

Phytochemicals as nutraceuticals

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- Phytochemicals are natural compounds found in plants that offer health benefits beyond basic nutrition.
- As nutraceuticals, they help in disease prevention and health promotion.
- Key categories include sulfides, polyphenolics, flavonoids, phytoestrogens, tocopherols, and prebiotics/probiotics.

Various phytochemicals as nutraceuticals

A. Sulfides

- Found in Allium vegetables (garlic, onions, leeks), these sulfur compounds like allicin have antimicrobial properties.
- **Benefits:** May reduce cholesterol, blood pressure, and have anticancer effects.

B. Polyphenolics

- Include flavonoids, phenolic acids, stilbenes, and lignans.
- Abundant in fruits, vegetables, grains, tea, and wine.
- **Benefits:** Strong antioxidants, may lower risk of heart disease, diabetes, and cancer.

C. Flavonoids

- A major class of polyphenols, found in nearly all fruits and vegetables.
- Includes flavanols, flavones, flavanones, isoflavones, and anthocyanidins.
- **Benefits:** Anti-inflammatory, immune-boosting, protective against chronic diseases.

D. Phytoestrogens

- Plant compounds that mimic estrogen, found in soy, flaxseeds, and sesame seeds.
- **Benefits:** May ease menopausal symptoms, support bone and heart health.

E. Tocopherols (Vitamin E)

- Potent antioxidants found in nuts, seeds, oils, and green vegetables.
- **Benefits:** Protect against free radical damage, support immune and heart health.

F. Prebiotics & Probiotics

- **Prebiotics:** Non-digestible fibers (e.g., in bananas, garlic) that feed beneficial gut bacteria.
- **Probiotics:** Live bacteria in fermented foods like yogurt, kimchi, and miso.
- **Benefits:** Enhance gut health, immunity, and reduce inflammation.

Various Carotenoids as Nutraceuticals

α and β -Carotene

Overview:

- Orange pigments present in foods such as carrots, sweet potatoes, and pumpkins.
- Both are provitamin A carotenoids – converted into vitamin A in the body.
- Known for antioxidant activity and support for vision, immune function, and skin health.

Occurrence:

- **α -Carotene:** Found in yellow to orange fruits and vegetables (carrots, pumpkins, sweet potatoes); less common than β -carotene.
- **β -Carotene:** Widely distributed in the plant kingdom – abundant in carrots, spinach, kale, sweet potatoes, and cantaloupe.

Chemical Nature:

- Classified as **terpenoids** (hydrocarbons).
- Characterized by **conjugated double bonds** which provide antioxidant properties.
- The difference lies in the **position of a double bond** in one of the end rings, influencing their bioactivity and vitamin A conversion efficiency.

Medicinal Benefits:

1. **Vitamin A Source:** Crucial for vision, immune defense, and skin health.
2. **Antioxidant Activity:** Scavenges free radicals and reduces oxidative stress.
3. **Eye Health:** Contributes to preventing age-related macular degeneration.
4. **Immune System Support:** Enhances immune function through vitamin A activity.

Lycopene

Overview:

- A bright red pigment primarily found in tomatoes, as well as in watermelon, pink grapefruit, and papaya.
- Unlike α and β -carotene, lycopene is not converted into vitamin A.
- Recognized as one of the most powerful dietary antioxidants.

Occurrence:

- Found in tomatoes (especially when cooked), watermelon, pink grapefruit, guava, and papaya.

Chemical Nature:

- A non-provitamin A carotenoid.
- Structurally consists of 11 conjugated double bonds in an acyclic form.
- These structural features account for its strong antioxidant activity.

Medicinal Benefits:

1. **Antioxidant Activity:** Excellent free radical scavenger; protects cells from oxidative damage.
2. **Cardiovascular Health:** Improves lipid profile, reduces LDL cholesterol, and helps lower blood pressure.
3. **Cancer Prevention:** Linked with reduced risk of several cancers, especially prostate cancer.
4. **Skin Protection:** Guards skin against UV-induced damage and sunburn.
5. **Heart Health:** Further contributes to cardiovascular protection through anti-inflammatory actions.

Xanthophylls

Overview:

- Yellow pigments found in green leafy vegetables (e.g., spinach, kale) and egg yolks.
- Lutein and zeaxanthin are two key xanthophylls, highly concentrated in the macula of the eye.
- These compounds help protect the eyes from oxidative damage and high-energy blue light.

Occurrence:

- **Rich sources:** Spinach, kale, Swiss chard, collard greens.
- Also found in egg yolks, yellow/orange fruits and vegetables, and some fish.

Chemical Nature:

- Contain oxygen atoms in addition to carbon and hydrogen.
- This sets them apart from carotenes and contributes to fat solubility and unique antioxidant behaviors.
- Their structure allows them to absorb light and protect plant tissues and human cells alike.

Medicinal Benefits:

1. Eye Health:

- Lutein and zeaxanthin accumulate in the retina (macula) and protect against age-related macular degeneration (AMD) and cataracts.
- Shield the eyes from oxidative stress and blue light exposure.



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