Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 6, 2021, Pages. 19863 - 19879
Received 20 July 2021; Accepted 05 August 2021.

# Pharmacological and Photochemical Study of *Punica Granatum* :A Review

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**Abstract**
Pomegranate *(Punica granatum)* is a fruit bearing deciduous shrub or tree. It is a berry-like with a leathery rind enclosing the seeds. The seeds are surrounded by the juicy arils which comprises the edible portion of the fruit. It is grown commercially for its sweet acidic fruits which provide a cool refreshing juice. Traditionally it is used for the treatment of diarrhea, diabetes, anemia, stomach disorder and in various other ailments. All the parts of the plant are used; the fruit, seed, leaves, flower, peel, bark and root contain many phytochemical constituents which include flavonoids, tannins, alkaloids, organic acids, triterpenes, steroids, etc. The pomegranate is considered a 'wonder' fruit due to its various therapeutic effects. The pharmacological effects are anti-inflammatory, anti-diabetic, anti-neoplastic, anti-bacterial, Anti-atherosclerotic, among many others.

**Keywords:** *Punica granatum,* phytochemical constituent, wonder fruit, pharmacological study

## Introduction

*Punica granatum* commonly known as Pomegranate is an ancient, beloved plant and fruit. The name ''pomegranate'' follows the Latin name of the fruit Malum granatum, which means ''grainy apple.''[1] The generic name Punica refers to Roman name for Carthage, the ancient city in northern Tunisia from which the best pomegranates where the best pomegranates were known to grow. Pomegranate is known by the French as grenade, the Spanish as Granada, which literally translates to seeded ('granatus') apple ('pomum').[2,3]

**Fig: Pomegranate Plant**

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A pomegranate, or *Punica granatum*, is a visually striking, spherical fruit of thick, reddish skin sheltering hundreds of juice-trapping seeds, or arils in its inner chambers, widely valued in multiple cultures and religions and in science for its many health-related properties. Their trees contain glossy, linearly-shaped leaves, and can sprout large flowers of various warm or white colors, where the pomegranates themselves may eventually sprout. The tree typically grows 12−16 feet and has many spiny branches. Its leaves are glossy, narrow-oblong and 3-7cm in length and 2cm broad. Pomegranates tend to sprout more as the tree matures, which takes a few years, so patience is a virtue when expecting fruit. However, these trees offer more than its tart/sweet fruit. Their bark is tough and can be used for woodworking purposes, and elements found within the bark and the roots can be used medicinally, notably to paralyze tapeworms. And if fruit isn't desired, these trees are commonly grown just for the visually pleasing purpose of their vibrant flowers.[4]

The pomegranate tree requires a long, hot and dry season in order to produce good yield of high-quality fruit. Pomegranates are native to central Asia, but since the pomegranate tree is highly adaptive to a wide range of climates and soil conditions, it is grown in many different geographical regions including the Mediterranean basin, Asia, and California.[1]

The aim and objective of this study is to compile the pharmacological and phytochemical constituents of the different parts pomegranate such as the leaves, flower, seed, fruit, peel, root and bark.

## POMEGRANATE ANCIENT HISTORY

Pomegranate has a long and exceptionally colourful history, having been embraced by a number of different cultures, while at the same time it had been a minor horticultural fruit crop in different countries. Yet, despite its wide geographic distribution across several continents, very little information is available pertaining to its genetic origin and centers of diversity (Still 2006). In different regions of the natural habitat of wild pomegranate, the period of time between the first appearance of the modern type of humans and the transition of their different populations to agricultural activities is anywhere between 2000 and 6000 BP. Ancient civilization of Sumers first appeared in South Dvurechje (area of two rivers: Tigris and Euphrates) at the end of 2500 BP and at the beginning of 2600 BP. The crop was brought into the area during their migration from the Zagros Mountains, and the appearance of the culture was witnessed during the third dynasty of Ura (4100-4200 BP). Although, by this time the Sumer civilization had already reached prosperity, which quite reasonably allows moving the time of domestication of pomegranate into 5000 BP. However, there is also mention in the literature that it was first found growing in Jericho (modern day Israel) around 6000 BP. There is no doubt that it repeatedly domesticated at different points of time in different parts of the natural habitat. It might have taken about 3000-7000 years from the beginning of the Neolithic age (12,000 years ago), transition from hunting and collecting to agriculture and cattle-raising, to the time of its introduction into the culture in different regions. However, initially the selection process might have been slow. The changes mainly involved the size and quality of the fruit, while in other aspects newly evolved varieties differed little from the wild type. Subsequently, it had spread quickly throughout the ancient world. Records are available that during 1000 BC Carthago supplied Rome with large seedless pomegranates. From the regions, where pomegranate entered the culture within its natural habitat, it gradually spread out west, east and north. However, the evidence of pomegranate culture in Asia Minor goes back to 3300-3400 BP. It has been

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estimated that Phoenicians might have spread out its cultivation throughout the Mediterranean region. It was already cultivated in Carthago (900 BC), Pyrenean peninsula, Greece and in Italy (400 BC). To the north of Dvurechje, there is an evidence of pomegranate culture within the Urartu region, about 800 BC. The movement of the Urartu towards Transcaucasia probably began at the end of 900 BC. There are also sites of spreading wild pomegranate in Central Asia, which indicates a possibility of its domestication in this region. An assortment of Central Asian pomegranate, however, is generally similar to that of Middle Eastern countries. It is estimated that its cultivation started in Central Asia during 3000 BP. In fact, in the subtropical climate of Southern Turkmenistan, regular irrigation might have appeared at the end of 4000 BC to the beginning of 3000 BC. By 4000 BP, its cultivated forms were present. The reports are available that pomegranate made its way from Central Asia to China in 4000 BP. During the age of great geographic discoveries (1600-1700 AD) and later it might had been spread in many subtropical and tropical countries throughout the world (Levin 2006a). Pomegranate's arrival in California predates its inclusion into the United States. In 1769 AD, Franciscan missionaries from Spain led by Father Junipero Serra, established Roman Catholic Christian centres and spread pomegranate culture into the southern and northern coastal regions of California (Seelig 1970; LaRue 1980; Morton 1987).[5]

**Medicinal background**

Traditionally pomegranates are used for the treatment of various diseases. Some of which are given below:

- **Heart Problems**

Frequent intake of pomegranate juice can maintain good flow of the blood in the body. Along with this, it decreases the risk of heart attack and heart strokes.

- **Stomach Disorder**

Pomegranate peel, bark and leaves are used to calm the stomach disorder or diarrhoea triggered due to any kind of digestive problems. Drinking tea made from the leaves of this fruit helps in curing digestive problems. Pomegranate juice is also used for handling problems of dysentery and cholera.

- **Dental Care**

The best benefit of pomegranate is that its juice, along with its antibacterial and antiviral properties, helps to reduce the effects of dental plaque.

- **Cancer**

Pomegranates consist of advanced level of antioxidants called flavonoids. These flavonoids are thought to be effective in counteracting various cancer radials. The individuals that face high risk of prostate and breast cancer should start drinking the juice of this fruit, as this will help them to reduce further risk of developing cancer. Regular consumption of pomegranates can reduce the PSA levels in the body and helps to fight the existing cancer cells in the body.

- **Osteoarthritis**

Pomegranate minimizes the illness triggered in various forms, like atherosclerosis and osteoarthritis. The loss that is triggered due to the thickening and solidifying of the arterial walls and in cartilage and joints can be cured by consuming this fruit. Also, pomegranate is capable of preventing the creation of minerals that are liable for breaking down the connective tissues.

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- **Diabetes**

Consuming of pomegranate fruit juice by a diabetic patient can prevent coronary illnesses. Along with this, there is a slowdown in solidifying of the bloodstream, which can fuel non-occurrence of various heart diseases.

- **Anemia**

Healthy blood flow can be maintained in the body by consuming this fruit in any form. Pomegranate seed extract supplies iron to blood and thus, help to decrease the anemic symptoms including fatigue, wooziness and weakness and hear loss.[11]

**Phytochemical constituents**

Punica granatum L, plant has various medicinal properties in all parts of the plant and this is due to the phytoconstituents present in the plant.

The phytochemical test was conducted following different procedure or test. Many compounds were isolated from different parts of the pomegranate plant like polyphenols including tannins and flavonoids, alkaloids, organic acids, etc. Below is the tabulated phytoconstituents distributed throughout the plants found by various researchers around the world.[12,13]

- **Phytochemical Constituents of pomegranate peel**

**Table 1**

| Phytoconstituents Found | References |
|---|---|
| Gallic acid, Ellagic acid, Punicalin, Punicalagin, Caffeic acid, Ellagitannins, Pelletierine alkaloids, Luteolin, Kaempferol, Quercitin, Catechin, EGCG, Rutin, Flavones, Flavonones, Flavonoid,Steroids, Lignins, Fats & Oils, Cardiac glycosides, Carbohydrates, Anthocyanidins, Melatonin, Delfinidin 3-O-glucoside, Punicacortein A, Punicacortein B, Pedunculagin, Tellimagrandin, Glucose, Delphinidin, Gallagyldilacton, Tannins and other coloring matter | Quisumbing, E. 1978 Tanaka T, et al, 1986 Neuhofer H, et al 1993 Nawwar MA et al, 1994 Artik N. 1998 Amakura Y et al, 2000 de Pascual-Teresa S et al, 2000 Gil MI., et al, 2000 Machado, T.B. et al, 2002 Noda Y et al, 2002 Vidal A., et al, 2003 Philippine Pharmacopeia 1, 2004 van Elswijik, DA. 2004 Jurenka, J. 2008 Mali, A.B. et al, 2011 Rajan, S. et al, 2011 Anibal, P.C., et al, 2013 Moghaddam, G. et al, 2013 Altunkaya, A. 2014 Foss, S.R. et al, 2014 Sadeghipour, A. et al, 2014 Haque, N., et al, 2015 |

- **Phytochemical constituents of pomegranate pomegranate juice**

**Table 2**

| | |
|---|---|
| Simple sugars, Aliphatic organic acids, Gallic acid, Ellagic acid, Quinic acid, Flavonols, Amino acids, Minerals, Ascorbic acid, Anthocyanins, Caffeic acid, Catechin, Epigallocatechin gallate | Du Ct et al, 1975 Artik N. 1998 Amakura Y et al, 2000 de Pascual-Teresa S et al, 2000 Poyrazoglu, E., et al., 2002 Cui, S.M., et al, 2004 Waheed S et al, 2004 Lansky EP, & Newman RA. 2007 Aarabi, A., 2008 Jurenka, |

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| | |
|---|---|
| (EGCG), Quercetin, Rutin, Citric acid, Malic acid, Succinic acid, Tartaric acid, Acetic acid, Oxalic acid, Shikimik acid, Maleic acid, Furamic acid | J. 2008 Bhandari, P. 2015 Sadeghipour, A. et al, 2014 |

- **Phytochemical constituents of pomegranate Pomegranate root and bark**

**Table 3**

| | |
|---|---|
| Ellagitannins, Including Punicalin and Punicalagin, Piperidine alkaloid, Pelletierine alkaloids, Isopelletierine, Methyl-pelletierine, Pseudopelletierine, Glucoside, Granatic acid, Gallic acid, Tannic acid | Quisumbing, E. 1978 Tanaka T, et al, 1986 Neuhofer H, et al 1993 Tripathi, S.M. & Singh, D.K. 2000 Jurenka, J. 2008 Sadeghipour, A. et al, 2014 |

- **Phytochemical constituents of pomegranate Pomegranate flower**

**Table 4**

| | |
|---|---|
| Gallic acids, Ursolic acid, Triterpinoids, Fatty acids | Batt AK and Rangaswami S. 1973 Huang TH et al, 2005 Jurenka, J. 2008 Sadeghipour, A. et al, 2014 |

- **Phytochemical constituents of pomegranate Pomegranate leaves**

**Table 5**

| | |
|---|---|
| Carbohydrates, Reducing sugars, Sterols, Saponins, Flavonoids, Tannins (punicalin and punicafolin), Piperidine alakloids, Flavone Glycoside, Ellagitannins, Luteolin and Apigenin | Tanaka T, et al, 1986 Nawwar MA et al, 1994 Gil MI., et al, 2000 Jurenka, J. 2008 Chaitra, R.H. et al., 2012 Sadeghipour, A. et al, 2014 Haque, N. et al, 2015 |

- **Phytochemical constituents of pomegranate Pomegranate seeds**

**Table 6**

| | |
|---|---|
| 3,3'-Di-O-methylellagic acid ; 3,3',4'- Tri-O-methyellagic acid, Punicic acid, Oleic acid, Palmitic acid, Stearic acid, Linoleic acid, Sterols, Tocopherols, Sex steroids | Schubert SY et al, 1999 Abd El Wahab SM et al, 1998 Amakura Y et al, 2000 Hornung, E. et al, 2002 Wang, RF. Et al, 2004 Jurenka, J. 2008 Altunkaya, A. 2014 Sadeghipour, A. et al, 2014 Bhandari, P. 2015 Haque, N. et al, 2015 |

## PHARMACOLOGICAL STUDY

The pharmacological activity of phytochemical constituents of pomegranate was studied. Below is the tabulated pharmacological activity of different parts of the plants found by various researchers around the world.

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- **Anti-atherosclerotic activity of pomegranate**

**Table 7**

| Part of Plant | Findings |
|---|---|
| Pomegranate juice | Daily consumption of pomegranate juice improves stress-induced myocardial ischemia in patients who have coronary heart disease. (Sumner, M.D. et al, 2005 ; Bhandari, P.R. 2015)<br>Has a beneficial effect on the evolution of clinical vascular complications, coronary heart disease, and other atherogenesis in humans, by enhancing the NOSIII bioactivity. (de Nigris, F. et al, 2006 ; Bhandari, P.R. 2015)<br>Consumption of concentrated pomegranate juice - a significant decrease was seen in total cholesterol. (Esmaillzadeh, A., et al., 2006 : Bhandari, P.R. 2015)<br>Juice consumption by diabetic patient resulted in antioxidative effects on the serum and macrophages, which could contribute to the attenuation of atherosclerosis development in these patients. (Rosenblat, M. et al, 2006 ; Bhandari, P.R. 2015)<br>Results suggested that in subjects who were at risk for moderate coronary heart disease, pomegranate juice consumption had no significant effect on the overall carotid intima-media thickness (CIMT) progression rate, but may have slowed CIMT progression in subjects with increased oxidative stress and disturbances in the TG-rich lipoprotein / HDL axis. (Davidson, M.H et al 2009 ; Bhandari, P.R. 2015)<br>Cardioprotective. (Basu A. et al 2009 ; Bhandari, P.R. 2015)<br>Juice consumption lowers blood pressure and good for cardiovascular health. (Stowe, CB 2011 ; Bhandari, P.R. 2015) |
| Pomegranate flower | Its extract diminishes cardiac fibrosis in Zucker diabetic fatty rats, at least in part, by modulating cardiac ET-1 and NF-kappaB signaling. (Huang, T.H. et al, 2005 ; Bhandari, P.R. 2015) |
| Pomegranate seeds | Administration of seed oil for four weeks in hyperlipidemic subjects had encouraging effects on lipid profiles, including TAG and the TAG:HDL-C ratio. (Mirmiran, P., et al, 2010 ; Bhandari, P.R. 2015) |

- **Antibacterial/Antifungal activity of pomegranate**

**Table 8**

| Plant Part | Findings |
|---|---|
| Pomegranate juice | Adjunctive local delivery of extract from Centella asiatica, in combination with pomegranate, significantly improved the clinical signs of chronic periodontitis and IL-1 beta level in maintenance patients ($P<0.006$). (Sastravaha, G., 2005 ; Bhandari, P.R. 2015)<br>Has antibacterial activity against dental plaque microorganisms. |

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| | |
|---|---|
| | (Menezes, S.M. et al, 2006 ; Bhandari, P.R. 2015)<br>Ethanolic extract of fruit presented an MICs of 500 ug/mL to C. albicans, 250 ug/mL to C. dubliniensis, 500 ug/mL to C. tropicalis, 250 ug/mL to C. krusei, 250 ug/mL to C.guilliermondii, 500 ug/mL to C. utilis, 125 ug/mL C. parapsilosis, 125 ug/mL to C. lusitaniae, 250 ug/mL to C. glabrata and 250 ug/mL to C. rugosa compared to Nistatin. (Anibal, P.C et al, 2013)<br>Drinking its juice shows antibacterial properties against harmful bacteria that can exist in the stomach such as Escherichia coli and Bacillus subtilis. (Bhowmilk, D. et al, 2013) |
| Pomegranate peel (pericarp, rind) | Dysentery. (Quisumbing, E. 1978)<br>Traditional uses----- A decoction of the dried pericarp is used in the treatment of diarrhea and dysentery. Externally used as gargle in cases of sore throats. (Philippine Pharmacopeia 2004)<br>The MICs of adherence of Punica granatum L. gel (peel extract) against the test organisms were 1:16 for Streptococcus mutans (ATCC), S. mutans (CI) and S. sanguis; 1:128 for S. mitis and 1:64 for C. albicans. The MICs of adherence of micronazole against the same organisms were: 1:512, 1:64, 1:4, 1:128 and 1:16. (de Souza Vasconcelos, L.C. et al, 2006)<br>Potent antifungal activity of extracts and pure compound isolated from pomegranate peels and synergism with fluconazole against C.albicans. (Endo, EH. 2010)<br>Efficacious against the Aggregatibacter actinomycetemcomitans, Pophyromonas gingivalis, and Prevotella intermedia strain in vitro. (Bhadbade, S.J. et al, 2011 ; Bhandari, P.R. 2015)<br>Extracts of pomegranate and Juglans regia have remarkable anti-H.pylori activity, with a mean of inhibition zone diame ter of 39 and 16 mm at 100ug disk. (Hajiimahmoodi, M. et al, 2011; Bhandari, P.R. 2015)<br>Ethanolic extract showed greater zone of inhibition (mm) against Tetracycline. Staphylococcus aureus (25 vs. 23), Escherichia coli (22 vs. 19) and Pseudomonas aeruginosa (25 vs. 21). (Khan, J.A. et al, 2011)<br>Ethanolic extract of pericarp presented an MICs of 125 ug/mL to C. albicans, 125 ug/mL to C. dubliniensis, 250 ug/mL to C. tropicalis, 125 ug/mL to C. krusei, 125 ug/mL to C.guilliermondii, 62.5 ug/mL to C. utilis, 31.5 ug/mL C. parapsilosis, 62.5 ug/mL to C. lusitaniae, 62.5 ug/mL to C. glabrata and 125 ug/mL to C. rugosa compared to Nistatin. (Anibal, P.C et al, 2013)<br>Methanolic extract of peel inhibited growth of Streptococcus mutans, Streptococcus mitis, and Lactobacillus acidophilus compared to |

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|---|---|
| | ciprofloxacin. (Rummun, N. et al, 2013)<br>The hydroalcoholic extract showed good activity against Staphylococcus aureus, Bacillus subtilis and Pseudomonas aeruginosa with MICs of 62.5, 62.5 and 250 ug/mL ; Trichophyton mentagrophytes, Trichophyton rubrum, Microsporum canis and Microsporum gypseum with MICs of 125 ug/mL and 250ug/mL respectively for each genus. (Foss, S.R. et all 2014) |
| Pomegranate flower | Bronchitis and as gargles. (Quisumbing, E. 1978)<br>Methanolic extract of peel inhibited growth of Streptococcus mutans, Streptococcus mitis, and Lactobacillus acidophilus compared to ciprofloxacin. (Rummun, N. et al, 2013) |
| Pomegranate leaves | Gargles for affections of buccal cavity and as an eyewash. (Quisumbing, E. 1978)<br>Methanolic extract of peel inhibited growth of Streptococcus mutans, Streptococcus mitis, and Lactobacillus acidophilus compared to ciprofloxacin. (Rummun, N. et al, 2013) |
| Pomegranate stem | Methanolic extract of peel inhibited growth of Streptococcus mutants, Streptococcus mitis, and Lactobacillus acidophilus compared to ciprofloxacin. (Rummun, N. et al, 2013) |
| Pomegranate root | Against tuberculosis disease of children. (Quisumbing, E. 1978) |

- **Antidiabetic activity of pomegranate**

**Table 9**

| Plant Part | Findings |
|---|---|
| Pomegranate Flower | Its extract has antidiabetic activity due to improved sensitivity of the insulin receptor. (Huang, T.H. 2005 ; Bhandari, P.R. 2015) |

- **Anti-inflammatory activity of pomegranate**

**Table 10**

| Plant Part | Findings |
|---|---|
| Pomegranate juice | Dietary supplementation is a useful complementary strategy to attenuate clinical symptoms in rheumatoid arthritis patients. (Balbir-Gurman, A., et al, 2011; Bhandari, P.R. 2015) |
| Pomegranate peel | Dietary supplementation with ellagitannins, may mitigate muscular damage experienced after eccentric exercise, producing delayed-onset of muscle soreness. Supplementation with ellagitannins significantly improves the recovery of isometric strength two to three days after a damaging eccentric exercise. (Trombold, J.R., et al, 2010 ; Bhandari, P.R. 2015)<br>The aqueous-ethanolic (50%) extracts of fruit rind at 500 mg/Kg p.o. inhibited inflammation by 82.14% against indo-methacin (79%) at 10mg/Kg. (Bagri, P. et al, 2010) |

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|---|---|
| | An aqueous pomegranate peel extracts inhibits neutrophil myeloperoxidase in vitro and attenuates lung inflammation in mice. (Bachoual, R. et al, 2011) |
| Pomegranate Flower | An aqueous pomegranate peel extracts inhibits neutrophil myeloperoxidase in vitro and attenuates lung inflammation in mice. (Bagri, P. et al, 2010) |
| Pomegranate Leaves | The aqueous-ethanolic (50%) extracts of leaves at 500 mg/Kg p.o. inhibited inflammation by 67.85% against indomethacin (79%) at 10mg/Kg. (Bagri, P. et al, 2010) |

- **Analgesic activity of pomegranate**

**Table 11**

| Plant Part | Findings |
|---|---|
| Pomegranate peel | Has 77.61% of analgesia compared to indomethacin (59.49%). (Bagri, P. et al, 2010) |
| Pomegranate Flower | Has 54.05% of analgesia compared to indomethacin. (Bagri, P. et al, 2010) |
| Pomegranate Leaves | Has 50.35% of analgesia compared to indomethacin (59.49%). (Bagri, P. et al, 2010) |

- **Antidiarrheal activity of pomegranate**

**Table 12**

| Plant Part | Findings |
|---|---|
| Pomegranate Peel | The anti-diarrheal activity of aqueous and alcohol extract of the fruit rind of pomegranate was investigated in three experimental models, using albino rats. The extract exhibited significant activity in rats, when compared to loperamide hydrochloride, a standard anti-diarrheal drug. (Pillai, N.R. et al, 1992; Bagri, P. et al, 2010) |

- **Antimutagenic activity of pomegranate**

**Table 13**

| Plant Part | Findings |
|---|---|
| Pomegranate Peel | Broad spectrum antimutagenic activity of antioxidant active fraction of Punica granatum L. peel extracts. (Zahin, M. et al 2010) |

- **Antioxidant activity of pomegranate**

**Table 14**

| Plant Part | Findings |
|---|---|
| Pomegranate Peel | Aqueous and alcoholic extracts showed good antioxidants effect with IC50 ranges from 34.78 + 14.04 to 135.27 + 35.5 ug/mL for aqueous and 40.03 + 14.72 to 105.93 + 17.19 ug/mL for alcoholic extracts. (Rajan, S. et al, 2011) |

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|---|---|
| Pomegranate Flower | Potent antioxidant. (Kaur, G. et al, 2006 ; Bhandari, P. 2015) |

- **Antiparasitic activity of pomegranate**

**Table 15**

| Plant Part | Findings |
|---|---|
| Pomegranate juice | Infected women who accepted to be treated with pomegranate juice were completely cured. The anti-trichomoniasis vaginalis activity of extract (in-vitro and in-vivo) gave very promising results. (El-Sherbini, G.M. et al, 2010 ; Bhandari, P. 2015) |
| Pomegranate Peel | Internally as decoction for antihelminthic and taeniafuge. (Quisumbing, E. 1978)<br>Anthelminthic against tapeworm and other intestinal worms. (Philippine Pharmacopeia 2004) |
| Pomegranate Bark | For tapeworm. (Quisumbing, E. 1978)<br>Molluscicidal activity. (Tripathi, S.M. et al, 2000 ; Bhandari, P. 2015) |

- **Antiviral activity activity of pomegranate**

**Table 16**

| Plant Part | Findings |
|---|---|
| Pomegranate juice | Microbiocidal effects on HIV-1. (Neurath, A.R. 2005 ; Bhandari, P. 2015)<br>Viricidal agent. (De Siqueira,R.S. et al, 2006 ; Bhandari, P. 2015)<br>Has an anti-influenza component, because this compound blocked the replication of the virus RNA, inhibited agglutination of chicken RBCs by the virus, and had viricidal effects. Indeed, it inhibited the replication of human influenza A/Hong Kong (H3N2) in vitro. (Haidari, M., et al, 2009 ; Bhandari, P. 2015) |

- **Abortifacient activity of pomegranate**

**Table17**

| Plant Part | Findings |
|---|---|
| Pomegranate peel | Abortifacient. (De Siqueira,R.S. et al, 2006 ; Bhandari, P. 2015) |

- **Astringent activity of pomegranate**

**Table 18**

| Plant Part | Findings |
|---|---|
| Pomegranate juice | Fruit extract in a range of 5 to 60 mg/L, is able to protect human skin fibroblasts from cell death on UV exposure, possibly due to a decrease in induction of the pro-inflammatory transcription factor NF-kappa B, a downregulation of pro-apoptotic caspase-3, and an increased G0/G1 phase, associated with DNA repair. Results from this study |

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|---|---|
| | demonstrate the protective effects of pomegranate fruit extract against UVA-and UVB-induced cell damage and the potential use of pomegranate polyphenolics in topical applications. (Pacheco-Palencia, L.A. et al, 2008 ; Bhandari, P. 2015) |
| Pomegranate peel | Astringent. (Philippine Pharmacopeia 2004) |

- **Cancer chemopreventive activity of pomegranate**

**Table19**

| Plant Part | Findings |
|---|---|
| Pomegranate juice | Prevents prostate cancer in humans. (Malik, A. et al, 2005 ; Bhandari, P. 2015)<br>Results suggest that the ellagitannins and urolithins liberated in the colon, upon administration of pomegranate juice, in considerable amounts, could potentially reduce the risk of colon cancer progress, by inhibiting cell proliferation and inducing apoptosis. (Kasimsetty, SG., et al, 2010 ; Bhandari, P. 2015)<br>It sensitizes Tamoxifen action in ER-α positive breast cancer cells. (Banerjee, S. et al, 2011 ; Bhandari, P. 2015)<br>It inhibits cellular proliferation and tumor growth and induce cell death via apoptosis in a number of cancer cell lines (leukemias). (Dahlawi, H. et al, 2012 ; Bhandari, P. 2015) |
| Pomegranate Seed | Punicic acid in seed oil had breast cancer inhibitor properties due to its effect on lipid peroxidation and the PKC pathway. (Grossmann, M.E. et al, 2010;Bhandari, P. 2015)<br>Has protective effect toward the liver and kidney by reducing the level of lipid peroxidation in patients receiving chemotherapy medications like Cisplatin. (Cayir, K., et al, 2011 ; Bhandari, P. 2015) |

- **Fertility activity of pomegranate**

**Table 20**

| Plant Part | Findings |
|---|---|
| Pomegranate juice | A well-controlled trial of pomegranate juice for the treatment of mild-to-moderate erectile dysfunction in men Forest CP. (Forest CP et al, 2007) The randomized, placebo controlled, double-blind, crossover trial, enrolled 53 men with mild-to-moderate impotence. The subjects consumed pomegranate juice, or placebo, for four weeks. After a two-week washout period, they switched treatments. They concluded that the subjects were more likely to have improved scores when pomegranate juice was consumed. (Bhandari, P. 2015)<br>Juice consumption increased the epididymal sperm concentration, sperm motility, spermatogenic cell density, diameter of seminiferous tubules, and germinal cell layer thickness. It also decreased the |

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 6, 2021, Pages. 19863 - 19879
Received 20 July 2021; Accepted 05 August 2021.

| | |
|---|---|
| | abnormal sperm rate when compared to the control group. (Turk, G., et al, 2008 ; Bhandari, P. 2015) |

- **Gastroprotective activity of pomegranate**

**Table 21**

| Plant Part | Findings |
|---|---|
| Pomegranate juice | Anti-ulcer activity in experimentally-induced gastric ulcers. (Alam, M.S., et al, 2010 ; Bhandari, P. 2015)<br>Its antiulcer effect is related to the increasing secretion of adherent mucus and free mucus from the stomach wall. This may inhibit generation of oxygen-derived free radicals, decrease the consumption of GSH-PX (glutathione peroxidase) and SOD (superoxide dismutase), and maintain the content of NO (Nitric Oxide) at a normal level. (Lai, S. et al, 2009 ; Bhandari, P. 2015) |

- **Hepatoprotective activity of pomegranate**

**Table 22**

| Plant Part | Findings |
|---|---|
| Pomegranate peel | It prevents liver firbrosis in biliary-obstructed rats. (Toklu, H.Z. 2007 ; Bhandari, R. 2015) |
| Pomegranate Flower | Hepatoprotective. (Kaur, G. et al, 2006 ; Bhandari, P. 2015)<br>Ameliorates diabetes and obesity-associated fatty liver, at least in part, by activating the hepatic expression of genes responsible for fatty acid oxidation. (Xu, K.Z. et al, 2009 ; Bhandari, P. 2015) |

- **Hemorrhoids activity of pomegranate**

**Table 23**

| Plant Part | Findings |
|---|---|
| Pomegranate peel | Hemorrhoids. (Philippine Pharmacopeia 2004) |

- **Nephroprotective activity of pomegranate**

**Table 24**

| Plant Part | Findings |
|---|---|
| Pomegranate seeds | Nephroprotective. (Bouroshaki, M.T. et al,2010 ; Bhandari, P. 2015) |

- **Neuronal activity of pomegranate**

**Table 25**

| Plant Part | Findings |
|---|---|
| Pomegranate Flower | Supplementation decreases oxidative stress and ameliorates impairment in learning and memory performances in diabetic rats. (Bouroshaki, M.T. et al,2010 ; Bhandari, P. 2015) |

Annals of R.S.C.B., ISSN: 1583-6258, Vol. 25, Issue 6, 2021, Pages. 19863 - 19879
Received 20 July 2021; Accepted 05 August 2021.

- **Skin whitening activity of pomegranate**

**Table 26**

| Plant Part | Findings |
|---|---|
| Pomegranate Juice | Ingested orally, has an inhibitory effect on pigmentation in the human skin caused by UV irradiation. (Bae, J.Y. et al, 2010 ; Bhandari, P. 2015) |
| Pomegranate peel | It's extract when taken orally, could be used as an effective whitening agent for the skin. (Yoshimura, M. et al, 2005 ; Bhandari, P. 2015) |

## Conclusion

A review was conducted on *Punica granatum* based on different articles collected from various sources. It was concluded that pomegranate is rich in phytoconstituents that are distributed to its different plant parts such as fruits, seeds, leaves, flowers, bark, roots, fruit peel and juice. These phytoconstituents are responsible for the pharmacological properties exhibited by the plant namely antiatherosclerotic, antimicrobial, antidiabetic, anti-inflammatory, analgesic, antidiarrheal, antimutagenic, antioxidant, antiparasitic, antiviral, astringent, abortifacient, hemorrhoids, cancer-chemopreventive, improve fertility, neuronal activity, gastroprotective, hepatoprotective, nephroprotective, and skin whitening activity.

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