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Unlocking the medicinal secrets of *P. granatum*: A pharmacognostic perspective

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Abstract
P. granatum (P. granatum), also referred to as pomegranate, has been revered for its diverse medicinal properties across various cultures for centuries. This study delves into the pharmacognostic aspects regarding *P. granatum*, aiming to unravel its intricate biochemical composition and therapeutic potential. Employing a multidisciplinary approach, we explore the plant's morphological characteristics, phytochemical profile, and pharmacological activities. The pharmacognostic analysis involves a comprehensive examination of the anatomical features of numerous plant parts, providing valuable insights into identifying and authenticating *P. granatum*. Furthermore, advanced analytical techniques are employed to elucidate the chemical constituents responsible for its pharmacological effects. The study encompasses the identification along with quantification of bioactive compounds, including polyphenols, flavonoids, and alkaloids, well known for the anti-inflammatory, antioxidant, & antimicrobial properties. The pharmacological perspective encompasses its applications in conventional medicine along with contemporary research findings, shedding light on its efficacy in the preventing & treating various diseases. This study not only adds to the existing knowledge about *P. granatum* but also emphasises its importance as a valuable reservoir of natural chemicals that could be used for therapeutic purposes.

Keywords: *P. granatum*, pomegranate, pharmacognostic aspects, flavonoids, antioxidant, antimicrobial property

Introduction
P. granatum (P. granatum), also defined as pomegranate, a fruit that holds great significance in the historical fabric of human society. This ancient fruit is highly regarded for its tantalizing flavour, vibrant colour and symbolic importance. Moreover, it has played a significant role in conventional medical practice throughout various cultures [1]. *P. granatum*, known for its culinary appeal, has also gained recognition for its possible therapeutic effects. This has led to a modern investigation into its medicinal properties from a pharmacognostic standpoint. Pharmacognosy, the study of the complex relationship regarding plants and their therapeutic capabilities, with the goal of understanding the biochemical makeup that gives them their healing abilities. *P. granatum* is an intriguing area for research due to its profound historical importance and the increasing amount of evidence supporting its many medical uses [2]. This study embarks to thoroughly explore the pharmacognostic properties having numerous components of *P. granatum*. Through careful examination of its morphological traits, our aim is to establish a strong basis for the accurate identification and categorization of this valuable botanical specimen [3]. At the same time, sophisticated analytical methods are used to analyse the complex chemical composition of *P. granatum*, revealing the specific components those are being responsible for its pharmacological effects [4-5]. The present research aims to enhance the scientific understanding of *P. granatum*, a complex plant, and emphasise its potential as a valuable source of new medicinal components in pharmacognostical field [6]. Through the integration of ancestral wisdom and contemporary scientific techniques, our aim is to connect the divide between folklore and evidence-based medicine. This will facilitate a greater understanding regarding the functionalization of *P. granatum* in enhancing human health and well-being [7-9].

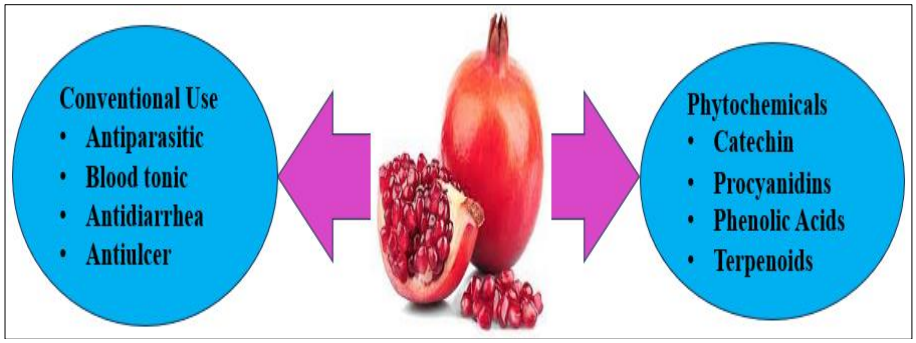


Fig 1: Pharmacognostical assessments of *P. granatum*

Fundamental Details

Botanical Statistics

Table 1: Taxonomical classification

Kingdom	Plantae
Phylum	Tracheophyta
Order	Myrtales
Class	Magnoliopsida
Family	Punicaceae
Subfamily	Punicoideae
Genus	*Punica*
Species	*Granatum*

Synonym

Punica florida, Punica grandiflora, Punica nana, Punica spinosa

Common Name

Pomegranate, Grenadier, Granada, Granado, Mangrano

Geographical Origin

P. granatum, a deciduous shrub that bears fruit and reaches a height of 5 to 10 meters. The plant is primeval to Afghanistan & Iran & deliberately grown in several regions worldwide, including China, India, Russia, Uzbekistan, Spain, Italy, Greece, Morocco, and America [10]. Their cultivation is extensive in the Caucasus region, West Asia, Central Asia, South Asia, northern & tropical Africa, the arid regions of Southeast Asia, & the Mediterranean Basin.

Table 2: Vernacular Names

Language	Name
Hindi	Anar
English	Pomegranate
Marathi	Dalimb
Russian	Granat
Sanskrit	Phalamla, Kuchaphala, Shukavallabha, Raktabeeja, Raktapushpa, Dantabeeja
Tamil	Matuli
Malyalam	Matalam

Morphology

The pomegranate plant, scientifically known as *P. granatum*, a visually appealing shrub that can either lose its leaves or remain green throughout the year [11-14]. It is classified under the family Punicaceae. The plant has the capacity to attain a height ranging from 6 to 10 metres and produces several branches covered in thorns. The plant's leaves are perennial, measuring 1-10 cm in length and having a short stalk [15-17]. They are arranged in clusters of 5-6 on the branches. The flowers exhibit a red hue, pointed sepals, and a profusion of stamens, measuring 3 cm in width. Each branch has a varying number of flowers ranging from two to seven at its periphery. Fruits having a hexagonal form and is 6-12 cm in width, with a weight of approximately 200 g [18]. Fruit is adorned having a dense tubular calyx. The fruit's exterior displays a crimson shade, possesses a firm texture, and is characterised by a leathery consistency. The sarcotesta, which is consumable, well known as a berry consisting of 600 arils, which are casings for seeds, enclosed by a thick skin [19]. The mature fruit acquires a red hue. Those arils are arranged in many clusters, with each cluster being divided by thin walls and containing white spongy tissue [20].

Tree form and size

Pomegranate is a compact, spherical small tree/shrub, that can reach a height of 20 to 30 ft., although it most commonly grows to a height of 12 to 16 ft. typically, this plant is deciduous, although in specific regions the leaves may stay on the tree. The trunk is adorned with a reddish-brown bark, eventually transitions into a grey hue [21]. The branches exhibit rigidity, sharp angles, and frequently possess thorns. There is a pronounced inclination to sprout from the base. Pomegranates exhibit a lengthy lifespan. The vitality of a pomegranate diminishes after around 15 years [22-25].

Leaves

The pomegranate plant possesses lustrous, tough leaves that are slender and fashioned like a lance [26].

Fruits

The fruit, which is almost spherical and measures 2-1/2 to 5 inches in width, is topped by a noticeable calyx at its base. The resilient and durable skin or outer layer is commonly yellow, with a covering of pale, deep pink, or vibrant red [27-30]. The fruit’s interior portion divided by thin, flexible partitions and contains white, porous, and unpleasant-tasting tissue. Those compartments are having densely filled with sacs that contain pleasantly acidic, juicy pulp. The colour of the pulp can range from red to pink to pale. Each sac contains a single seed, which can be angular and either soft or firm. Optimal temperatures are crucial during the fruiting phase to achieve the highest quality flavour. The pomegranate tree typically starts producing fruits after 1 year upon being planted, although it is more typical for it for taking 2-1/2 to 3 years. Under optimal circumstances, the fruit should reach maturity approximately 5 to 7 months following the blooming period [31].

Flowers

The pomegranate contains a diverse range of flavonoids, making up around 0.2%-1.0% of the fruits [32]. Around 30% of all anthocyanidins present in the peel of *P. granatum*. The isoflavones genistein, diadzein, genistin, and diadzin, along with estrone, which is the metabolic product of estradiol, have been extracted from seeds. Pomegranate plant's roots & stems include alkaloids such as, pseudopelletierine, & N-methylisopelletierine, isopelletierine [33]. Additionally, they contain anthocyanidins such pelargonidin, ellagotannins, along with ellagic acid & gallic acid [34-36].

Physiochemical properties

Table 3: Physicochemical properties of PPP

Component (%)	Pomegranate Peel Powder (PPP)
Moisture	10.32±0.41
Total Solids	89.68 ±0.52
Protein	5.57 ±0.18
Fat	4.66 ±0.34
Ash	3.32 ±0.22
Fiber	9.13 ±0.4
Carbohydrates	67.00 ±0.43
Total Soluble Solid (TSS)	0.9 ±0.06
pH values	3.74 ±0.11
Acidity values	4.75 ±0.15

Traditional use

Primitive Ayurvedic medicine in India conventionally used pomegranate to lower fever. In Greek medical care, the blossoms were employed in treating diabetes, while the bark & root were utilised to halt bleeding, alleviate dysentery, and promote the healing of ulcers [37]. It is crucial to acknowledge that although *P. granatum* has a significant historical background in traditional practices [38-41]. Pomegranate has historically been utilised in conventional medicine due to its potential therapeutic advantages [42]. Fruit is considered to possess antioxidant qualities and might aid in the mitigation of inflammation. Pomegranate is being utilised in certain cultures to address gastrointestinal problems and enhance general health and wellness [43-45]. Pomegranates are often associated with fertility, abundance, and fortune in some cultural customs [46]. Pomegranate peel containing tannins allows it to be utilised for the purposes of leather tanning and fabric dyeing. Pomegranate has been utilised for ages in certain cultures like a coventional source of natural dye [47]. The fruit is reputed to possess skin-rejuvenating effects and is employed for the formulation of cosmetic masks, creams, and lotions. *P. granatum* has been employed in certain cultures as a therapeutic agent for diarrhoea and other gastrointestinal ailments [48]. Pomegranate may be suggested by traditional healers for its potential anti-parasitic qualities.

Phytochemistry

P. granatum plant contains numerous phytoconstituents, like polyphenols, tannins, flavonoids, alkaloids, sterols, & anthocyanins in its fruit, seeds, bark, and leaves.

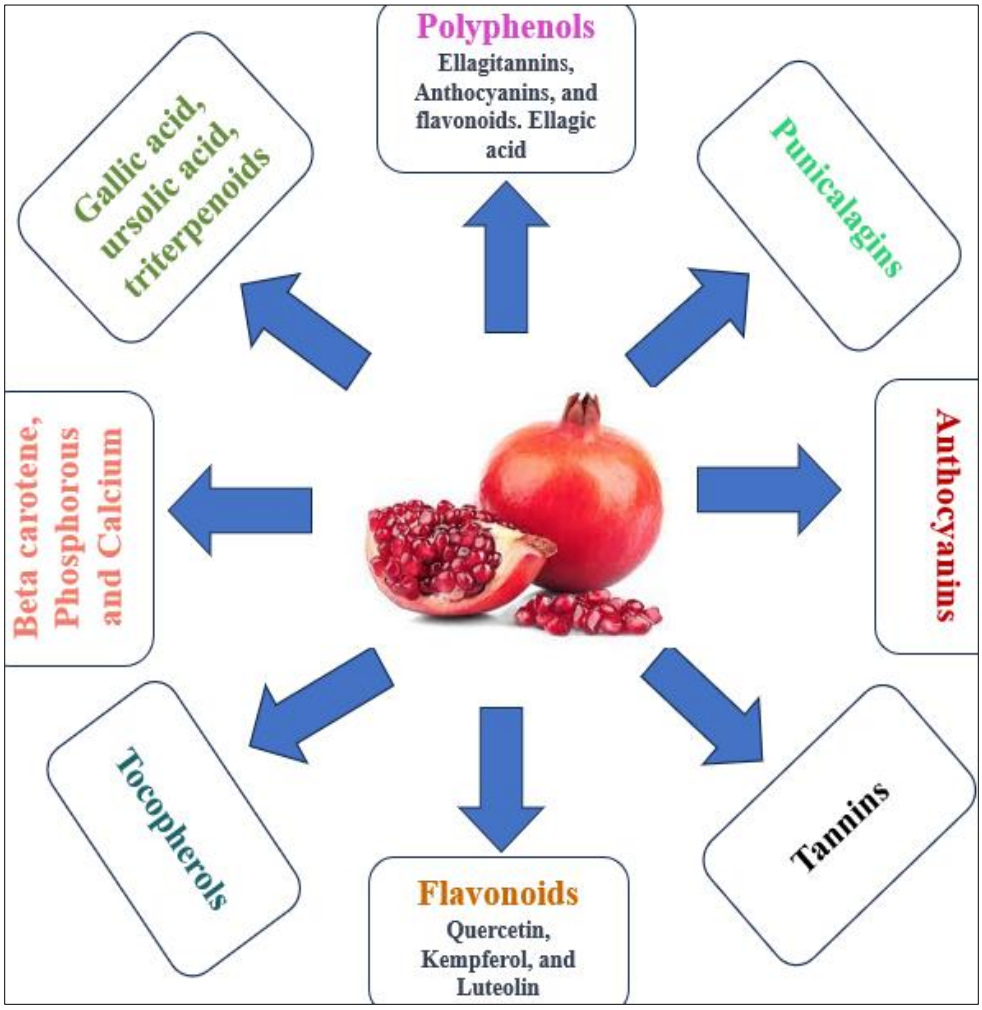
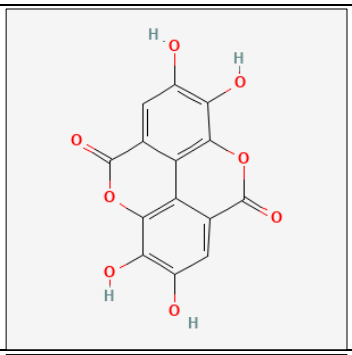
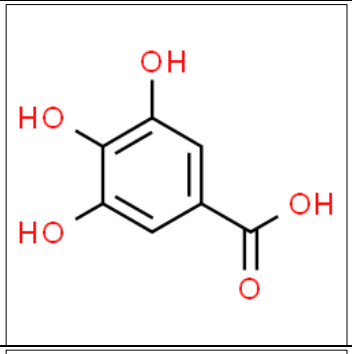
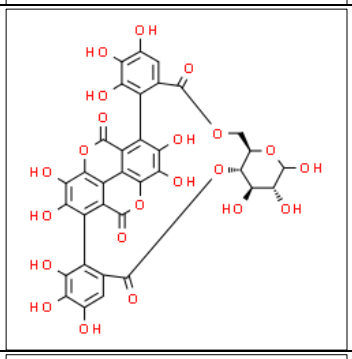
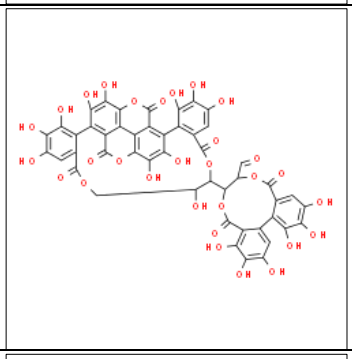
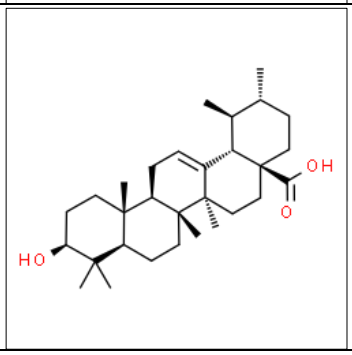
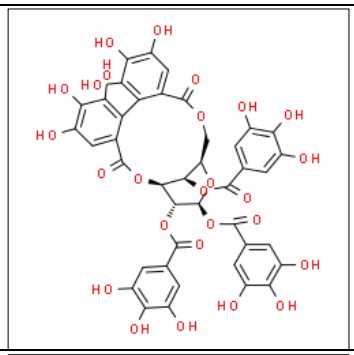
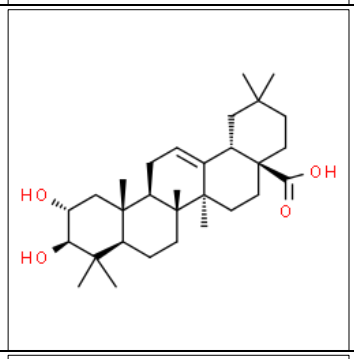
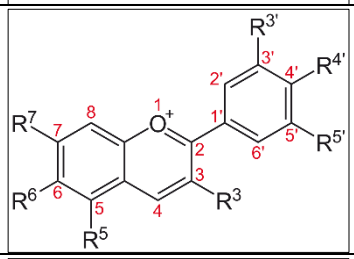
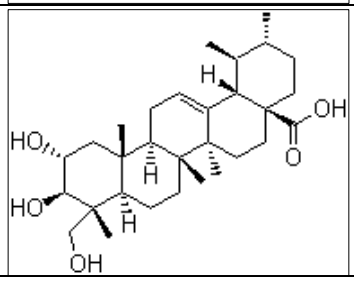


Fig 2: Interpreting Phytoconstituents in *P. granatum*

Table 4: Chemical structure of various constituents in *P. granatum* with Medicinal activity

Sl. No.	Constituents	Chemical Structure	Activity
1	Ellagic Acid		Anticancer
2	Gallic Acid		Antioxidant
3	Punicalin		Antioxidant Hepatoprotectant Antiinflammatory
4	Punicalagin		Antiviral Antioxidant Antimicrobial
5	Ursolic Acid		Antibacterial Anticancer Antidiabetic

6	Punicafolin		Antitumour
7	Maslinic Acid		Anti-diabetic
8	Anthocyanidins		Antioxidant, Neuroprotective, Anti-inflammatory, Anti-angiogenic, Anticancer, Anti-mutagenic, Cytoprotective, Cardiovascular protective, Anti-diabetic, Anti-ulcerogenic, Hepatoprotective, Antibacterial and Antifungal potentials.
9	Aciatic Acid		Neuroprotective

Plant Parts
It grows on woody plants that more closely resembles shrubs than trees. Matured plants are generally 6-12 ft in height & deciduous, having small sized oval leaves & are some extent throny.

Roots
Tannins: The roots contain tannins, those are the polyphenolic compounds with astringent properties [49]. Tannins have anti-inflammatory & antioxidant effects.

Stem
Ellagic Acid: *P. granatum*'s stem contains ellagic acid, a polyphenolic compound with antioxidant properties. It is known for its potential anticancer effects.

Leaves
Alkaloids: Pomegranate leaves may contain alkaloids, which are nitrogenous organic compounds. Alkaloids can have diverse physiological effects and are often associated with plant defence mechanisms [50].

Flowers
Flavonoids: Pomegranate flowers are having high extent of lavonoids, such as quercetin and kaempferol. Flavonoids have anti-inflammatory & antioxidant properties as well as contribute to the plant's color and flavor [51].

Fruits
Punicalagins: Pomegranate fruit is well known for containing punicalagins, powerful antioxidants that contribute to the pomegranate's health benefits. Punicalagins, those are the polyphenolic compounds with anti-inflammatory and cardiovascular protective properties.

Seeds
Punicic Acid: Pomegranate seeds are a rich origin of punicic acid, one type of conjugated linolenic acid [52]. This acid is well known for its potential anti-inflammatory and anti-cancer properties.

Peel
Anthocyanins: The peel of pomegranate, especially in the outer layer of the fruit, contains anthocyanins, which contribute to the red color. Anthocyanins have antioxidant and anti-inflammatory effects.

Bark
Polyphenols: *P. granatum*'s bark may contain polyphenolic compounds with antioxidant properties. These compounds

contribute to the overall health benefits associated with pomegranate.

Conclusion

To summarise, the research on *P. granatum*, also referred as pomegranate, from a pharmacognostic standpoint uncovers a wealth of medical knowledge hidden within its different plant components. The plant bearing each component, including the stem, roots, flowers, leaves, fruit, seeds, peel, and bark, contains distinct phytoconstituents that provide the plant having a wide range of therapeutical characteristics. The plant having a wide range of bioactive substances, including tannins in the roots, ellagic acid content in the stem, alkaloids in the leaves, and flavonoid content in the flowers. The fruit, containing punicalagins, and the seeds, including punicic acid, are significant sources of antioxidants that have the ability to minimize inflammation & fight against cancer. The study of pharmacognosy also encompasses the examination of the peel, which contains anthocyanins that provide its vivid colour as well as antioxidant properties. Polyphenolic contents present in *P. granatum*'s bark, contributes to its therapeutic potential.

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Conflict of Interest

The contributors assert that they have no personal or financial stakes in the subject under consideration.

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