Acta Scientific MEDICAL SCIENCES (ISSN: 2582-0931)

Volume 8 Issue 5 May 2024

Short Communication

Medicinal Properties of Plant Polyphenolic Compounds

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DOI: 10.31080/ASMS.2024.08.1813

Received: April 15, 2024

Published: April 30, 2024

Abstract

The key role of reactive oxygen species and other oxidants in the development of various diseases is well known. Long-term experience with antioxidant therapy has shown its effectiveness in the treatment of many pathological processes, which was confirmed by studying the parameters of cellular and tissue metabolism. At this time, introducing synthetic compounds with antioxidant properties in medical practice is often unsuccessful due to their instability, manifestation of side effects, or inability to be absorbed by the body. The biological activity of exogenous compounds with antioxidant properties is manifested through the direct inactivation of free radicals and/or the restoration of the activity of other endogenous antioxidants. In both cases, these mechanisms lead to the suspension of the free radicals' oxidation processes.

Great interest in medicinal plants is due to their long-term use in folk medicine for both curative and prophylactic purposes (especially in developing countries). They can improve signals transmition between cells and influence gene expression. It is established that plant origin compounds are completely harmless to the metabolism of normal cells. The differential effects of phytochaemical compounds on normal and diseased cells are due to their high redox sensitivity, their ability to regulate oxidative metabolism, and affect the activity of detoxification systems

In recent years' natural antioxidant compounds (propolis extract, citrus hesperidin, tea polyphenolic compounds, red grape extract, etc.) have been used for neutralization of free radical oxidation processes involved in the pathogenesis of various acute and chronic diseases (such as diabetes, atherosclerosis, aging, immunosuppression, and neurodegeneration).

In given review the origin, structure, positive effects and medical application of plant origin polyphenols are discussed.

Keywords: Polyphenols; Antioxidant Properties; Detoxication; Medical Application

Introduction

The key role of reactive oxygen species and other oxidants in the development of various diseases is well known. The human body has an antioxidant protection system that provides stabilization or inactivation of free oxygen radicals [22] and provides antimutagenic, anticarcinogenic protection, regulates aging processes [10,11]. During various nosology, against the background of oxidative stress, a "deficiency" of natural enzymatic and non-enzymatic antioxidant systems is recorded, requiring exogenous non-enzymatic antioxidants. The possibility of using antioxidant compounds to prevent and treat various diseases and maintain human health attracted scientists' attention [14].

Long-term experience with antioxidant therapy has shown its effectiveness in the treatment of many pathological processes, which was confirmed by studying the parameters of cellular and tissue

metabolism. The positive role of antioxidant therapy for the correction and prevention of lipid peroxidation processes during the chronic inflammatory process has been shown. A sharp decrease in the concentration of immunoglobulins, circulating immune complexes, lysozyme, complement activity, blast-transformed forms of lymphocytes, and other parameters of homeostasis were revealed against the background of antioxidant therapy.

At this time, introducing synthetic compounds with antioxidant properties in medical practice is often unsuccessful due to their instability, manifestation of side effects, or inability to be absorbed by the body. The biological activity of exogenous compounds with antioxidant properties is manifested through the direct inactivation of free radicals and/or the restoration of the activity of other endogenous antioxidants. In both cases, these mechanisms lead to the suspension of the free radicals' oxidation processes.

Since ancient times, herbal medicines have been used for the treatment of various diseases [*22*]. Despite the great advances in modern medicine in recent decades, plant-origin remedies still make an important contribution to health care. Great interest in medicinal plants is due to their long-term use in folk medicine for both curative and prophylactic purposes (especially in developing countries). In recent years natural antioxidant compounds (propolis extract, citrus hesperidin, tea polyphenolic compounds, red grape extract, etc.) have been used to neutralize free radical oxidation processes involved in the pathogenesis of various acute and chronic diseases (such as diabetes, atherosclerosis, aging, immunosuppression, and neurodegeneration, radiation disease) [1,12,13,15,19,20,25]. Although the toxic activity of many medicinal plants is often not studied and evaluated in detail, it is generally accepted that drugs with antioxidant properties derived from plant products are safer than their synthetic counterparts [3,23].

It is known that a wide range of phytochemicals is synthesized in plants, including representatives of polyphenols which can transmit signals between cells and influence gene expression [9,17,28,29]. At the same time, it is established that these compounds are completely harmless to the metabolism of normal cells. The differential effects of phytochemical compounds on normal and diseased cells are due to their high redox sensitivity, their ability to regulate oxidative metabolism, and affect the activity of detoxification systems [18,24,33].

In recent years, polyphenols have attracted the attention of both researchers in the field of physiology and medicine, as well as manufacturers of functional and specialized food products for dietary (therapeutic and preventive) nutrition, which is connected with the accumulation of data on the positive biological effects of these substances. This is one of the most numerous and widespread groups of substances in the plant world. To this group belong compounds having hydroxyl groups in aromatic rings.

Natural polyphenols are widely distributed in the plant world and are defined as organic chemical substances characterized by the presence of one or more phenolic units. Polyphenols are usually divided into several classes according to their basic chemical structures: phenolic acids, stilbenes, ligands, and flavonoids.

Phenolic acids are found in plant tissues, most often in a form associated with saccharides or other polyphenols. In the human body, they are formed as a result of microbial breakdown in the colon or during intracellular metabolism of more condensed molecules [16]. Depending on the structure of the molecules, they are divided into 2 main groups: derivatives of hydroxycinnamic and hydroxybenzoic acids. The greatest interest of researchers is attracted by gallic, ellagic, and caffeic acid and its derivatives - chlorogenic, neochlorogenic, rosmarinic acids, etc. Stilbenes are represented by cis- and trans-isomers, capable of mutual transition. The trans- form exhibits greater biological activity. The most common derivatives in plants are hydroxylated (resveratrol) and methoxylated (pterostilbene). They are found in significant quantities in grapes, blueberries, and nuts [27].

Flavonoids are the most diverse group. Flavonoids represent the most important family of plant antioxidant compounds. About 6,000 flavonoid molecules have been identified so far. These compounds, secondary metabolites of plants, participate in metabolic processes important for life (growth-proliferation, protection from ultraviolet radiation, etc.), and are involved in the regulation of flower pollination processes due to the sharp coloring of anthocyanin pigments. Depending on the structural changes in the rings (degree of hydrogenation, hydroxylation, oxidation), flavonoids are divided into several families: flavonols, flavones, flavanones, catechins, leukoanthocyanidins, anthocyanins, etc. The most common and studied representatives of flavonols are quercetin and kaemp-

ferol. They are containing in vegetables, fruits, and grain crops [32]. A typical representative of flavanols is dihydroquercetin. Chon is contained in large quantities in the wood of the Siberian larch *Larix sibirica* L. and some other coniferous plants [4], which serves as raw material for its production. Among the catechins, epi-catechin, epigallocatechin, and epigallocatechin gallate (EGCG), represented by several stereoisomers, are more common. They are, as a rule, not glycosylated, and can polymerize and esterify, forming tannins. Catechins are found in large quantities in tea, especially green tea, as well as in some fruits [27,32].

Scheme of polyphenolic compounds

The chemical properties of polyphenols are difficult to characterize because they depend on the number of phenolic rings in the molecule and the number of hydroxyl groups in the aromatic rings [30]. In addition to the chemical structure, the bioavailability and bioactivity of phenols contained in food products depend on the plant harvest, processing methods, storage conditions of the processed products, the interaction of phenolic compounds with other compounds in the extract, and also on the environment. - on the physiological state of the patient (on factors such as gender, age, or state of health) [6].

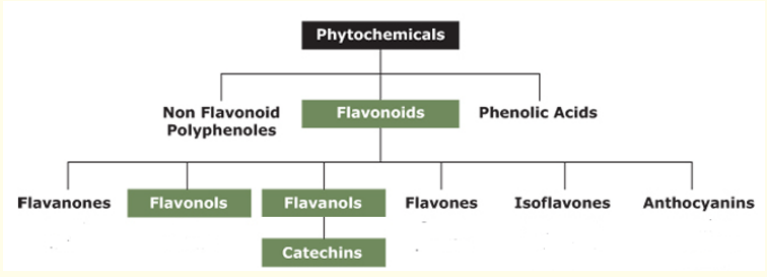

Figure 1

The nutritional habits of each nation were formed over the centuries not only as a complex of food products with different tastes (organoleptic properties), but also characterized by useful properties, and the ability to influence and prevent many pathological conditions.

Humans get polyphenols daily from green vegetables, onions, fruits (apples, grapes, strawberries, etc.), soybeans, beans (isoflavonoids), and other foods and beverages (coffee, tea, beer, and red wine) in the form of Consumption of polyphenols varies in different countries [6]. Average human consumption of flavonoids ranges from 3 to 68 mg/day, with an average of 23 mg/day [27]. About 28% of polyphenol intake comes from fruits (mainly apples and strawberries) and vegetables (e.g. potatoes, green onions). According to some authors, the daily consumption of polyphenols varies significantly in different countries and in some countries it is much higher, in particular, it is between 150 and 1000 mg/day [26]. For example, in France, the total consumption of polyphenols is relatively high and amounts to 300 mg per day [3].

Eating habits have changed dramatically over the last century, and these changes are considered one of the etiological factors of the development of obesity, cardiovascular diseases, atherosclerosis, and other diseases. Therefore, it is appropriate to investigate the active substances of traditional food plants to use their prophylactic and possibly therapeutic effects. Natural antioxidant compounds are also widely used in pharmaceutical and cosmetic production because they are characterized by versatile and pronounced activity and a huge range of effects [4,8].

Since fruits, vegetables, tea, coffee, and red wine are rich in polyphenols, these products are the object of intense scientific research.

Research's are focused on the identification of compounds with novel effective pharmacological properties and the study of their molecular mechanisms of action. Studies conducted on plant extracts reveal the therapeutic efficacy of their antioxidant compounds, such as phenols, flavonoids, tannins, and proanthocyanidins.

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