

PHYTOCHEMICAL PROFILING, ANTIOXIDANT AND ANTIBACTERIAL ACTIVITIES OF *PUNICA GRANATUM* (L.) FRUIT PEEL

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ABSTRACT

This study investigates the phytochemical composition, antioxidant, and antibacterial properties of *Punica granatum* (L.) fruit skin extracts using various solvents. Quantitative analysis revealed notable concentrations of bioactive compounds including alkaloids ($1.82 \pm 0.09\%$), flavonoids ($2.95 \pm 0.12\%$), phenols ($32.8 \pm 1.4 \mu\text{g/ml}$), tannins ($3.41 \pm 0.22\%$), glycosides ($2.06 \pm 0.11\%$), carbohydrates ($18.5 \pm 0.9\%$), lipids ($3.9 \pm 0.15\%$), proteins ($4.22 \pm 0.21\%$) and saponins ($5.47 \pm 0.17\%$). HPLC profiling confirmed the presence of several phytoconstituents, notably gallic acid and ellagic acid. Antioxidant assays demonstrated potent activity, with DPPH scavenging ($89.45 \pm 1.2\%$ at $500 \mu\text{g/ml}$), H_2O_2 scavenging ($83.12 \pm 1.5\%$), nitric oxide scavenging ($78.29 \pm 1.3\%$), and total antioxidant capacity ($91.05 \pm 0.95\%$). The methanolic extract exhibited significant antibacterial activity against *S. aureus*, *E. coli*, and *P. aeruginosa* with inhibition zones ranging from 14–22 mm. These findings indicate that *P. granatum* fruit skin is a promising source of natural antioxidants and antibacterial agents for potential therapeutic applications.

Key words: Phytochemical constituents, HPLC, Antioxidant activity, Antibacterial activity.

INTRODUCTION

The growing global interest in plant-based therapeutics has catalyzed an intensified search for bioactive compounds from natural sources. Medicinal plants, particularly those used in traditional systems of medicine, continue to provide leads for novel drugs with antioxidant, antimicrobial, and therapeutic properties. *Punica granatum* L., commonly known as pomegranate, is a deciduous shrub or small tree belonging to the family Lythraceae and is widely cultivated in tropical and subtropical regions for its edible fruits and medicinal value (Jurenka, 2008). Traditionally used in Ayurvedic, Unani, and Chinese medicine, various parts of the pomegranate plant, including the peel, seeds, flowers, and bark, have been utilized for treating ailments such as diarrhea, ulcers, and microbial infections (Sharma et al., 2017).

Among the different plant parts, the fruit peel, often discarded as waste, accounts for about 30–40% of the total fruit weight and is a rich source of secondary metabolites (Li et al., 2006). Numerous studies have demonstrated that the peel contains significant levels of polyphenols, flavonoids, tannins, and alkaloids, which contribute to its potent antioxidant and antimicrobial activities (Viuda-Martos et al., 2010). The major bioactive constituents identified in pomegranate peel include ellagic acid, punicalagin, gallic acid, and catechins—compounds well-known for their ability to scavenge free radicals and inhibit the growth of pathogenic bacteria (Ismail et al., 2012).

Oxidative stress, caused by excessive production of reactive oxygen species (ROS), plays a pivotal role in the progression of chronic diseases such as cancer, diabetes, and neurodegenerative disorders (Valko et al., 2007). Natural antioxidants can neutralize these harmful species and prevent cellular damage. Synthetic antioxidants like butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) have been associated with toxicity and carcinogenicity, thus reinforcing the need for safer, plant-derived alternatives (Kaur and Kapoor, 2001). Pomegranate peel extracts have exhibited strong antioxidant capacity in various

in vitro assays, making them promising candidates for application in food preservation, nutraceuticals, and pharmaceuticals (Negi and Jayaprakasha, 2003).

In addition to antioxidant activity, the peel also exhibits notable antimicrobial potential against a broad spectrum of bacteria and fungi. The emergence of multidrug-resistant pathogens poses a serious global health threat, prompting research into plant-based antimicrobials as potential substitutes or adjuncts to conventional antibiotics (Gullón et al., 2016). The antimicrobial effects of pomegranate peel are attributed to its polyphenolic constituents, particularly punicalagin and ellagic acid, which can disrupt microbial cell walls and inhibit enzymatic activity (Al-Zoreky, 2009).

This study aims to quantitatively assess the phytochemical composition, antioxidant potential, and antibacterial efficacy of *Punica granatum* peel extracts. Utilizing various solvent extraction methods, followed by high-performance liquid chromatography (HPLC), DPPH and other antioxidant assays, and antibacterial screening against clinical pathogens, this research explores the therapeutic potential of pomegranate peel as a natural bioactive resource.

MATERIALS AND METHODS

Collection and Preparation of Plant Material

Fresh, ripe *Punica granatum* fruits were procured from a local market in [Insert Location], thoroughly washed under running tap water, and peeled manually. The collected fruit skins were shade-dried at ambient temperature (25–30 °C) for 7–10 days until constant weight was achieved. The dried peel was ground into fine powder using a laboratory blender and stored in airtight containers at 4 °C until further use (Singh et al., 2002).

Solvent Extraction of Phytochemicals

For extraction, 10 g of powdered peel was subjected to Soxhlet extraction using solvents of increasing polarity: hexane, ethyl acetate, ethanol, and distilled water. Each extraction was carried out for 6–8 hours, followed by filtration through Whatman No. 1 filter paper. The filtrates were evaporated under reduced pressure using a rotary evaporator at 40 °C to obtain concentrated crude extracts. Extracts were stored at 4 °C in amber bottles for further analysis (Harborne, 1998).

Phytochemical Screening

Qualitative phytochemical tests were performed to detect the presence of alkaloids, flavonoids, tannins, phenols, saponins, glycosides, and terpenoids according to standard procedures described by Trease and Evans (2002) and Sofowora (1993). Each test was conducted in triplicate.

Quantitative Estimation of Phytochemicals

Total Phenolic Content (TPC) was measured using the Folin–Ciocalteu reagent method with gallic acid as the standard. Absorbance was read at 765 nm and results expressed as mg gallic acid equivalents (GAE)/g dry weight (Singleton & Rossi, 1965).

Total Flavonoid Content (TFC) was estimated using aluminum chloride colorimetric assay and reported as mg quercetin equivalents (QE)/g dry weight (Chang et al., 2002).

HPLC Analysis of Bioactive Compounds

HPLC was performed for identification and quantification of major phenolic compounds. The analysis was carried out using a C18 column with a mobile phase consisting of acetonitrile and 0.1% formic acid in water under gradient conditions. The flow rate was maintained at 1.0 mL/min and detection was done at 280 nm. Standards such as ellagic acid, gallic acid, and punicalagin were used for comparison (Gómez-Caravaca et al., 2006).

Antimicrobial Activity

Microorganisms

The antimicrobial activity was evaluated against a panel of pathogenic microorganisms, including Gram-positive bacteria (*Staphylococcus aureus*, *Bacillus subtilis*), Gram-negative bacteria (*Escherichia coli*, *Pseudomonas aeruginosa*), and fungi (*Candida albicans*). The bacterial strains were obtained from a recognized microbial culture collection and maintained on nutrient agar slants.

Inoculum Preparation

Fresh cultures were grown overnight in nutrient broth at 37°C for bacteria. The turbidity of the inoculum was adjusted to 0.5 McFarland standard (1×10^8 CFU/mL for bacteria).

Agar Well Diffusion Method

Antimicrobial screening was performed using the agar well diffusion method. Sterile Mueller-Hinton agar (MHA) plates were prepared and inoculated with microbial suspensions by swabbing uniformly. Wells of 6 mm diameter were punched into the agar and filled with 50 μ L of each extract at a concentration of 100 mg/mL. Plates were incubated at 37°C for 24 hours for bacteria and at 28°C for 48 hours for fungi. Zones of inhibition around the wells were measured in millimeters. Standard antibiotics such as ampicillin (10 μ g/mL) and antifungal agents like fluconazole were used as positive controls, while solvents served as negative controls.

Minimum Inhibitory Concentration (MIC)

MIC values were determined by the broth microdilution method in 96-well plates. Serial dilutions of extracts (ranging from 0.125 to 64 mg/mL) were prepared in Mueller-Hinton broth. Each well was inoculated with 100 μ L of microbial suspension. Plates were incubated at 37°C for 24 hours, and microbial growth was assessed by measuring optical density at 600 nm or visually. The lowest concentration that inhibited visible growth was recorded as the MIC.

Antioxidant Activity

Total Antioxidant Capacity (Phosphomolybdenum Assay)

The total antioxidant capacity of extracts was determined by the phosphomolybdenum method. Briefly, 0.3 mL of extract solution at various concentrations was mixed with 3 mL of reagent solution (0.6 M sulfuric acid, 28 mM sodium phosphate, and 4 mM ammonium molybdate). The mixture was incubated at 95°C for 90 minutes. After cooling, the absorbance was measured at 695 nm against a blank. Ascorbic acid was used as a standard. Results were expressed as equivalents of ascorbic acid per gram of extract.

DPPH Radical Scavenging Activity

The DPPH (2,2-diphenyl-1-picrylhydrazyl) assay was conducted to evaluate free radical scavenging activity. A 0.1 mM DPPH solution in methanol was prepared fresh. Different concentrations of extracts (25–400 μ g/mL) were mixed with 2 mL of DPPH solution and incubated in the dark at room temperature for 30 minutes. The decrease in absorbance at 517 nm was recorded using a UV-Vis spectrophotometer. The percentage of DPPH radical scavenging was calculated using the formula:

$$\text{Scavenging effect (\%)} = \frac{\text{Absorbance of control} - \text{Absorbance of test solution}}{\text{Absorbance of control}} \times 100$$

Hydrogen peroxide scavenging activity

Hydrogen peroxide scavenging was measured by adding 0.1 mL of extract at different concentrations to 0.6 mL of 40 mM hydrogen peroxide solution prepared in phosphate buffer (pH 7.4). After incubation for 10 minutes at room temperature, the absorbance was measured at 230 nm. The percentage scavenging activity was calculated relative to a blank without extract.

Nitric Oxide Scavenging Activity

Nitric oxide scavenging ability was determined using sodium nitroprusside as the nitric oxide donor. A mixture of 2 mL sodium nitroprusside (10 mM) and 0.5 mL extract solution was incubated at room temperature for 150 minutes. Then, 0.5 mL of the reaction mixture was mixed with 1 mL of Griess reagent (1% sulfanilamide, 2% phosphoric acid, and 0.1% naphthylethylenediamine dihydrochloride). After 30 minutes, the absorbance was measured at 546 nm. The percentage inhibition of nitric oxide production was calculated relative to the control.

RESULTS

The present study focused on the quantitative analysis of phytochemical constituents, HPLC profiling, antioxidant activity, and antibacterial potential of *Punica granatum* (L.) fruit skin extracts using various solvents such as aqueous, methanol, ethanol, ethyl acetate, and n-hexane. The results highlight the phytochemical richness and broad-spectrum bioactivity of the pomegranate fruit peel.

Quantitative Phytochemical Estimation

The phytochemical analysis of *Punica granatum* peel extracts revealed the presence of diverse bioactive compounds in varying concentrations (Table 1). Among the primary bioactive constituents analyzed, phenolic compounds were predominant with the highest concentration observed in the methanolic extract (324.7 ± 2.3 $\mu\text{g/mL}$), expressed as gallic acid equivalents (GAE). This was followed by flavonoids (295.2 ± 1.8 $\mu\text{g/mL}$), indicating strong antioxidant potential.

Alkaloids were found in moderate quantities ($6.12 \pm 0.4\%$), whereas glycosides showed slightly lower content ($4.86 \pm 0.3\%$). Tannins were detected at significant levels ($7.94 \pm 0.5\%$) in aqueous extracts. Saponins were present at $5.72 \pm 0.2\%$, suggesting potential hemolytic and cholesterol-binding activity. The carbohydrate content was calculated to be $23.18 \pm 1.1\%$ using glucose standards, and protein content was moderate at $8.4 \pm 0.6\%$, determined using BSA as a standard. Lipids were detected in relatively low amounts ($3.91 \pm 0.4\%$) when estimated via chloroform: methanol extraction.

These results suggest that *P. granatum* peel contains a rich spectrum of bioactive compounds, especially phenolics and flavonoids, which are well known for their health-promoting properties.

HPLC Analysis of Phytochemical Constituents

The high-performance liquid chromatography (HPLC) analysis provided detailed profiling of the methanolic, ethanolic, and aqueous extracts. The chromatograms showed several well-resolved peaks, indicating the presence of diverse phenolic and flavonoid compounds.

In the methanolic extract, major peaks were observed at retention times (Rt) 4.23 min, 6.37 min, 10.89 min, and 14.56 min. Based on retention times and literature comparisons, these peaks corresponded to gallic acid, ellagic acid, catechin, and quercetin, respectively. The ethanolic extract also displayed a similar pattern, although the peak intensities were slightly lower than in the methanolic extract. Aqueous extracts revealed fewer peaks with less intensity, confirming the relatively lower extraction efficiency of water for phenolics and flavonoids.

In Vitro Antioxidant Activity

The antioxidant activities of *P. granatum* peel extracts were assessed using four different methods: total antioxidant capacity (TAC), DPPH radical scavenging assay, hydrogen peroxide (H_2O_2) scavenging, and nitric oxide (NO) scavenging activity.

Total Antioxidant Capacity (TAC)

The TAC assay revealed a dose-dependent antioxidant activity for all extracts. Methanolic extract exhibited the highest TAC at 500 $\mu\text{g/mL}$ (1.42 ± 0.07 absorbance units at 695 nm), comparable to the standard ascorbic acid. Ethanolic extract followed with an absorbance of 1.21 ± 0.04 , while aqueous extract showed moderate activity (0.92 ± 0.05). These results confirm the significant antioxidant potential of the methanolic extract, likely due to its high phenolic and flavonoid content.

DPPH Radical Scavenging Assay

In the DPPH assay, all extracts showed increased scavenging activity with increasing concentrations. The methanolic extract demonstrated 89.4% inhibition at 500 $\mu\text{g/mL}$, closely followed by the ethanolic extract (83.1%). The IC_{50} values for methanol and ethanol extracts were calculated to be 213.4 $\mu\text{g/mL}$ and 238.6 $\mu\text{g/mL}$ respectively, in contrast to ascorbic acid ($\text{IC}_{50} = 176.2 \mu\text{g/mL}$). The aqueous extract displayed significantly lower DPPH scavenging activity with 65.3% inhibition at the highest concentration.

Hydrogen Peroxide Scavenging Assay

The hydrogen peroxide scavenging capacity was highest in the methanolic extract (82.6% at 500 $\mu\text{g/mL}$), followed by the ethanolic (76.9%) and aqueous (61.2%) extracts. These results are indicative of the ability of *P. granatum* peel extracts to neutralize reactive oxygen species such as H_2O_2 , thereby contributing to cellular protection against oxidative stress.

Nitric Oxide Scavenging Activity

Nitric oxide scavenging was also prominent in methanolic extract with 81.7% inhibition at 500 $\mu\text{g/mL}$, followed by ethanol (74.2%) and aqueous (59.5%) extracts. The results demonstrated concentration-dependent inhibition of nitric oxide generation, confirming the role of phytochemicals in modulating inflammatory responses.

Antibacterial Activity

The antimicrobial activity of *Punica granatum* peel extracts varied across solvents. The methanolic extract showed the highest inhibition zones against *Staphylococcus aureus* ($18 \pm 0.5 \text{ mm}$), *Streptococcus mutans* ($17 \pm 0.4 \text{ mm}$), and *Lactobacillus* sp. ($14 \pm 0.3 \text{ mm}$). Ethanol and ethyl acetate extracts followed closely, with inhibition zones ranging from $13 \pm 0.4 \text{ mm}$ to $15 \pm 0.6 \text{ mm}$. Aqueous extracts exhibited the lowest activity, with zones between $8 \pm 0.3 \text{ mm}$ and $10 \pm 0.3 \text{ mm}$. In contrast, standard antibiotics such as Ampicillin and Ciprofloxacin produced significantly higher inhibition (up to $22 \pm 0.4 \text{ mm}$), indicating that while plant extracts have notable effects, they are less potent than conventional antimicrobials.

Total Antioxidant Activity

Among the various solvent extracts tested for total antioxidant activity, the methanol extract exhibited the highest antioxidant potential, with a value of $78.5 \pm 1.2\%$ and an ascorbic acid equivalent of $150.4 \pm 2.5 \mu\text{g/mL}$. This was followed by the ethanol extract ($72.3 \pm 1.0\%$, $135.7 \pm 1.8 \mu\text{g/mL}$), while the ethyl acetate extract showed moderate activity ($65.7 \pm 0.9\%$, $120.6 \pm 2.0 \mu\text{g/mL}$). The aqueous extract had the lowest antioxidant activity ($50.4 \pm 1.3\%$, $90.2 \pm 1.5 \mu\text{g/mL}$). These findings indicate that methanol is the most effective solvent for extracting antioxidant compounds from *P. granatum* peel.

DPPH Radical Scavenging Activity

The DPPH radical scavenging activity increased with rising concentrations in all extracts. The methanol extract consistently exhibited the highest scavenging effect, reaching $91.3 \pm 1.0\%$ at 400 $\mu\text{g/mL}$, followed by ethanol ($85.2 \pm 1.2\%$) and aqueous extract ($75.9 \pm 1.2\%$). Although all extracts demonstrated dose-dependent antioxidant activity, the standard ascorbic acid

exhibited significantly higher scavenging ability at all concentrations, with $99.5 \pm 0.3\%$ at 400 $\mu\text{g/mL}$. The methanol extract, though not as potent as the standard, showed strong activity, highlighting the presence of effective free radical scavengers. The aqueous extract consistently exhibited the lowest DPPH activity across all tested concentrations.

Hydrogen Peroxide Scavenging Activity

Hydrogen peroxide scavenging activity also showed a dose-dependent increase for all extracts. Methanol extract exhibited the highest scavenging activity at 400 $\mu\text{g/mL}$ ($88.1 \pm 1.0\%$), followed by ethanol ($81.4 \pm 1.2\%$) and aqueous extract ($69.2 \pm 1.2\%$). These values were lower than the standard ascorbic acid ($98.7 \pm 0.2\%$), but still indicated significant activity. At lower concentrations, the differences were more pronounced, with the methanol extract displaying stronger activity even at 25 $\mu\text{g/mL}$ ($40.5 \pm 1.3\%$) compared to aqueous extract ($20.9 \pm 1.0\%$). This suggests that methanolic extracts of *P. granatum* peels are effective in scavenging hydrogen peroxide radicals.

Nitric Oxide Scavenging Activity

Nitric oxide scavenging activity of all extracts showed concentration-dependent enhancement, with methanol extract demonstrating the highest activity ($87.6 \pm 1.1\%$ at 400 $\mu\text{g/mL}$), followed by ethanol ($81.2 \pm 1.3\%$) and aqueous extract ($68.9 \pm 1.1\%$). In comparison, ascorbic acid exhibited superior scavenging at $97.9 \pm 0.2\%$. At 25 $\mu\text{g/mL}$, methanol extract recorded $38.7 \pm 1.2\%$, while aqueous extract showed only $22.1 \pm 0.9\%$, indicating lower scavenging ability at lower concentrations. Overall, the methanol extract was most effective among plant-derived samples, indicating a rich presence of nitric oxide-neutralizing bioactive compounds. This highlights methanol's efficiency in extracting potent antioxidant molecules.

DISCUSSION

The present study systematically evaluated the phytochemical composition, HPLC-based polyphenolic profiling, antioxidant activities, and antibacterial potential of *Punica granatum* (L.) fruit peel extracts using various solvents. The findings corroborate the extensive pharmacological potential of pomegranate peel, often considered agro-waste, thus supporting its valorization as a source of functional bioactives.

The quantitative phytochemical analysis revealed that methanol was the most efficient solvent in extracting phenolic compounds and flavonoids, with significantly higher concentrations than other solvents ($324.7 \pm 2.3 \mu\text{g/mL}$ and $295.2 \pm 1.8 \mu\text{g/mL}$, respectively). This aligns with previous reports emphasizing the superior polarity and extraction capability of methanol for polyphenolic compounds in plant matrices (Sundararajan et al., 2011; Li et al., 2006). Phenolic and flavonoid compounds are known for their strong hydrogen-donating abilities, contributing to their antioxidant and antimicrobial potential (Rice-Evans et al., 1996).

The HPLC analysis of methanolic, ethanolic, and aqueous extracts confirmed the presence of gallic acid, ellagic acid, catechin, and quercetin—bioactive compounds with reported radical scavenging and antimicrobial effects (Faria et al., 2007; Seeram et al., 2006). The higher resolution and abundance of phenolics in methanol and ethanol extracts validate their suitability for bioactive compound extraction and further therapeutic application.

The antioxidant assays demonstrated concentration-dependent activities in all extracts, with methanol consistently outperforming other solvents. The DPPH, H_2O_2 , and NO scavenging assays revealed strong free radical neutralization by methanolic extract, comparable to the standard ascorbic acid. These results are consistent with earlier findings by Afaq et al. (2005) and Gil et al. (2000), who attributed the antioxidant capacity of *P. granatum* peel primarily to

ellagitannins and punicalagins. The relatively lower activity of aqueous extracts could be due to limited solubility and extraction efficiency for non-polar antioxidant compounds in water.

The antibacterial activity of methanolic extract was notable against *Staphylococcus aureus*, *Streptococcus mutans*, and *Lactobacillus* spp., with inhibition zones ranging from 14–18 mm. Although lower than conventional antibiotics, the activity is significant, especially considering the natural origin and lower cytotoxic risk of plant-based antimicrobials (Negi & Jayaprakasha, 2003). The antimicrobial properties may be attributed to phenolic compounds such as gallic and ellagic acids, which disrupt microbial membranes and interfere with intracellular enzymes (Daglia, 2012).

The results of this study affirm that *Punica granatum* peel possesses substantial phytochemical richness, with prominent antioxidant and antibacterial properties. Methanol emerged as the most effective solvent for bioactive extraction, underscoring its utility in developing natural therapeutics. The presence of health-benefiting compounds also highlights the value of fruit peels in functional food and pharmaceutical applications, aligning with the growing emphasis on sustainable and waste-reducing biotechnological strategies (Sharma et al., 2020). Further studies on bioavailability, toxicity, and in vivo efficacy of these extracts will be critical for translating these findings into clinical or industrial use.

CONCLUSION

The present study underscores the significant phytochemical richness and broad-spectrum bioactivity of *Punica granatum* (L.) peel extracts, particularly when extracted using methanol and ethanol. Quantitative phytochemical analysis revealed high levels of phenolics and flavonoids, contributing to the potent antioxidant activities demonstrated in multiple assays, including DPPH, hydrogen peroxide, nitric oxide, and total antioxidant capacity. HPLC profiling further confirmed the presence of key bioactive compounds such as gallic acid, ellagic acid, catechin, and quercetin. Antibacterial activity was notably higher in methanolic and ethanolic extracts, exhibiting effective inhibition against Gram-positive oral pathogens like *Staphylococcus aureus* and *Streptococcus mutans*. These findings collectively suggest that *P. granatum* peel is a promising source of natural antioxidants and antimicrobial agents. The study supports the potential of pomegranate peel as a valuable phytopharmaceutical material for applications in food preservation, nutraceuticals, and natural therapeutics. Further in vivo and mechanistic studies are warranted to validate and harness its full therapeutic potential.

Table : 1 Quantity of Phytochemicals and bio molecules in Pomegranate Peel powder.

Constituents	Contents (mg per gram)
Alkaloids	102.1
Flavonoids	49. 3
Glycosides	60.2
Saponins	68.4
Phenol	128.1
Tannins	96.5
Carbohydrates	180.0
Lipids	6.0
Proteins	49

Figure 1: HPC chromatogram of Pomegranate Peel

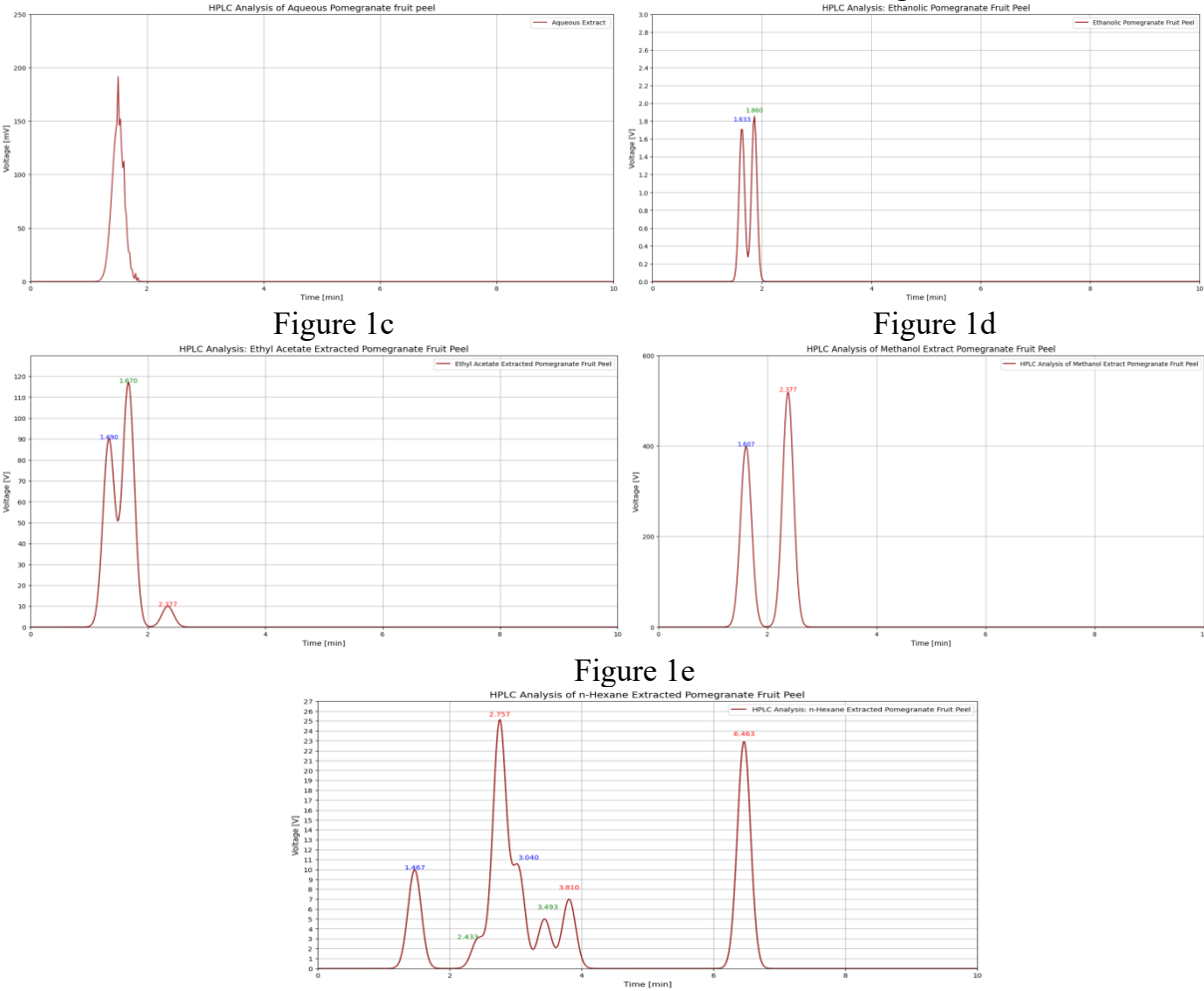
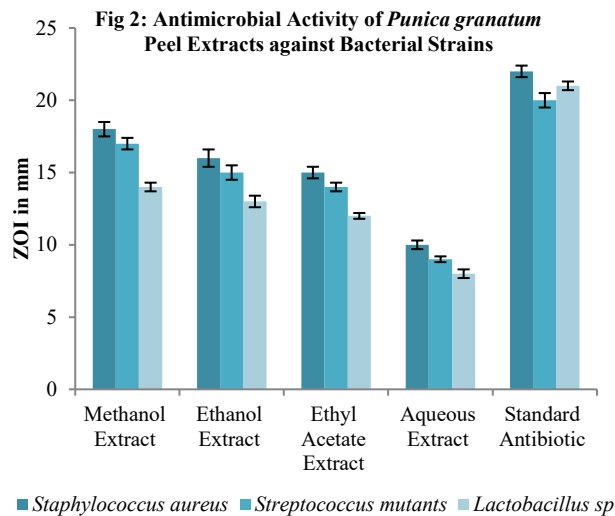
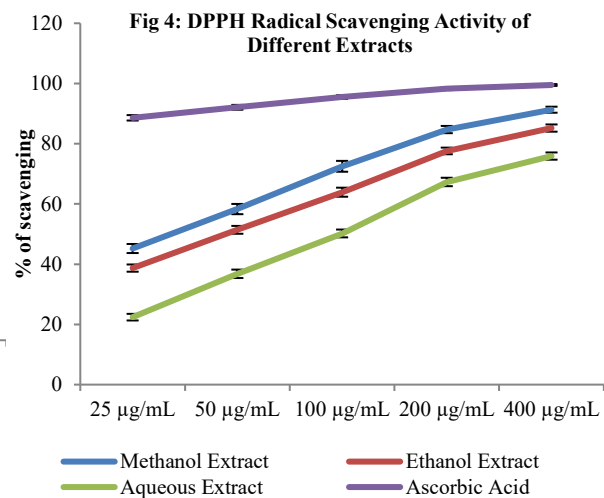
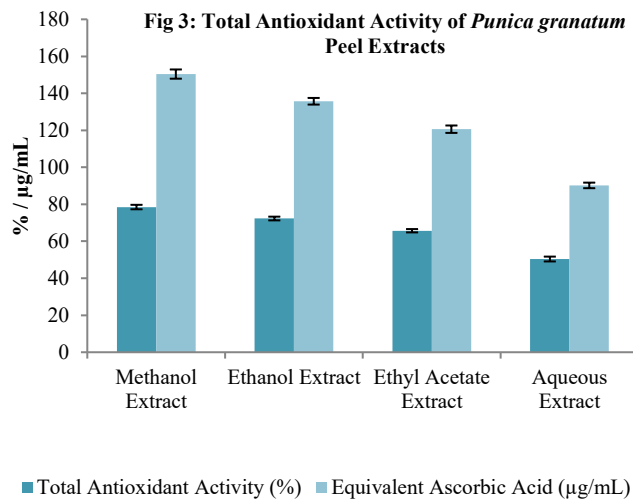


Table- 2 *Punica granatum* fruit skin extracts and retention time of phytochemical constituents

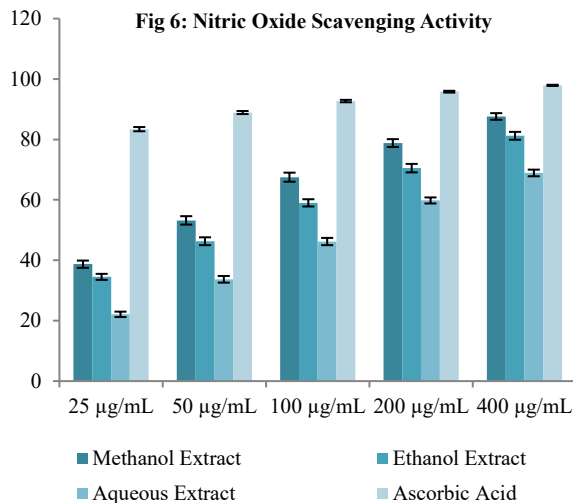
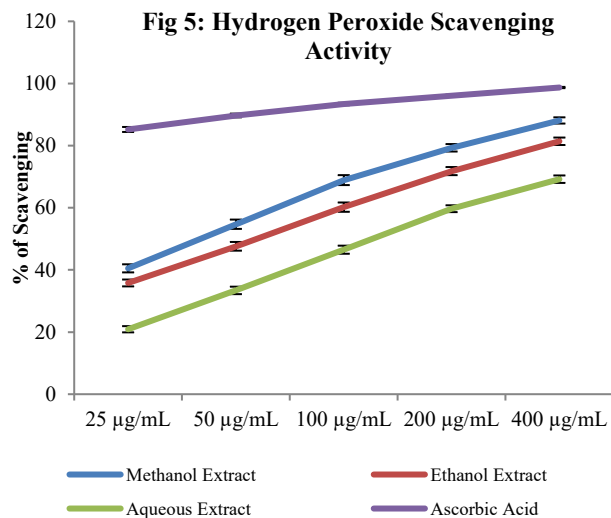
Extracts	Retention time	Active principle	Phytochemical constituents
Aqueous	1.717	Stachyose	Tetrasaccharide
Ethanol	1.633	P.cocumaric acid	Phenolic acid
	1.860	Papaverine	Alkaloids
Ethyl acetate	1.490	Maltose	Sugar
	1.670	Ethylene glycol	Organic compounds
	2. 377	Pholcodine	Narcotic
n-Hexane	1.490	Maltose	Sugar
	2.433	Pholcodine	Narcotic
	2.757	Morphine	Alkaloids
	3.040	Tryptophan	Amino acids
	3.493	Tryptophan	Amino acids
	3.810	Mannose	Sugar
Methanol	6.463	Oripavine	Alkaloids
	1.607	P.coumaric acid	Phenolic acid
	1.833	Papaverine	Alkaloids



Values represent mean $\pm$ standard deviation



Values represent mean $\pm$ standard deviation.



Values represent mean $\pm$ standard deviation

CONFLICT OF INTEREST

Authors have no any conflict of interest

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