



Prospective Phytochemicals for alleviation of different chronic ailments

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Received: 12-Oct-2015 Accepted on: 26-Nov-2015 Published on: 1-Dec-2015

ABSTRACT

'Phytochemicals' include a variety of plant ingredients that are capable of promoting good health. Phytochemicals include a variety of compounds - terpenoids, polyphenols, and thiols. Researchers have concluded that phytochemicals can stimulate our immune system, prevent toxic substances in the diet from becoming carcinogenic, also reduce inflammation, prevent damage to DNA, and assist in the repair. They also reduce the oxidative damage to the cells and slow down the pace of cancer cells. However, much focus is given on the antioxidant properties of phytochemicals. Change in the dietary patterns by including more fruits and vegetables and grains is a practical strategy to include phytochemicals in our diet. This dietary pattern may provide desirable health benefits beyond basic nutrition to reduce the risk of chronic diseases.

Keywords: Phytochemicals, Carcinogenic, Immune System, Terpenoids, Polyphenols, Thiols.

Introduction

Phytochemicals refer to plant chemicals that are present abundantly in nature, especially in fruits and vegetables. Phytonutrients are natural substances but they are not designated as nutrients in the traditional sense, since they are synthesized by plants neither in energy metabolism nor in other metabolism, but they are formed only in specific cell types. They differ from primary plant compounds as they are not essential to the plant. Many phytochemicals have been identified, and researchers speculate that there are likely many more which needs to be discovered in the foods we eat. Phytonutrients perform other important tasks in the secondary metabolism of plants by acting as repellents to pests and to the sunlight. They also have role as growth regulators and usually have a pharmacological effect. These are present in large amount in raw foods but intensities are reduced during processing and handling (Wang et al., 1996). Epidemiological studies have proven that there is a considerable association between fruit and vegetable consumption and reduced risk of many degenerative diseases. Phytochemicals are linked with the prevention of certain chronic diseases like cardiovascular diseases (CVD), cancer, diabetes, osteoporosis, and vision-related disorders. Fruits and vegetable consumption is inversely associated with the incidence of any type of cancer,

including stomach, colon, breast, lung, and prostate cancers (Kris-Etherton et al, 2002; Temple and Kerri, 2003). The strong antioxidant ability of phytochemicals appears to reduce the damage (Park et al, 2003). The phytochemical may stimulate the immune system, slow the growth rate of cancer cells, and prevent DNA damage that may trigger cancer and other degenerative diseases. Phytochemicals having the antioxidant property helps to protect our body from the oxidative damage. Hence, eating a balanced diet which includes whole grains, legumes, nuts, seeds and a variety of colourful fruit and vegetables will furnish the body with loads of phytochemicals. These phytochemicals are linked with a reduced risk of cardiovascular and other diseases. Depending on dose these phytochemicals may have good health benefits or adverse health effects, so careful consumption is required. The purpose of this study is to become aware of the type of phytochemicals available and how could they be instrumental in alleviating many ailments.

Classification of Phytochemicals

There are three major groups of phytochemicals:

- Terpenoids
 - Carotenoid terpenoids
 - Non-Carotenoid terpenoids
- Polyphenols
- Thiols

1. Terpenoids

Terpenoids, also known by the name isoprenoids, are the most abundantly found and structurally diverse natural products found in many plants. Several studies have indicated that this class of compounds exhibit a wide array of very important pharmacological properties. These properties have created a lot of interest in them with respect to their

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Cite as: *Integr. J. Soc. Sci.*, 2015, 2(1), 36-39.

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IJSS ISSN: 2348-0874

<http://pubs.iscience.in/ijss>

commercial use. Terpenoids provide scent to the cinnamon, clove, eucalyptus, and ginger, the yellow color of sunflowers, and the red color of tomatoes (Kuete, 2013). Terpenoids have a diverse role in the field of foods, drugs, cosmetics, hormones, vitamins, and many more. These can be carotenoid terpenoids or non-carotenoid terpenoids.

(a) Carotenoid Terpenoids: Carotenoids are widespread plant pigments that contribute to the yellow, orange, and red colours of fruits and vegetables (Ochoa-Alejo, 2013). Over 700 different carotenoids have been identified (Arvayo-Enríquez et al., 2013). Carotenoids found as free forms are dissolved in oil solvent. They may be esterified with fatty acids or complexed with sugar and proteins (Sajilata et al., 2008). The conjugate double bond structure in carotenoids also determines its biological functions (Deming and Erdman, 1999). Carotenoids have an important role in protecting the cells from free radicals. They are also associated with cellular protection, regulation of cell growth, and cell differentiation. Carotenoids are well known for their antioxidant property, which is linked with a reduction in the risk of several cancers, CVDs, macular degeneration, and cataracts, as well as enhancement of the immune system (Mathew and Micheline, 1991; Fraser et al., 2004). The most important examples of carotenoids are beta carotene, lycopene, lutein, and zeaxanthin.

Carotene: Carotenoids with hydroaromatic rings are called carotene (Ahamad, 2007). There are three main types of carotene—alpha-carotene, beta-carotene and gamma-carotene. The carotenoids are known as precursors of vitamin A and are converted into vitamin A in the body (Harjes, 2000; Shete and Quadro, 2013). It is widely present in orange-coloured fruits and vegetables like carrot, pumpkin, sweet potato, apricot, and green leafy vegetables like spinach and kale. Beta carotene is fat soluble provitamin and its active form is vitamin A (Valko et al., 2007). It has the ability to be converted to vitamin A and has an important role as an antioxidant. Beta carotene is a major carotenoid in the skin. Human intervention studies show moderate UV protective effects of beta carotene in the skin (Kopcke et al., 2008; Sies et al., 2004). As a result of oxidative stress in our body radicals and non-radical reactive species are generated. Beta carotene has been postulated to be an important chain-breaking antioxidant, scavenging lipid oxide and lipid peroxide radicals (Krinsky et al., 2005). Studies have indicated that beta-carotene's antioxidant properties prevent diseases, such as atherosclerosis, cataracts, multiple sclerosis, and some types of cancers (Terao, 1989).

Lycopene: Lycopene is a lipophilic carotenoid which is found in red coloured fruits and vegetables like tomatoes, watermelon, red grapefruits. As it is lipophilic, consumption with lipids increases its bioavailability. Cooking or processing lycopene-rich foods like tomatoes can release lycopene from protein complex, thereby increasing its bioavailability. Lycopene is an antioxidant that cannot be synthesized by animals and humans (Rao and Rao, 2007). Lycopene is known to have a higher antioxidant capacity than other carotenoids and it inhibits the risk of prostate cancer (Stahl and Sies, 2005; Giovannucci et al., 1995).

Lycopene has several cardiovascular beneficial effects, such as antioxidative, anti-inflammatory, anti-atherogenic, cardioprotective, and antiplatelet effects, improving endothelial function, the metabolic profile, and blood pressure control (Reid et al., 2011; Bohm, 2012).

Lutein and Zeaxanthin: They both are structurally similar and occur as a yellow pigment in nature. Egg yolk, yellow bell pepper, pumpkin, peas, broccoli are their food sources. They belong to the particular family of carotenoids referred to as xanthophylls. They are found in the macula of the eye in high concentrations which indicates that they play an important role in the prevention of macular degeneration, glaucoma, and cataracts (Abdel-Aal, et al., 2013; Koo et al., 2014). Tapiero et al (2004) reported that yellow pigments play an active role in protecting the eye from retinal damage. Lutein and zeaxanthin have been associated with slowing the progression of age-related macular degeneration (SanGiovanni et al., 2007; Rochtchina et al., 2007). They also act as an antioxidant and provide us protection from oxidative stress caused by smoke and sunlight. They have a role in the decreased risk of cartilage defects.

(b) Non-Carotenoid Terpenoids: These include perillyl alcohol and saponins. Perillyl alcohol has a role in slowing down cell division, apoptosis and thus shows anticancer activity. It is abundantly present in cherries and mint.

Saponins are found in chickpea, soybean, peanuts as well as in some herbs and spices like fenugreek, nutmeg, sage, and thyme. These are known to inhibit the important nutrients (Lakra and Sehgal, 2009; Gahlawat and Sehgal, 1994). Studies indicate they reduce cholesterol and also have beneficial effects on some cancer. Saponins also act as anti-inflammatory, immunomodulatory, and antiallergic agents (Wang et al., 2014).

2. Polyphenols

Polyphenols are phytochemicals, found mostly in fruits, vegetables, tea, coffee, chocolates, legumes, cereals, and beverages. There are over 8000 polyphenols which have been identified in nature and they are known for their role as an antioxidant. They help to protect our body from the damage of free radical and defense against UV radiation or aggression by pathogens. For the last few decades, keen interest has developed in the potential health benefits of dietary polyphenols as antioxidant (Pandey and Rizvi, 2009; Liu et al., 2014). They are abundantly available in our diet and have been associated with many health benefits. Polyphenols are a collective term for several subgroups of phenolic compounds. The main classes include phenolic acid, flavonoids, stilbenes, and lignans.

Phenolic Acid: These are found in cinnamon, cherries, strawberries, licorice, etc. It has many beneficial properties like blood-thins, anti-fungicidal, and antitumor. They can occur in free or bound form in nature. Fruits and vegetables contain free phenolic acids whereas bran of grains and oilseeds have bound phenolic acid.

Flavonoids: They are abundantly found in nature and are present in commonly consumed foods such as fruits, legumes, red wine, and green tea, onion, etc. They are available in the form of glycosides and are non-nutritive compounds of plants. They have a potential effect on radical scavenging and inflammatory reactions. Also, they are further divided into a number of subgroups namely, flavones, flavanols, flavanones, isoflavones, anthocyanidins, chalcones, and catechins.

Stilbenes: Stilbenes are natural compounds and are found in some type of plants. Some stilbenes have health benefits. Resveratrol and pterostilbene are two stilbenes of importance. Resveratrol is well-known stilbenes. It is found in grape skins,

red wine, peanuts, blueberries, and cranberries. Some observational studies indicate that people who drink wine tend to have a lower risk of cardiovascular disease. Pterostilbene is found in blueberries and grapes. It has got antioxidant properties and can be beneficial in the treatment and prevention of cancer, cardiovascular disease, and cognitive decline.

Lignans: Flax seeds and sesame seeds contain higher levels of lignans than most of the food. It is also present in pumpkin seeds and sunflower seeds. It has got Phyto estrogenic properties.

Sesame is a common component of the Indian diet, and both sesame seeds and oil are rich in lignans. Despite lignans comprising only a small proportion of total sesame seed mass, it has gathered attention for their notable health-promoting properties (demonstrated both in vitro and in vivo), including anti-inflammatory, antioxidant and anti-hypertensive activities (Liu, 2006).

Health Benefits of Polyphenols:

Research studies have repeatedly shown an inverse association between the risk of chronic human diseases and the consumption of polyphenolic rich diet (Scalbert et al, 2005; Spencer et al, 2008; Martín-Peláez et al., 2013; Fraga et al., 2010). The phenolic groups in polyphenols can accept an electron to form relatively stable phenoxyl radicals, thereby disrupting chain oxidation reactions in cellular components. (Clifford, 2000). As an antioxidant, polyphenols protect cell constituents against oxidative damage and, therefore, limit the risk of various degenerative diseases associated with oxidative stress (Luqman and Syed, 2006; Pandey et al, 2009). Evidence suggests that polyphenols slow pro-inflammatory transcription factors by their interaction with proteins which are involved in gene expression and cell signaling. This leads to protective effects against many inflammation-mediated chronic diseases (Khoddami et al., 2013). Resveratrol, component found in red wine, is reported to prevent platelet aggregation and relax the arterial blood vessels, disrupting the oxidation of low-density lipoprotein (LDL) cholesterol (Guo et al., 2013; Guo et al., 2014).

As polyphenols are most commonly found in plant-based foods like fruits and vegetables, recommendations for consumption should be incorporated into existing nutrition education programs and guidelines to promote healthy diets. In spite of the benefits of polyphenols the supplementation and fortification of polyphenols is not encouraged as their consumption might replace intake of healthy options like fruits and vegetables. Also, polyphenol extracts used in supplementation and fortification may not be having the effects as the natural diet sources (Crowe and Francis, 2013). Further research is required to know how the same benefits from polyphenols consumed in whole foods can be derived from isolated forms.

3. THIOLS: Thiols are a class of organic sulfur derivatives characterized by the presence of sulfhydryl residues. Thiols have a very important role to play in the antioxidant defense system as well as in protein synthesis, formation, redox-sensitive signal transduction, cellular growth and proliferation, organising programmed cell death, and the immune system (Manda et al., 2010)

A very good example is *Allium Sativum* (garlic) which is known for anti-carcinogenic, antithrombotic anti-

atherosclerotic, anti-inflammatory, anti-microbial, and anti-oxidative effects. The most active compound found in garlic is allicin (diallyl disulfide). Allicin only exists as a biologically active compound when garlic is crushed or cut. In a review of the literature examining the action mechanism of garlic, it was suggested that garlic derivatives influence DNA adduct formation, mutagenesis, cell proliferation, scavenging of free radicals, and differentiation (Capasso, 2013).

Conclusion

This study identified the types, characteristics and health benefits of consuming phytochemicals. Phytochemicals contained in plant foods play important roles in disease prevention. Today, choosing a healthy and wholesome diet has become an essential part of healthy living and fitness. Increasing the intake of phytochemical sources like fruits, vegetables, and grains in our diet seems to be advantageous to the consumers as it will not only optimize their health but will also reduce the risk of chronic diseases.

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