
# Beneficial Effects of Pistachio Pericarps on Some Disorders

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## 1. Introduction

Pistachios are considered among the most important tree nuts worldwide. The *pistacia* genus is from the Anacardiaceae family that contains approximately 70 genera and over 600 species. The *P. vera* is the only commercial species, with Iran and the USA being the main pistachio producing countries today [1]. Pistachio skins are rich in all phenolic groups, including catechins, cyanidin-3-O-galactoside, gallic acid, eriodictyol-7-O-glucoside, epicatechin, and unidentified compounds [2]. Quercetin, the most frequently studied flavonoid, has been shown to have anti-cancer properties in in vivo and in vitro experiments [3]. Many studies have reported beneficial effects of dietary kaempferol on reducing the risk of chronic diseases, especially cancer [4]. Epidemiological studies have shown an inverse relationship between kaempferol intake and cancer development. Epicatechin is a novel anticancer drug [5]. Interestingly, anthocyanins are only found in pistachio pericarps with excellent antioxidant properties [6]. Thus, pistachio pericarps are considered as an herbal remedy for the treatment of multiple diseases. The present study aims to examine beneficial effects of pistachio pericarps on some disorders, such as cancer.

### Effects of pistachio pericarps on some disorders

Cancer is a malignant neoplasm that occurs as a result of the growth and proliferation of uncontrolled cells. These cells may be replicated and distributed by circulatory and lymphatic systems to other parts of the body [7]. The prevalence of cancer in the world, including Iran, is on the rise. In addition, it is known as the second category of non-transmissible diseases as well as the third leading cause of human mortality [8]. Nowadays, due to the complications of chemotherapy, medicinal plants have been considered by researchers for the treatment of cancer [9].

Data from epidemiological and interventional studies indicate that the frequency of the hydro-alcoholic extract of pericarps is related to their anti-cancer effects. Harandi *et al* (2018) reported that the hydro-alcoholic extract of *P. vera* pericarps had anti-cancer and cytotoxicity effects on HepG2. In fact, the pistachio pericarp extract has the potential for apoptosis induction and cytotoxic activity against HepG2 cells. The

results of gene expression showed that expressions of P53 and Bax in HepG2 cells were upregulated at the IC50 concentration, but the expression of the Bcl2 gene was downregulated at this concentration [10]. Another study investigated anti-proliferative effects of pistachio pericarps on the PC-3 prostate cancer cells. The results of this research indicated that the extract significantly reduced cell viability in cancerous cells in a dose- and time-dependent manner [11]. Moreover, cytotoxic effects of hexane, ethyl acetate, methanol, and the pistachio pericarp extract on human colon cancer (HT-29 and HCT-116), breast adenocarcinoma (MCF-7), lung adenocarcinoma (H23), liver hepatocellular carcinoma (HepG2), cervical cancer (Ca Ski), and normal fibroblast (BJ-5ta) cells were assessed using an MTT cell viability assay. The ethyl acetate extract of pistachio pericarps demonstrated a suppressive effect on MCF-7, HT-29, and HCT-116. Besides, the expression of bax increased, yet the expression of bcl-2 decreased in treated MCF-7 cells [12].

Few studies have examined anticancer effects of pistachios. Pistachio hulls are used in traditional medicine to heal stomach pain, prevent diarrhea, and improve hemorrhoids [13]. Besides, secondary metabolites are found in pistachio hulls with various nutritional properties, including antioxidant, antimicrobial, enzyme inhibitory, and anti-cancer. These properties probably result from their key role in decreasing oxidative stress in organisms [14]. Biological, medicinal, and therapeutic effects of pistachio pericarps and seeds are associated with their radical scavenging and antioxidant activities [15].

Bulló *et al* (2015) investigated anti-inflammatory properties of polyphenol extracts from natural raw shelled pistachios. To determine the amount of protection provided by natural raw shelled pistachios against lipopolysaccharide (LPS)-induced inflammation, the monocyte/macrophage cell line J774 was utilized. The results showed that, at lower doses, polyphenols present in pistachios possessed anti-inflammatory properties [16]. Similarly, the hydro-alcoholic extract of ripe pistachio hulls was shown to have effects on the learning and memory of diabetic male rats. Epidemiological research shows that phenolic flavonoids, as antioxidants in pistachio red peels, lead to improved memory performance in older rats [17]. Pistachio red peels have a parenchymal and fibrous structure. Besides, they consist of minerals, such as potassium, magnesium, calcium, and sodium. Flavonoids are important compounds in pistachios, which improve cholinergic activity, learning, and memory. It has been proven that acetylcholine receptor stimulation improves memory and cognition. In addition, it seems that the extract of ripe pistachio hulls improves memory through potentiation of the cholinergic system [18].

## 2. Conclusion

Past research has proved anti-bacterial, anti-cancer, and anti-angiogenesis effects of some components of pistachios (*P. vera L.*), such as hulls, leaves, seeds, essential oil, and gum. Anti-carcinogenesis effects of pistachios could be due to the presence of a great number of biologically-active components, including phenolic and antioxidant compounds. Besides, anthocyanin, causing skin color in pistachios and fruits, only exists in pistachio skins. Meanwhile, more than

400,000 tons of pistachio skins are annually obtained after peeling the pistachio crop in Iran. These pistachio skins are discarded as a waste product or used after processing to increase proteins and reduce phenolic and tannin compounds in animal feed. Interestingly, pistachio skins have a low economic value, with their disposal causing environmental pollution. The results of the present study showed that the pistachio kernel could be effective in inhibiting cancer due to its phenolic compounds with high antioxidant properties. Despite the presence of various antioxidants in plasma, the immune system itself is not able to eliminate free radicals in the body; therefore, it needs to receive antioxidants from external sources supplied through foods. It is noteworthy that natural antioxidants with less toxicity and greater effectiveness are considered urgent necessities. Today, many nutritionists recommend consumption of nuts, such as pistachios, to provide necessary antioxidants for the body. This is because the consumption of plant antioxidants usually causes fewer side effects and provides better treatment. Furthermore, due to the high production of pistachio skins in Iran and the existence of abundant valuable antioxidant compounds, they can be used as a cost-effective and accessible source for preparing effective herbal medicines used in the treatment of cancer.

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