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POMEGRANATE: A MYRIAD OF SUPER BIOACTIVE COMPOUNDS FOR HEALTH BENEFITS

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ABSTRACT

Pomegranate is known as a rich source of nutraceuticals due to the presence of high levels of phytochemicals in its fruit parts, viz., peel, arils, and juice. The major phytochemicals present in the peel of pomegranate are phenolics, flavonoids, ellagitannins, and anthocyanins. The high concentration of tannins and anthocyanins in its fruit increases its demand for production due to its medicinal value. Several reports demonstrate that pomegranate exhibits higher antioxidant properties compared to grapes, cranberries, blueberries, grapefruit, and orange juice. Numerous studies have investigated the presence of antioxidants, anti-carcinogens, and anti-inflammatory agents in pomegranate, which have been proven beneficial in controlling various human diseases such as cancer, heart disease, arthritis, and diabetes.

KEYWORDS: Bioactive compounds, fruit, medicinal properties, pomegranate

BIOACTIVE COMPOUNDS IN POMEGRANATE FRUIT

Pomegranate fruits contain both edible and non-edible parts. The edible portion consists of a high proportion of arils and a lower proportion of seeds. Arils mainly contain water, sugar, organic acids, and are rich in anthocyanins, the main flavonoids. Seeds are rich in protein, minerals, vitamins, pectin, sugar, polyphenols, isoflavones, polyunsaturated fatty acids, and lipids. The non-edible part (peel) is found to be rich in polysaccharides, minerals, and phenols. Besides these compounds, the main component present in pomegranate fruit is ellagitannins, which are abundant in the pericarp, seeds, flowers, and bark. The antioxidant activity of pomegranate fruit juice is primarily attributed to the presence of punicalagin, a member of the ellagitannin family. Additionally, pomegranate juice is rich in flavonols, anthocyanins, and phenolic acids. The high concentration of antioxidants in the peel makes pomegranate a valuable bioactive compound.

The major edible part, the aril, contains water (85%), total sugars (10%), and 1.5% pectin, along with ascorbic acid, citric acid, malic acid, and bioactive compounds such as phenolics, flavonoids, and anthocyanins. The major anthocyanins present in the seed cover and fruit juice include delphinidin-3-glucoside, cyanidin-3-glucoside, delphinidin-3,5-diglucoside, cyanidin-3,5-glucoside, pelargonidin-3-glucoside, and pelargonidin-3,5-diglucoside.

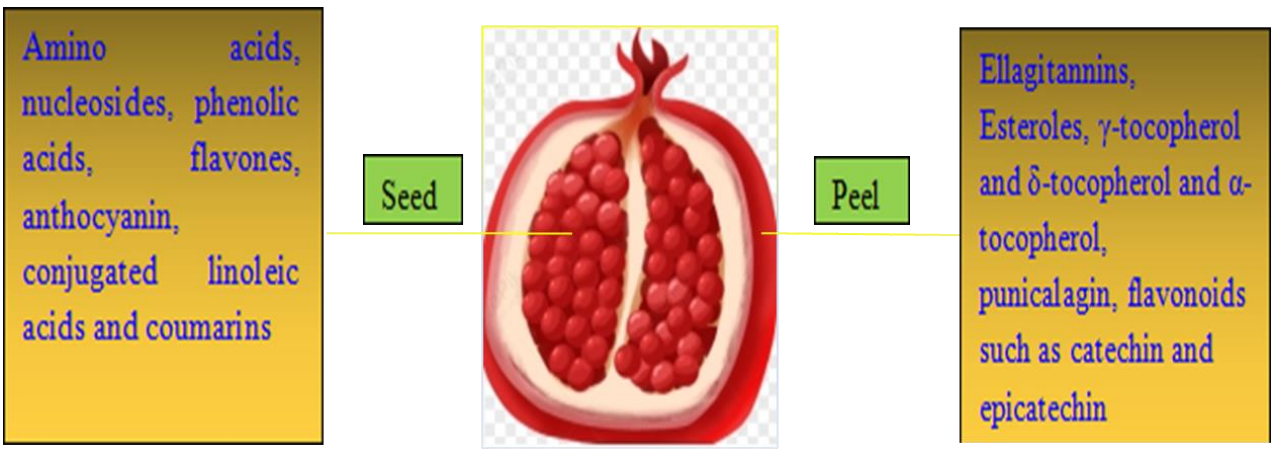

Fig 1. Bioactive compounds in pomegranate

The antioxidants present in fruits have been reported to interact specifically with free radicals, which are known to promote oxidative stress in the human body. Oxidation is a major issue that leads to significant nutrient loss in foods, reducing their organoleptic properties and visual appeal (Fernandez et al., 2007). The polyphenol and flavonoid activities of pomegranate provide health benefits by preventing inflammatory, cardiovascular, and other diseases (Noda et al., 2002; Miguel et al., 2004). Pomegranate fruits and their derivatives, such as oil, peel, and juice, contain higher levels of flavonoids, polyphenols, and anthocyanins, including cyanidin, pelargonidin, and delphinidin. Several studies have reported the antioxidant activity of pomegranate juice (Noda et al., 2002; Seeram et al., 2006b). Pomegranate fruit extract exhibits free radical scavenging activity against superoxide anions and hydroxyl radicals (Guo et al., 2007). Research also indicates that pomegranate peel has the highest antioxidant activity in methanolic extracts, as evaluated by FRAP, DPPH, and CUPRAC assays (Kulkarni et al., 2007; Zahin et al., 2010). The antioxidant activity of pomegranate and its parts offers benefits for disease prevention in both in vivo and in vitro studies. Consuming pomegranate juice may protect against ultraviolet-A&B-induced cell damage, inactivate pro-carcinogens through CYP (CYP1A2 and CYP3A) expression, and reduce hepatic oxidative stress (Faria et al., 2007a; Faria et al., 2007b; Pacheco et al., 2008; Sun et al., 2016).

MEDICINAL PROPERTIES OF POMEGRANATE

The therapeutic potential of pomegranate is increasing due to the abundance of antioxidants present in different plant parts. The most significant bioactive agent in pomegranate is ellagic acid, which contributes to its anticancer properties. Several preclinical and clinical trials have been conducted to determine the role of phytochemicals as anticancer agents. Numerous studies have proven that the intake of fresh fruits and vegetables has chemopreventive effects. These are rich sources of phytochemicals such as lycopene, isoflavonoids, and flavonoids, along with vitamins, minerals, and fiber.

Table 1. Therapeutic properties of different parts of pomegranate fruit

Source	Activity	Bioactive Compound	Target
Peel	Antiviral	Gallic acid (GA)	Hepatitis C Virus
Peel	Antiviral	Punicalagin	Influenza virus
Peel	Antiviral	Punicalagin and Punicalin	SARS-CoV-2 spike glycoprotein, ACE2
Peel	Antimicrobial	Punicalagin	Clostridia and Staphylococcus aureus
Peel	Antimicrobial	Punicalagin	Streptococcus mutans
Seed	Hypolipidemic	Punicic acid	Reduction of blood lipid levels
Seed	Anticarcinogenic	Linolenic acids	Colon adenocarcinomas
Juice	Anticarcinogenic	Ellagitannins and urolithin	Colon cancer cells
Peel	Antifungal	Punicalagin	T. mentagrophytes, T. rubrum
Peel	Antifungal	Tannin	Candida species

Extracts from pomegranate fruits, seeds, and peel have been shown to inhibit the growth of lung and prostate cancer cells without adverse effects on normal cells. The effects of different acids, viz., ellagic, caffeic, and punicic acid, have been tested for their individual and combined chemopreventive effects. Polyphenol extracts from pomegranate have been reported to inhibit secretory phospholipase expression in prostate cancer cells. Another study indicated that pomegranate juice can inhibit proliferation and induce apoptosis in both androgen-dependent and -independent prostate cancer cell lines without causing toxicity to epithelial cells. The inhibitory effect of pomegranate juice also downregulates the expression of androgen-synthesizing enzymes and androgen receptors. Additionally, pomegranate extract has been

reported to inhibit NF-KB signaling, a biochemical indicator for post-surgery tumor recurrence, in both in vitro and in vivo prostate cancer models.

Mechanisms involved in the anticancer activity of pomegranate were evaluated using MALDI-TOF spectrometry. Pomegranate fruit extract was found to be rich in phytochemicals, which upregulated key cell cycle regulators, such as CKi-cyclin cdk networks, during the G1 phase, leading to cell cycle arrest. This correlates with the downregulation of cyclins D1, D2, and E, as well as cyclin-dependent kinases. Ellagic acid and quercetin have also been reported as potential agents to control prostate cancer. Numerous reports highlight the health benefits of bioactive compounds isolated from different parts of pomegranate (Siddiqui et al., 2024).

CONCLUSION

The bioactive compounds found in different parts of pomegranate exhibit broad-spectrum potential in nutraceutical and healthcare industries. Modern and advanced analytical techniques could further enhance the extraction of these valuable bioactive compounds, expanding their applications in both sectors.

REFERENCES

Feng, Y. Lin, J. He, G. Liang, L. Liu, Q. Yan, J.Yao, Q. .2022. Compositions and biological activities of pomegranate peel polyphenols extracted by different solvents. *Molecules*. 27(15): 47-96

Siddiqui, A.S. Singh, S. Nayik, G.A. 2024. Bioactive compounds from pomegranate peels - Biological properties, structure–function relationships, health benefits and food applications – A comprehensive review. *Journal of functional food* 116:106132

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