International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

The Potential Health-Promoting Effects of Specific Phytochemical Found in Fruits and Vegetables: A Mini Review

Pruthvi Gowda Sudhakara

Masters, Poznan University of Life Sciences

Abstract

This systematic review investigates the diverse array of phytochemicals present in fruits and vegetables, assessing their potential for enhancing health. Phytochemicals have attracted significant interest due to their noteworthy biological properties. The primary aim of this review is to gather and meticulously evaluate contemporary research in order to explain the precise health advantages linked to certain phytochemicals present in different fruits and vegetables. The method involves performing extensive searches in major academic databases, including papers published during a certain timeframe. The predetermined criteria for inclusion are thoroughly evaluated and undergo a rigorous examination of quality. The research involves the discovery of crucial phytochemicals, the clarification of their mode of action, and the examination of their influence on human health.

Keywords: Phytochemical, Antioxidants, Flavonoids, Carotenoids, Ant Inflammatory

1. Introduction

Phytochemicals are mostly metabolized by the same enzymes that process food and medications. Cytochrome P450 (CYP450) is a group of enzymes that were first identified and studied by Julius Axelrod in the 1950s. These enzymes have the ability to facilitate the elimination of foreign substances (xenobiotics) from the body by catalyzing hydroxylation processes, with a heme molecule serving as a cofactor (Chan et al., 2016). Phytochemicals are inherent molecules found in plants that provide therapeutic or nutritional properties, capable of safeguarding the liver. Researchers worldwide have long been investigating the chemical compounds derived from plants that has the potential to either prevent or treat liver ailments (Bachar et al., 2020). Phytochemicals, often known as plant chemicals, have significant functions in the growth and development of plants. They provide protection to plants against detrimental agents such as insects and bacteria, as well as against challenging circumstances including ultraviolet (UV) radiation and severe temperatures. Additionally, they have the ability to attract advantageous avian and insect species that facilitate the processes of pollination, germination, and seed dissemination. Phytochemicals provide pigmentation to plants and a variety of tastes, ranging from enjoyable to unpalatable, when ingested. They exhibit specificity towards certain plants and plant components, and their prevalence often amplifies during periods of stress. Phytochemicals have advantageous effects on health when ingested. They include vital elements necessary for good health, such as proteins, carbohydrates, vitamins, and minerals, as well as additional compounds like phenolic acids, flavonoids, and other phenolics, which have lesser-known functions in promoting health or preventing diseases.

Several of these phytochemicals are acknowledged as bioactive constituents in conventional herbal remedies (such as salicylates (aspirin) present in willow bark utilised for inflammation reduction, quinine in cinchona bark employed for malaria treatment, and proanthocyanidins in cranberries used for urinary tract infection treatment). Polyphenols are the most abundant type of phytochemicals and possess strong antioxidant properties because of their many hydroxyl groups (Martinez et al., 2017).

2. Definition and Classification

Phytochemicals are compounds derived from plants. Phytochemicals, derived from the Greek word "phyto" meaning "plant," refer to compounds that plants make as a result of their main or secondary metabolic processes. Typically, they exhibit biological activity inside the plant host and contribute to plant development or serve as a defence mechanism against rivals, diseases, or predators (Breslin, A. 2017).

Phytochemicals are often considered to be research compounds rather than essential nutrients due to the lack of solid evidence about their potential health impacts (Oregon. 2017). Phytochemicals now being studied may be categorised into primary groups, including carotenoids and polyphenols, which include phenolic acids, flavonoids, stilbenes, and lignans (Oregon. 2016). Flavonoids may be classified into several categories according on their analogous chemical composition, including anthocyanins, flavones, flavanones, isoflavones, and flavanols. Flavanols may be categorised into three subgroups: catechins, epicatechins, and proanthocyanidins. A total of around 50,000 to 130,000 phytochemicals have been identified (Afendi et al., 2012).

A polyphenol antioxidant is a theoretical kind of antioxidant that would consist of a polyphenolic substructure (Corvallis et al., 2015). Dietary intake is the primary source of polyphenols, since they are present in a diverse range of phytochemical-rich foods. For instance, honey, legumes, and various fruits like apples, blackberries, blueberries, cantaloupe, pomegranate, cherries, cranberries, grapes, pears, plums, raspberries, aronia berries, and strawberries (berries in general have a high polyphenol content), as well as vegetables such as broccoli, cabbage, celery, onion, and parsley, are abundant in polyphenols. Red wine, chocolate, black tea, white tea, green tea, olive oil, and other cereals serve as sources. Polyphenols are ingested via the consumption of a diverse range of plant-based meals (Hidalgo & Almajano, 2017)

Flavonoids, a diverse set of phenolic compounds, are naturally occurring chemicals present in a wide range of plant-based sources such as fruits, vegetables, cereals, bark, roots, stems, flowers, tea, and wine. The health benefits of these natural chemicals are well recognised, and there are ongoing attempts to extract and isolate the specific compounds known as flavonoids. Flavonoids are increasingly recognised as an essential element in a wide range of nutraceutical, pharmacological, therapeutic, and cosmetic uses. These abilities are due to their ability to prevent oxidation, reduce inflammation, prevent mutations, and inhibit the growth of cancer cells, as well as their ability to regulate important biological enzymes (Panche et al., 2016)

Carotenoids are intrinsic pigments that undergo metabolic processes inside plants, algae, and photosynthetic bacteria. They are accountable for the many hues of yellow, orange, and red seen in several fruits and vegetables. Carotenoids may be categorised into two classes based on their functional groups. Xanthophylls, such as lutein and zeaxanthin, include oxygen as a functional group. Carotenes, including α-carotene, β-carotene, and lycopene, do not have any functional groups and consist entirely of a hydrocarbon chain. The introduction of polar groups such as epoxy, hydroxyl, and keto modifies the polarity of carotenoids, hence impacting their biological roles. Fruits and vegetables are the primary reservoir of carotenoids and have a significant impact on the diet by providing vitamin A activity. In

addition, carotenoids have a crucial role in antioxidant activity, intercellular communication, and immune system function. Epidemiological studies have shown that consuming diets that are high in carotenoids is linked to a reduced occurrence of cancer, cardiovascular disorders, age-related macular degeneration, and cataract development. The absence of carotenoids leads to the manifestation of many clinical symptoms related to the conjunctiva and cornea, such as xerophthalmia, night blindness, keratomalacia, corneal ulcers, scarring, and ultimately, permanent blindness (Saini et al., 2015).

Anthocyanins are compounds that give vegetables their red, blue, and purple hues. They have been shown to have significant anti-inflammatory effects on obese adipose tissues. Additionally, anthocyanins are related with mechanisms that help combat-obesity.

Anthoxanthins, colourless or white to yellow molecules, are categorised into five main groups: flavonols, flavanones, flavones, flavanols, and isoflavones. Moreover, among the many categories of anthoxanthin, flavonoids, flavonols, and flavones have the broadest distribution in fruits and vegetables (Thakur et al.,2018).

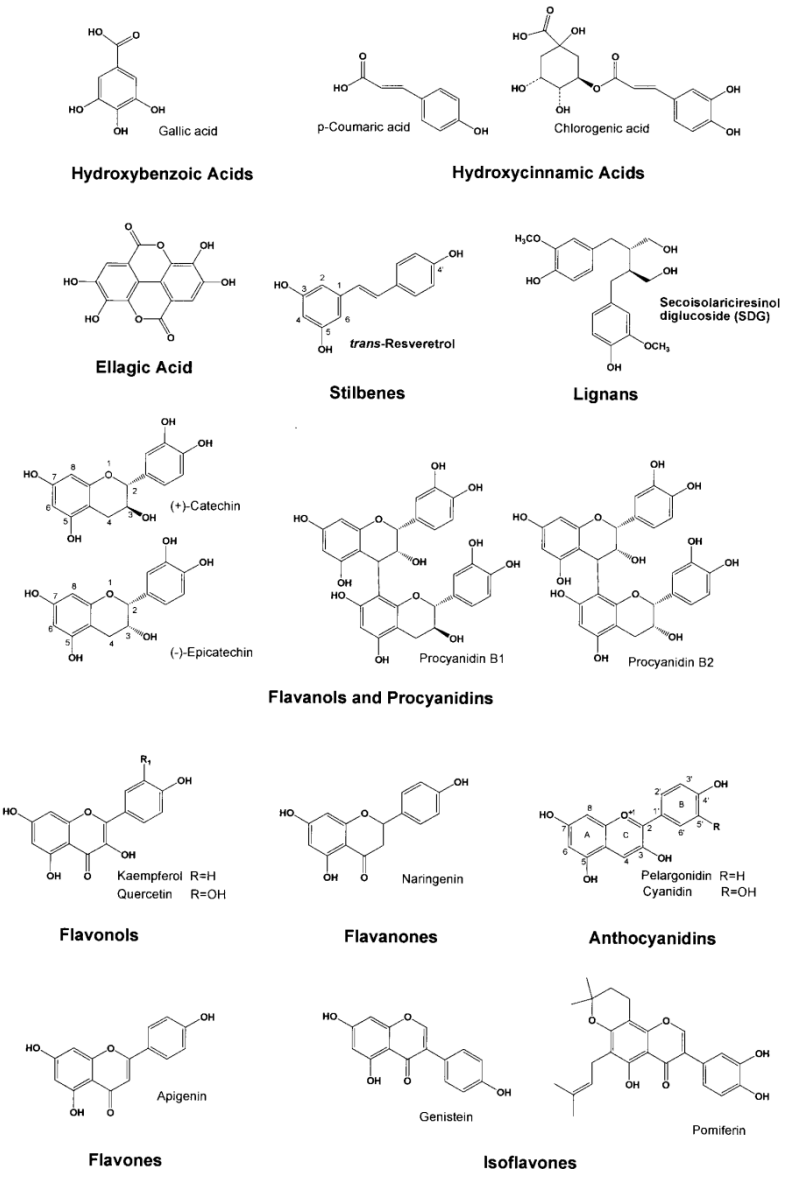

Fig. 1. Major polyphenol groups found in fruits and vegetable

3. Phytochemicals and their health benefits

The majority of the existing information about the advantages of phytochemicals has been derived from the observation of individuals who primarily consume diets consisting of plants. These individuals have shown notably reduced incidence of certain cancer kinds and cardiovascular diseases. The American Institute for Cancer Research recommends consuming a mostly plant-based diet. Currently, there is no definitive proof that any one phytochemical can guarantee a reduction in cancer risk or eradicate cancer. However, there is intriguing research suggesting that phytochemicals may have the ability to:

- Enhance the functionality of the immune system
- Safeguard cellular structures and genetic material against harm that might potentially result in the development of cancer.
- Alleviate or decrease inflammation
- Inhibit the proliferation of some cancer cells
- Assist in the regulation of hormones (Internet 1).

Phytochemical	Foods	Potential benefit
Carotenoids (beta carotene, lycopene)	Cooked tomatoes, orange squash, carrots, sweet potatoes and green plants, such as broccoli	May inhibit cancer cell growth, reduce risk of cardiovascular disease and boost immunity
Flavonoids	Berries, apples, citrus fruits, soybeans, coffee, tea, walnuts, whole grains	May fight inflammation, decrease damage to DNA and reduce tumor growth
Anthocyanins	Berries	May help lower blood pressure
Isothiocyanates (sulforaphane)	Cruciferous vegetables, such as broccoli, cauliflower and kale	May protect against cancer and cardiovascular disease
Lutein and zeaxanthin	Dark, leafy greens, such as spinach and chard	May promote eye health

Table 1. The following chart displays many instances of distinct phytochemicals and their possible advantages, as well as the corresponding meals in which they may be found.

3.1 Antioxidant properties

An antioxidant is a stable molecule capable of donating an electron to a highly reactive free radical, so neutralizing it and lowering its ability to cause harm. The primary mechanism by which these antioxidants function is by their ability to scavenge free radicals, therefore delaying or preventing cellular damage. These antioxidants with a low molecular weight may effectively and safely interact with free radicals, preventing the chain reaction from causing harm to important components. Several antioxidants, such as glutathione, ubiquinol, and uric acid, are naturally synthesized in the body as part of regular metabolic processes. Additional, less potent antioxidants may be found in the food. The body has several enzyme systems that eliminate free radicals, but the primary micronutrient antioxidants are vitamin E (α-tocopherol), vitamin C (ascorbic acid), and B-carotene. The body lacks the ability to produce certain micronutrients, hence they must be obtained via dietary means (Lobo et al., 2010).

3.2 Anti-inflammatory effects

Inflammation is the first physiological reaction of the immune system to infection, damage, or irritation. The evidence indicates that the anti-inflammatory action is achieved by controlling the activity of several inflammatory cytokines, including nitric oxide, interleukins, tumor necrosis factor alpha-α, interferon gamma-γ, and a noncytokine mediator called prostaglandin E2. Fruits, vegetables, and dietary legumes are rich in phytochemicals that have potent anti-inflammatory properties, but their precise mechanisms of action remain incompletely understood. The production of distinct cytokines in response to particular physiological events might provide insight into the unique benefits of each source of phytochemicals in combating the inflammatory response. Phytochemicals found in fruits, vegetables, and dietary legumes have the ability to regulate the expression of proinflammatory genes. These phytochemicals may be used to create new bioactive formulations for anti-inflammatory nutraceuticals and medications. Ultimately, these phytochemicals are examined as a natural approach to enhance human health. Fruits and vegetables exhibited superior anti-inflammatory properties compared to other chemicals due to the presence of phenolics and triterpenoids. Lectins and peptides in dietary legumes shown anti-inflammatory properties in the majority of instances. However, there is a scarcity of human research evidence about the anti-inflammatory properties of phytochemicals derived from fruits, vegetables, and dietary legumes (Zhu et al., 2018).

4. Conclusion

To summarize, this brief review presents compelling information that strongly supports the notable health advantages of phytochemicals, which are often present in fruits and vegetables. These plant-based foods include a wide variety of bioactive chemicals, such as polyphenols, flavonoids, and carotenoids, which all contribute to their high nutritional value. As shown in several studies, these phytochemicals have a wide range of health-enhancing capabilities, including antioxidant, anti-inflammatory, and even anticancer activities.

Extensive data suggests that including a wide variety of fruits and vegetables into our diet may successfully protect against chronic diseases. Phytochemicals include potent antioxidants that play a critical role in fighting oxidative stress, which is a significant factor in causing numerous health problems. Furthermore, their anti-inflammatory characteristics may have a pivotal impact on enhancing general well-being and perhaps diminishing the likelihood of acquiring inflammatory conditions.

It is essential to acknowledge the complex relationship between phytochemicals and the human body. The absorption and degradation of these molecules are influenced by both genetic and environmental variables, which contribute to the complexity of their potential effects on health. Despite the useful insights gained from earlier studies, more comprehensive study is necessary to elucidate the underlying processes and establish definitive cause-and-effect correlations.

Based on the existing research, it is evident that promoting the consumption of a diverse range of fruits and vegetables is a pragmatic and efficient approach to enhance health and mitigate the risk of illnesses. Emphasizing the importance of diets rich in phytochemicals is essential for public health campaigns and personalized nutrition strategies. As our understanding of phytochemicals and their effects on health continues to grow, it is clear that these natural compounds, present in fruits and vegetables, have significant potential as crucial components of a holistic approach to general well-being.ss

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