



## Bioactive phytochemicals: A promising treatment for cancer

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### **Abstract**

Cancer is a significant public health concern both in industrialized and developing countries. In spite of the wide variety of treatments available, cancer is often uncomfortable due to its side effects and ineffective due to resistance to traditional anti-cancer medications or radiation therapy. Natural substances have been found to be effective against cancer in recent years. Chemicals derived from plants are especially appealing because they are bioavailable, safe, usually without side effects, and, most importantly, are inexpensive. Plant metabolites called flavonoids come from polyphenolic chemicals found in nature and have intriguing biological properties. As well as being abundant in our diets, such as green leaves, fruits, red wine, and tea vegetables due to their non-toxicity and broad range of benefits in biological activities, flavonoids have been extensively studied for their health benefits. In addition to having anti-cancerous properties at the beginning of the cancer, flavonoids can also act as a preventative measure as the disease progresses. An overview of flavonoids' potential role in cancer prevention, as well as their therapeutic application to the prevention of cancer, is presented in this review.

Keywords: flavonoids, phytochemicals, anti-cancer medications, therapeutic role, cancer, polyphenols

### **INTRODUCTION**

Medicinal plants have gained vast attention because of their commercial application in the medicine, treatment of disease, flowering, cosmetics, and colouring. All over the world, herbs are considered to be a reliable key resource of drugs that are safe, less toxic, and economical and provide health benefits over macronutrients and micronutrients. Since antiquity, nature has bestowed upon us a variety of herbs and plants, many of which are used as traditional medicines to relieve illness and are widely used today around the world. Health problems can still be treated with herbal treatment. They can provide people with more health benefits than macronutrients and micronutrients[1]. The development of cancer occurs in three phases: initiation, promotion, and progression. The diseases continue to be one of the leading causes of death around the world. There are many factors that can cause cancer, including oxidative stress, unhealthy eating habits, lifestyle disorders, radiation, stress, genetic mutations, and pollution.[2]. Herbs are safe, less toxic, economical, and are a reliable source of medicine in all parts of the world. Color, aroma, and flavor are all due to these substances. Plants are protected from diseases and damage by them. Phytochemicals derived from plants which that showed the beneficial effect to the anxiety, enhance eye health, protect from the pollution, and from the various electromagnetic waves. They have been proven to protect human health in recent years when their nutritional intake is significant. Plant tissues often contain concentrated amounts of phytochemicals, as well as pigment molecules. Different levels of these compounds are found in different plants depending on the variety, processing, cooking, and growing conditions. There is evidence that phytochemical supplements provide similar health benefits to dietary phytochemicals, but there is no convincing proof that they do so. Phytochemicals are also likely to have health benefits, including protection against degenerative disorders, cancers, cardiovascular disease, and neurological diseases. Phytochemicals are found most abundantly in culmination and vegetables. In combination or on their own, those phytochemicals have excellent healing capacities in treating a wide range of ailments. The phytochemicals in food have considerable value because of their therapeutic properties on health, as they provide protection against severe illness and health conditions such as cancer, heart disease, diabetes, hypertension, inflammation, microbial infections, parasitic infections, psychotic conditions, spasms, ulcers, etc. National Cancer Institute has prioritized the opportunities for most cancers prevention as a priority to the public through a superb focus on lifestyle, eating habits, prevention, and managing care. There were four major categories of nutraceuticals reviewed: vitamins and minerals, phytochemicals, and other supplements. Several nutrients, such as A, B6, B12, D, E, and folate, can assist in the fight against cancer, suppress the immune system, and prevent most cancers in susceptible populations. Research suggests that eating plenty of fruits, vegetables, and whole grains may help prevent oxidative damage and chronic illness.



[3]. Chemopreventive medications are necessary, including natural or synthetic compounds or their combinations, for halting, retarding, or reversing cancer's progression. By using drugs to limit tumor growth, cancer chemoprevention decreases cancer incidence. In addition to lifestyle and nutritional factors, nutrition plays a major role in cancer development and progression [4]. Increased fruit and vegetable consumption has been linked to a lower risk of cancer. Phytochemicals are a category of molecules produced by plants that help them thrive and protect them from predators. Using phytochemicals as anticancer medications, particularly polyphenols, is currently a promising approach because it reduces or eliminates the side effects of more aggressive standard therapy. In addition, our bodies build resistance to a variety of standard cancer treatments. Flavonoids are secondary phenolic chemicals found in the fruits, vegetables, grains, barks, roots, stems, and flowers of medicinal plants. These natural compounds, such as fruits and vegetables, are abundant in the human diet and have been shown to have a wide range of pharmacological activities and biological effects, including anticancer, anti-inflammatory, antioxidant, antimutagenic, antifungal, antiallergic, and antiviral properties. [5], [6]. The fact that polyphenols can be extracted using easy, environmentally friendly methods like ultrasound-assisted extraction and that polyphenols retain the majority of their properties following sterilisation will make research into polyphenols as potential anticancer treatments easier. Based on their chemical structure, flavonoids are categorised as flavonols, flavones, flavanones, flavan-3-ols, isoflavones, chalcones, and anthocyanidins [7]. Flavonoids help to prevent cancer by influencing a number of important cancer formation and metastasis pathways. Flavonoids have the ability to suppress tumour growth through regulating signalling molecules such as VEGF, MMPs, ILs, HIF, and others. [7]. In recent years, flavonoids and their synthetic counterparts have been widely researched for the treatment of ovarian, breast, cervical, pancreatic, and prostate cancer.

#### **PHYTOCHEMICALS: THEIR BIOLOGICAL EFFECTS**

Furthermore, phytochemicals may moreover have beneficial effects on health, protecting from persistent degenerative conditions including cancer, cardiovascular and neurological issues. Phytochemicals are found in great abundance in fruits and vegetables. When taken individually or in combination, each of these phytochemicals has excellent healing properties for severe ailments.

Aspects of phytochemicals identified in food that have nutraceutical homes are of huge significance because of their positive impact in the treatment of various cancer as they offer strength in variety of problem or ailment, together with various types of cancer, oral health, wound healing and also act as anti – microbial compounds. By focusing in particular on lifestyles, eating habits, prevention and comfort care, the National Cancer Institute has explained the possibility in maximum tumor growth inhibition as an essential element of public health. Vitamins, minerals, and phytochemicals were ranked as the top nutraceuticals.

Several vitamins were recommended as anticancer, immune-protective, and reducing the maximum cancers risk in the population susceptible to maximum cancers and individuals who self-medicate. Tocopherols, carotenes, phenols, steroids and polyphenols are all powerful antioxidants, capable of scavenging free radicals.

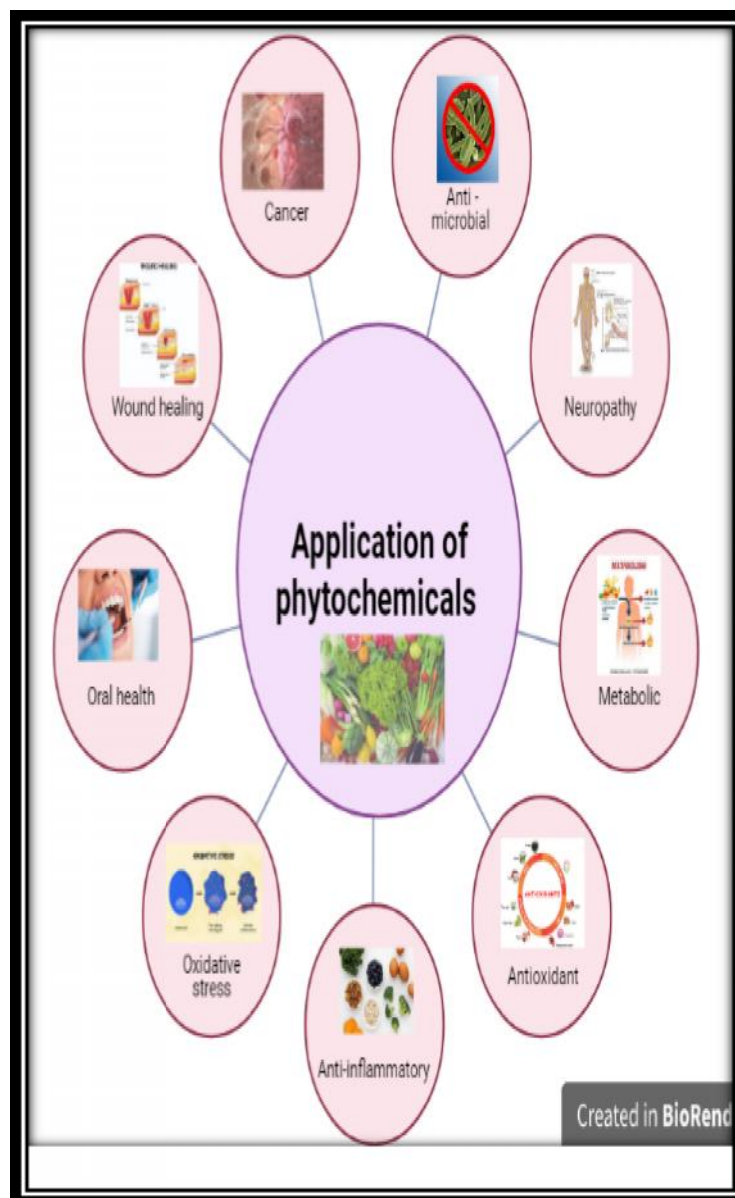


FIG - Application of phytochemicals in various fields

### A REVIEW OF THE PHARMACEUTICAL, ANTICANCER, AND PHYSIOLOGICAL PROPERTIES OF PLANT FLAVONOIDS–

Several studies have demonstrated flavonoids' potential to inhibition of cancer cells. Because flavonoids have a range of anti-cancer pathways, they have a significant anti-cancer effect.

Anti-cancer activity of flavonoids –



Flavonoids, by targeting the apoptotic signalling cascade, may trigger cell death pathways. Flavonoids and their subgroups have the ability to activate and propagate a variety of signalling pathways, including protein kinase C (PKC), tyrosine kinase, EGRF signalling pathway, Topoisomerase inhibition, and T- and B-cell population increase. [8]. Flavonoids act as potent aromatase inhibitors in breast cancer.

Anti-inflammatory activity of flavonoids –

The protective mechanism of the body is the result of the inflammation and results in tumor formation, angiogenesis pathways, proliferation, and metastasis. Quercetin, hesperidin, apigenin, and luteolin are the subclasses of flavonoids that have an anti-inflammatory effect. Flavonoids can modulate

flavonoids in anti-angiogenesis –

New blood cells are formed during this process, which is regulated by both angiostatic and endogenous factors. When this process is disrupted, the tumor can grow uncontrollably and metastasize. Flavonoids have the ability to prevent angiogenesis. These inhibitors can prevent nourishment and oxygen from reaching quickly proliferating cancerous cells, resulting in cell death, due to their anti-angiogenic properties. These inhibitors can cause endothelial cells to proliferate, create lumens, and migrate. [9].

Flavonoids in the apoptosis and cell cycle arrest –

By acting as a transactivator or transrepressor, p53 plays an important role in apoptosis and DNA repair. Flavonoids can block any step of the NF-B signalling cascade, including dimer DNA binding. Flavonoids have been found to decrease activator protein-1 (AP-1) activation and influence the expression of AP-1 target genes.[10].

### **FLAVONOIDS AS THERAPEUTIC AGENTS TARGETING DIFFERENT TYPES OF CANCER**

According to epidemiological studies, communities with high isoflavone intake from soy diet have decreased risks of breast, prostate, and colon cancer. Genistein is an isoflavone polyphenol found in soy protein that acts as a powerful cancer chemopreventive[11]. In several investigations, luteolin has been demonstrated to have antiproliferative properties, inhibiting cancer cell proliferation through cell cycle arrest and death. Luteolin may also block the proteasome-mediated process. Quercetin is a cancer-prevention drug that works by inhibiting protein kinases. When pterostilbene and quercetin were combined, cell proliferation, growth, and Bcl-2 expression all decreased..[4].

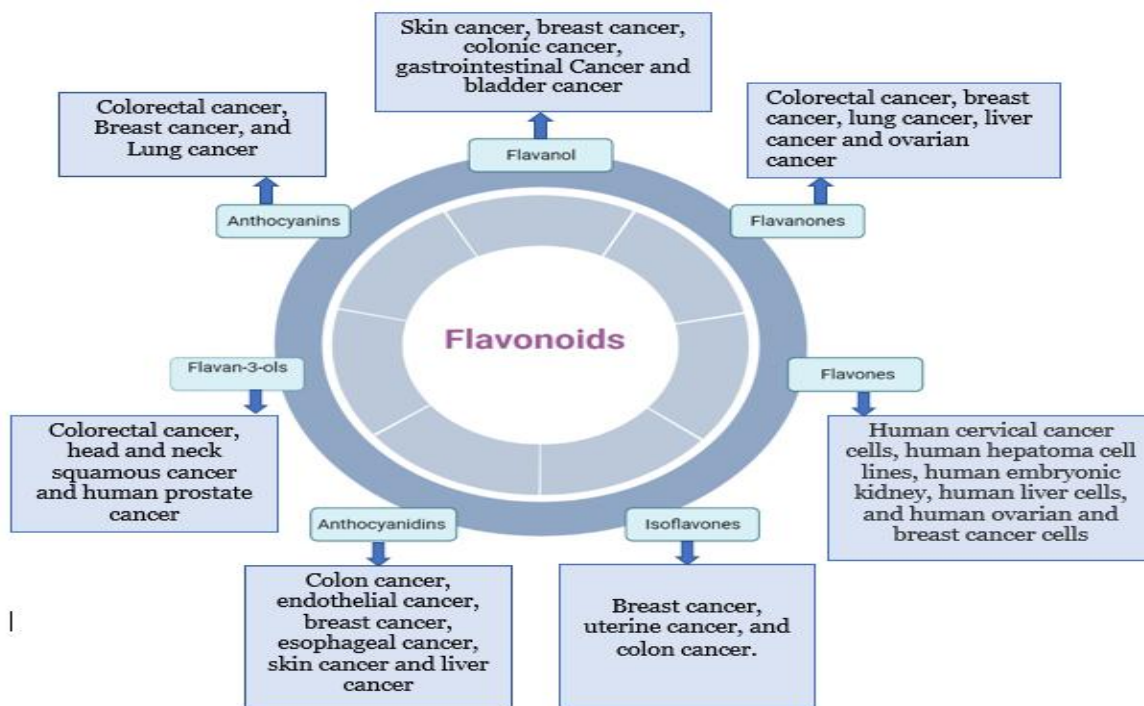


FIG 1 - Classification of flavonoids in various subgroups and their cancer types.

## CONCLUSION

The potential anticancer properties of diverse types of natural chemicals, such as flavonoids, flavones, anthocyanins, and isoflavonoids, were highlighted in this review. It is a powerful secondary metabolite that plays a significant function in cancer cell inhibition. It has a wide spectrum of anti-cancer properties.

Flavonoids aid cancer chemoprevention by modulating a variety of essential cancer development and metastasis pathways. Flavonoids have the ability to regulate signalling molecules like VEGF, MMPs, ILs, HIF, and others, allowing them to control tumour growth.

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