

Flavonoids: The Miracle Molecules of Nature

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Abstract

The current article describes the possible and potential areas of research with respect to flavonoids which are one of the most efficacious naturally occurring compounds which can be explored as a pharmaceutical and cosmeceutical. Flavonoids are phytoconstituents having multiple phenolic groups which have the basic skeleton of diphenylpropane (C6-C3-C6) in which a heterocyclic pyran ring is connected to two aromatic rings. According to their chemical structure flavonoids are categorised into different types such as flavones, isoflavones, flavonols, flavanones, flavanonols, flavanols or catechins, anthocyanins and chalcones. Diverse sources of flavonoids exist in nature widening the scope and opportunities in the area of research and development for the pharmaceutical industry. Flavonoids have a wide spectrum of pharmacological activities ranging from antioxidant, anticancer, cardioprotective, immunomodulator, neuroprotective, anti-inflammatory, antidiabetic, antiviral and so on. Flavonoids are one of the most potent antioxidants due to their ability to reduce the activity of reactive oxygen species making them the potential candidates for the treatment of a wide range of disorders linked to enhance oxidative stress in the body. Due to their anti-inflammatory, antioxidant and soothing effects they are currently the target for cosmeceutical industry as well. These facts point towards the immense opportunities and potential of flavonoids in the area of drug discovery and development.

Keywords: Flavonoids; Phytoconstituents; Pharmaceutical; Cosmeceutical

Introduction

Nature has always bestowed upon us various resources for the welfare of mankind. In this sense, medicinal herbs have been in use since antiquity for preventing and combating the occurrence of wide range of ailments. The therapeutic potential of plants is attributed to the presence of numerous phytochemicals which are synthesized as an outcome of the different metabolic pathways occurring in them. In this regard, flavonoids are a diverse group of secondary metabolites found in plants which are currently being explored for their possible therapeutic efficacy and can be the potential candidates for drug design. Flavonoids are secondary metabolites bearing polyphenolic groups and have the backbone of diphenylpropane (C6-C3-C6) having two aromatic rings connected

by a heterocyclic pyran ring [1]. Depending upon their chemical structure, there are several classes of flavonoids such as flavones, isoflavones, flavonols, flavanones, flavanonols, flavanols or catechins, anthocyanins and chalcones. The sources of flavonoids are innumerable in nature ranging from medicinal herbs such as *Bauhinia variegata*, *Aesculus indica*, *Polygonatum verticillatum*, *Camellia fangchengensis*, *Scutellaria baicalensis*, *Asplenium nidus*, *Marrubium vulgare* and so on [2]. Additionally, they are known to occur in different food sources as leeks, broccoli, blueberries, citrus fruits, tomatoes, soya, apricots, green tea, peaches, aubergines, onions and the list is countless [3]. It is evident that nature is a vast reservoir of these potent bioactive metabolites. With research in the field of natural products on the rise with advanced

techniques of extraction, isolation, purification, characterization and pharmacological studies, more natural sources are becoming explored with the evidence of the presence of flavonoids in them.

Flavonoids possess both pharmaceutical and cosmeceutical potential and are therefore, currently the most explored phytochemicals when it comes to drug discovery and product development. The nutraceutical market also revolves around harnessing the potential therapeutic and health benefits of the same. Several studies have shown the pharmaceutical benefits of flavonoids such as antioxidant, anticancer, antibacterial, antifungal, cardioprotective, immunomodulator, anti-inflammatory, neuroprotective, photoprotective, antidiabetic, antimalarial, antiviral and so on [4].

Flavonoids are one of the most potential antioxidants known as they help to decrease the activity of reactive oxygen species. Different reactive oxygen species are formed in the body such as superoxide radical (O_2^-), hydroxyl radical ($HO\bullet$) and hydrogen peroxide (H_2O_2) which arise from mitochondrial oxidative phosphorylation or by their interactions with external agents like xenobiotics [5]. The antioxidant activity of flavonoids is exhibited in several ways such as the suppression of the function of nitric-oxide synthase, hindering with the activity of xanthine oxidase, interacting with various enzyme systems or interfering with various pathways leading to their formation [6]. In fact, the antioxidant nature of flavonoids makes them ideal therapeutic agents to combat the occurrence of other diseases as most of the diseases are associated with the occurrence of oxidative stress and formation of reactive oxygen species such as atherosclerosis, Alzheimer's disease, Parkinson's disease, cancer, amyotrophic lateral sclerosis, ocular disease, multiple sclerosis, diabetes, depression, rheumatoid arthritis, memory loss and motor neuron disease [7].

Apart from pharmaceutical applications, flavonoids also possess immense cosmeceutical benefits and are currently finding enormous applicability in skincare products owing to their antioxidant and soothing action. They act as sunscreen by absorbing the UVB radiations and thus acting as a skin protectant. Various cosmetic skincare preparations of natural sources containing flavonoids have been shown to hinder the inflammation of skin induced by UV rays, decrease the production of reactive oxygen species (ROS) and prevent damage to DNA. Studies have shown their ability to ameliorate erythema induced by UV radiations,

enhanced microcirculation, betterment of skin structure by treating the different signs of skin damage like roughness, scaling and wrinkles [8]. Flavonoids have been reported to protect against telangiectasias and petechias arising from damaged blood vessels. They have a role in strengthening the walls of blood vessels thereby offering protection, forestalling the aggregation of platelets and reduction in the capillary permeability [9].

Conclusion

It is quite evident that with shifting trends in natural product research, the focus is more on the exploration of biologically active entities from natural sources. Due to their multidimensional benefits on the human body, flavonoids are currently one of the most targeted phytoconstituents for drug discovery and development. With continued research in the field of natural products, it is expected that more such potentially bioactive compounds will pave the way for the advancement of pharmaceutical, nutraceutical and cosmeceutical industry which will hopefully have a positive impact on the health of the common mass.

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