique flavonoid complex—containing silybin, silydianin, and silychrisin. These unique phytochemicals . Silymarin is a antioxidant or free radical scavenger. Skin care products often contain silymarin because it antioxidant activity may reduce the risk for skin cancer risk. It provides protection against different stages of induced carcinogenesis protects the liver by promoting the growth of new liver cells. Silymarin has also anti-atherosclerotic activity, by inhibiting the expression of adhesion molecules.

Lutein:

Lutein is one of the hydroxy carotenoids found in yellow and orange carrots and makes up the macular pigment of human retinas. Consuming foods high in lutein may increase the density of this pigment and decrease the risk for developing macular degeneration and other age-related diseases.

Flavonoids are a group of plant metabolites thought to provide health benefits through cell signalling pathways and antioxidant effects. These molecules are found in a variety of fruits and vegetables and include over 6,000 already-identified family members Flavonoids are polyphenolic molecules and are soluble in water.

Many flavonoids act as antioxidants

- May protect against cancers and heart disease by this mechanism
- More evidence is needed before any claims can be made for flavonoids themselves as the protective factor in foods
- Particularly when they are extracted from foods or herbs and sold as supplements

4:Antioxidant:

- An antioxidant is a molecule that inhibits the oxidation of other molecules. Oxidation is a chemical reaction involving the loss of electrons or an increase in oxidation state. Oxidation reactions can produce free radicals. In turn, these radicals can start chain reactions. Lower blood pressure.

Antioxidants are chemicals that interact with and neutralize free radicals, thus preventing them from causing damage. Antioxidants are also known as "free radical scavengers." The body makes some of the antioxidants it uses to neutralize free radicals. All living organisms utilize oxygen to metabolize and use the dietary nutrients in order to produce energy for survival. Vitamin C is the most important water-soluble antioxidant in extracellular fluids and also regenerating vitamin E.. Vitamin E is the most important lipid soluble antioxidant.

Antioxidants within the human body

The antioxidant enzymes – glutathione peroxidase, catalase, and superoxide dismutase (SOD) are such enzymes. They require micronutrient cofactors such as selenium, iron, copper, zinc, and manganese for their activity.

Antioxidants are used as food additives. These preservatives include natural antioxidants such as ascorbic acid (AA, E300) and tocopherols (E306).

Antoxidants are important

- free radicals are molecules missing electrons: unstable
- formation of 1 free radical causes a chain reaction with many free radicals formed
- antioxidants prevent formation of free radicals or break the chain reaction by becoming oxidized
- Black tea may lower LDL cholesterol
- Improved blood flow and blood vessel function
- Memory and Immune function
- Oral health
- Decreased risk of kidney stones and Obesity

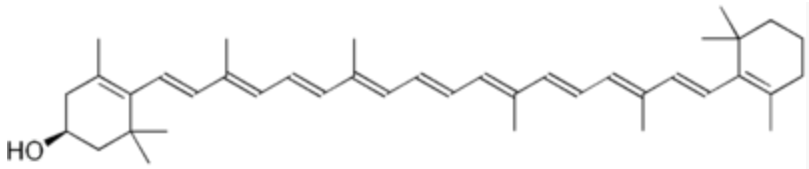
Phytoestrogens are plant-based compounds that are structurally similar to estrogen, the primary female sex hormone. Although phytoestrogens can perform most of the functions of estrogen, they are generally weaker than the hormone that is produced naturally by the human endocrine system. Phytoestrogens may reduce risk of adult bone loss and the sensation of elevated body temperature known as "hot flashes". A *diet* high in soy may offer bone protection rivaling that of hormone replacement therapy (HRT).

Xanthophylls :

Xanthophylls are the typical yellow pigments of leaves. These are oxygenated carotenoids that are synthesized within the plastids.Xanthophyll**s** do not require light for synthesis, so that xanthophylls are present in all young leaves as well as in etiolated leaves.

Dietary carotenoids, especially ***xanthophylls***, have attracted significant attention because of their characteristic biological activities.

Xanthophylls are present in two large protein-cofactor complexes, present in photosynthetic membranes of organisms using Photosystem I or Photosystem I



The chemical structure of cryptoxanthin

Food source:

Xanthophylls are found in all young leaves and in etiolated leaves. Examples of other rich sources include papaya, peaches, prunes, and squash, which contain lutein diesters

An **essential nutrient** is a nutrient required for normal human body function that either cannot be synthesized by the body at all, or cannot be synthesized in amounts adequate for good health (e.g., niacin,choline), and thus must be obtained from a dietary source.

Lycopene is not an essential nutrient for humans, but is commonly found in the diet mainly from dishes prepared from tomatoes. When absorbed from the intestine, lycopene is transported in the blood by various lycoproteins and accumulates primarily in the blood, adipose tissue, skin, liver, and adrenal glands, but can be found in most tissues. Carotenoids like lycopene are important pigments found in photosynthetic. They are responsible for the bright colors of fruits and vegetables, perform various functions in photosynthesis, and protect photosynthetic organisms from excessive light damage.

Lycopene in tomato paste is up to four times more bioavailable than in fresh tomatoes. While most green leafy vegetables and other sources of lycopene are low in fats and oils, lycopene is insoluble in water and is tightly bound to vegetable fiber. Processed tomato products such as pasteurized tomato juice, soup, sauce, and ketchup contain the highest concentrations of bioavailable lycopene from tomato-based sources.

Lycopene is fat-soluble, so the oil is said to help absorption. Lycopene may be obtained from vegetables and fruits such as the tomato,.

The cis-lycopene from some varieties of tomato is more bioavailable. An example is the blood orange, which is colored by anthocyanins, while other red colored oranges, and other citrus fruit are colored by lycopene.

5:Conclusion:

Phytochemicals, also known as phytonutrients, are found in fruits, vegetables, whole grains, legumes, beans, herbs, spices, nuts, and seeds. The consumption of fruits, vegetables, and whole grains, as well as dietary patterns such as the Mediterranean diet that emphasize these foods, have been associated with a reduced risk of several types of cancer, including breast, lung, and colon cancer. These natural plant compounds are edible disease fighters. Turmeric, ginger, coriander, cumin and fennel are just a few of the spices containing phytonutrients. Some of the well-known phytochemicals are lycopene in tomatoes, isoflavones in soy and flavanoids in fruits. Lycopene is well known specifically to help prevent many forms of cancer as well as the prevention and treatments of many illnesses and diseases. Isoflavones, found in soy, imitate human estrogens and help to reduce menopausal symptoms and osteoporosis.

Highest activity found in these foods: Highest anticancer activity can be found in garlic, soybeans, cabbage, ginger, licorice root, and the umbelliferous vegetables.
Additional foods found to have cancer protective activity: onions, flax, citrus, turmeric, cruciferous veggies, tomatoes, sweet peppers and brown rice.

- Soybeans and soy products.
- Tempeh.
- Linseed (flax)
- Sesame seeds.
- Wheatberries.
- Fenugreek (contains diosgenin, but also used to make Testofen®, a compound taken by men to increase testosterone).
- Oats.
- Barley.