

THERAPEUTICS, PHYTOCHEMISTRY AND PHARMACOLOGY OF AN IMPORTANT  
UNANI DRUG *PUNICA GRANATUM* LINN: A REVIEW<sup>1</sup>Ansari Shaiqua, <sup>2</sup>\*Wasim Ahmad, <sup>3</sup>Fahmeeda Zeenat and <sup>4</sup>Rizwan Mohiyuddin Khan<sup>1</sup>Dept of Qabalat wa Amraz-e-Niswan, Mohammadia Tibbia College, Malegaon.<sup>2</sup>Dept. of Ilmu Advia, Mohammadia Tibbia College, Malegaon.<sup>3</sup>Department of Amraz-e-Niswan wa Atfal, A.K. Tibbiya College, AMU, Aligarh.<sup>4</sup>Dept. of Qabalat wa Amraz-e-Niswan, ZVM Unani Medical College, Pune.

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Article Received on 09/05/2017

Article Revised on 29/05/2017

Article Accepted on 19/06/2017

**ABSTRACT**

*Punica granatum* Linn is deciduous, glabrous large shrub or a small and long-living tree. Pomegranate (*Punica granatum* fruit) is a mystical, unique fruit and very famous from ancient era. It is an oldest known edible fruit, mentioned in Bible and Quran and is often associated with fertility. Prophet Mohammad (SAWS) called it the 'purgative of hate, jealousy and envy'. In ancient Egyptian culture, it is regarded as a symbol of prosperity and ambition. *Gulnar* is the flower of wild variety, which does not have fruits. It is also known as *Ward-e-Ruman*. It is of various types but mostly red in colour, sour or bad in taste. *Gulnar Farsi* is best in all other types. Entire tree of pomegranate is of great economic importance. Apart from its demand for fresh fruits and juice, the processed products like wine and candy are also gaining importance in world trade. The plant is found growing wild in the warm valley and outer hills of the Himalayas between 900 and 1,800 meter and cultivated throughout the India. The different parts of the plant have various pharmacological activities. *Gulnar* (*Punica granatum* flower) has been used in Unani Medicine (*Tibb-e-Unani*) and other Traditional Systems of Medicine since centuries. Keeping in view the medicinal importance of it, an attempt has been made in the present paper to review the available literature on traditional uses, phytochemistry and pharmacological properties of flower of *Punica granatum*.

**KEYWORDS:** Anar, Gulnar, *Punica granatum*.**INTRODUCTION**

Pomegranate (*Punica granatum* Linn fruit) is a mystical, unique fruit (Soni *et al.*, 2012) belonging to family Punicaceae (Al-Laham & Al-Fadel, 2013) and very famous from ancient era. It is an oldest known edible fruit, mentioned in Bible and Quran and is often associated with fertility (Soni *et al.*, 2012). Prophet Mohammad (SAWS) called it the 'purgative of hate, jealousy and envy' (Ansari, 2009). In ancient Greek mythology, pomegranates are known as the fruit of the dead, the sustenance available in Hades for its residents (Lansky *et al.*, 2000). In ancient Egyptian culture, it is regarded as a symbol of prosperity and ambition, making it common practice to decorate sarcophagi with depictions of the plants (Soni *et al.*, 2012).

No less, in the ancient Hebrew tradition, pomegranates adorned the vestments of the high priest, the numbers of seeds were considered mystically equivalent to the number of virtues in even a simple person and for the initiated, and the pomegranate was understood to be symbolic of the female aspect of the Creator, i.e., the *Shekinah* (Wolfson, 1988).

The Babylonians regarded the seeds as an agent of resurrection, the Persians as conferring invincibility on the battlefield and for ancient Chinese alchemical adepts, the bright red juice was mythopoetically regarded as a soul concentrate, homologous to human blood, and capable of conferring on a person longevity or even immortality (Maadihassan, 1984).

In all these cultures, red, glistening, juice-encapsulated pomegranate seeds were seen as a natural symbol for fertility and fecundity, and the shape of the fruit itself evoked a primeval image of the female human's breast. All of this is reflected in a rich tradition of sacred and erotic art worldwide involving the pomegranate (Lansky *et al.*, 2000).

Entire tree of pomegranate is of great economic importance. Apart from its demand for fresh fruits and juice, the processed products like wine and candy are also gaining importance in world trade (Lal *et al.*, 2011). Dioscorides quite explicitly sets forth the medicinal properties of the different parts of the plant (Lloyd, 1897). The medicinal parts are the root, bark, fruits, peel of the fruit and the flowers (Al-Laham & Al-Fadel,

2013). Its flower is called as balaustion by Dioscorides (Lloyd, 1897).

*Gulnar* is the flower of wild variety, which does not have fruits (Naseeruddin, 2010; Kabiruddin, YNM). It is also known as *Ward-e-Ruman*. It is of various types, some are white, pink and red (Ibn baitar, 1985). It is mostly red in colour, sour or bad in taste. According to Dioscorides, *Gulnar* has a bitterish and astringent taste, but no odour. They colour the saliva violet-red (Lloyd, 1897). *Gulnar* Farsi is best in all other types (Naseeruddin, 2010). According to Ibn Baitar flower of wild variety is called as *Wardur Rumman*, while of cultivated variety is known as *Junbadur Rumman* (Ibn Baitar, 1985).

### Botanical Description

*Punica granatum* is deciduous, glabrous large shrub or a small (Anonymous, 1987) and long-living tree (Soni *et al.*, 2012), often with spinescent branchlets (Chatterjee & Pakrashi, 1994). It is nearly 20 feet long in height and stem is about 3 feet in width (Lubhaya, 1982). It has two varieties, one is sour and the other is sweet (Chatterjee & Parkashi, 1994).

### Flowers

The flower (*Gulnar*) is bell shaped and beautiful (Hussain, 2004), shortly pedicelled (Hooker, 1990) terminal or axillary, solitary, large, showy, scarlet or orange-red (Chatterjee & Pakrashi, 1994), 3.8–5 cm long, (Kirtikar & Basu, 1991), 3 cm wide, flowers are home on the branch tips singly or as many as 5 in a cluster. They are characterized by the thick, tubular, red calyx having 5 to 8 fleshy, pointed sepals forming a vase from which emerge the 3 to 7 crinkled, red white or variegated petals enclosing the numerous stamens (Soni *et al.*, 2012). Flower powder is pink in colour and has astringent taste. Powder analysis of the crude drugs revealed the presence of fragments of calyx, corolla, trichomes, stomata and sclereids (Anonymous, 1987).

**Bark:** It is smooth, grey, thin; often armed with small axillary or terminal tree (Kirtikar & Basu, 1991).

**Leaves:** They are opposite or sub opposite, often fascicled on short petioles (Chatterjee & Pakrashi, 1994), oblong-lanceolate, oblong-elliptic or oblong-oblong-lanceolate, glabrous, entire, minutely pellucid-punctate, shining above, bright green beneath (Kirtikar & Basu, 1991). It is about 5-6 cm long and 1.5-2 cm broad (Hussain, 2004; Anonymous, 1987).

**Calyx:** The calyx is coriaceous, persistent, prolonged above the ovary, free part campanulate (Chatterjee & Pakrashi, 1994), bell shaped, thick, more or less orange coloured, lobes are 5- 7 in numbers, pointed, about 1 cm long, 0.5 cm broad at the base (Anonymous, 1987).

**Stamen:** Stamens are very numerous, inserted on the calyx below the petals at various levels (Kirtikar & Basu, 1991).

**Ovary:** Ovary is inferior (Chatterjee & Pakrashi, 1994), with many locule (Anonymous, 1987), it is many-celled, the cells arranged in 2 concentric circles (Kirtikar & Basu, 1991).

**Style:** The style is long, bent with capitate stigma (Kirtikar & Basu, 1991). Style is having canal (Anonymous, 1987).

**Petals:** They are 5-7 lanceolate, wrinkled, and inserted between the calyx lobes (Hooker, 1990).

**Petiole:** Petioles are 2- 3 mm in size (Anonymous, 1987).

**Corolla:** It is numerous, bright red, stamens absent (Anonymous, 1987).

**Placenta:** The placenta is arising from wall of ovary (Anonymous, 1987).

**Fruits:** The fruits are nearly round (Soni *et al.*, 2012), 3.8-7.5 cm in diameter (Kirtikar & Basu, 1991). They are large globose, crowned by the somewhat tubular limb of the calyx, indehiscent, with a coriaceous rind; pulp red juicy, sometimes white (Chatterjee & Pakrashi, 1994), internally separated with the membranous walls of carpels; each carpel containing numerous seeds angular from mutual pressure (Kirtikar & Basu, 1991).

**Seeds:** Seeds are angular, testa coriaceous (Chatterjee & Pakrashi, 1994) and arranged inside the rind with watery outer coat containing pink juice and a horny inner coat (Kirtikar & Basu, 1991).

### Habitat

Pomegranate is considered to be a native of Iran, Afghanistan and Baluchistan, found growing wild in the warm valley and outer hills of the Himalayas between 900 and 1,800 meter and cultivated throughout the India (Anonymous, 1969).

### Vernaculars

The plant is known by different vernacular names in different language, areas and traditions: *Granaat*, *Granaatappel*, *Iralnate* (Africa); *Rumman*, *Shajraturrumman*, *Shajratur-Rumman*, *Aqma ul Rummn*, *Zahratul Rumman*, *Junbul Rumman* (Arabic); *Dalim* (Assam); *Daadima*, *Daadimba*, *Raktapushpa*, *Dantabijaa*, *Raktakusumaa* (Ayurved); *Dalimgachh*, *Dalimb* (Bengal); *Anara*, *Dalimba* (Bombay); *Roma* (Brazil); *Sale-bin*, *Talibin* (Burma); *Dalimba*, *Dalimbe*, *Hulidalimbe*, *Husidalimbe* (Canarese); *An Shih Liu*, *Che Lieou*, *Shih Liu* (Chinese); *Anar* (Deccan); Pomegranate, Pomegranate Tree (English); *Balaustier*, *Grenadier*, *Migraine*, *Grenadier Cultive* (French); *Granatbaum*, *Granate* (German); *Roia*, *Roidia*, *Roidion* (Greek); *Dadam* (Gujarat); *Rimaus*, *Rimmon* (Hebrew); *Dhalim*, *Dharimb*, *Anar Dhalim*, *Anar-ke-per* (Hindi); *Melogramato*, *Melogramano* (Italian); *Dalimba*, *Dalimbe*

(Kannada); *Dhaun* (Kashmir); *Darim* (Kumaon); *Shak liu* (Malaya); *Dadiman*, *Matalam*, *Pumatalam*, *Raktabijam*, *Talimatalam*, *Uruyampalam*, *Matalam*, *Dadiman* (Malayalam); *Pomegranate*, *Melogramato*, *Rimmien*, *Rummien* (Malta); *Dalimb*, *Dalimba* (Marathi); *Granado*, *Granado de China* (Mexico); *Granato*, *Granato Servaggio* (Naples); *Gulnar*, *Darakte-nar*, *Anar*, *Darakhtenar* (Persian); *Granada* (Philippines); *Romanzeira*, *Romeira* (Portuguese); *Anar*, *Daan*, *Daran*, *Dariun*, *Daruna*, *Daruni*, *Dharu*, *Daru*, *Jaman* (Punjab); *Anar*, *Anor*, *Gharnangoi*, *Nargosh* (Pushtu); *Pitligeen*, *Pitlingeian*, *Radiu* (Roumanian); *Granat*, *Granatnik* (Russian); *Bijapura*, *Dadima*, *Dadimasara*, *Dadimba*, *Dalika*, *Dalika*, *Dantabija*, *Dantabijaka*, *Karaka*, *Kuchaphala*, *Kuttima*, *Lohitapushpaka*, *Madhubija*, *Milapatra*, *Milapatraka*, *Mukhavallabha*, *Nagarata*, *Parvarut*, *Phalashadava*, *Pindapushpa*, *Pindira*, *Raktabija*, *Raktapushpa*, *Shukadana*, *Shukavallabha*, *Sunila*, *Suphala*, *Svadvamla*, *Valkaphaka*, *Vtittaphala* (Sanskrit); *Mathulai* (Siddha); *Anar*, *Dhalim*, *Dharimb* (Sind); *Anar Dakum* (Sindhi); *Granado* (Spanish); *Kalumal Madalai*, *Madulam*, *Madulungam*, *Pulimadalai*, *Tadimadalai*, *Tadimam*, *Tusagam*, *Madalai*, *Madalam*, *Madalangai*, *Kalumal Medelai*, *Pumadalai*, *Padimadalai* (Tamil); *Dadimamu*, *Dadimba*, *Dalimma*, *Danimma*, *Karakamu*, *Pulladanimma*, *Puvvudanimma*, *Tiyyadanimma* (Telugu); *Nar agaci* (Turkish); *Anaar*, *Julnar*, *Balositren* (Unani); *Anar*, *Anarmitha* (Urdu); *Dalimbo*, *Dalimo* (Uriya) (Anonymous, 1987; Hussain, 2004; Ibn Baitar, 1985; Khare, 2004; Kirtikar & Basu, 1991; Nadkarni, 1954).

#### **Mizaj (Temperament)**

Some Unani physicians described the temperament of *Gulnar* (*Punica granatum*) as Cold and Dry in second degree (Ibn Baitar, 1985), but some consider it as Cold and Wet (Ansari, 2009).

#### **Afa'al (Action)**

In classical Unani literature, various actions of *Punica granatum* Linn have been described in details such as *Anar* possess *musakkin-e-atash*, *musakkin-e-alam*, *muqawwi-e-bah*, *muqawwi-e-basar*, *muqawwi-e-a'aza-e-raeesa*, *musammin-e-badan* (Anonymous, YNM), *habis*, *qatil-e-didan-e-ama'a*, *musakkin-e-safra* (Ansari, 2009), *khafeef mudirr-e-bol*, *musakkin-e-hararat*, *muqawwi-e-qalb wa jigar*, *mulaiyan seena wa halaque properties* (Kabiruddin, YNM).

*Gulnar* possess *qabiz*, *mundamil*, *dafa-e-zaheer* (Ibn Baitar, 1985), *muqawwi-e-asnan wa lissa* (Abdul Hakim, 1999), *dafa-e-ishal*, *dafa-e-zaheer* (Hussain, 2004), *mujaffif*, *raade* (Kabiruddin, YNM) and *habisuddam* properties (Lubhaya, 1982).

#### **Istemat (Uses)**

*Anar* therapeutically used in various diseases such as *amraz-e-tehal*, *khafqan*, *dard-e-sina* (Anonymous, YNM), *yarqan*, *matli*, *qai* and *shiddat-e-peyas* (Ansari, 2009).

*Gulnar* is used to treat the diseases such as *jiryane-khoon*, *safravi dast*, *dafa ratubate meda wa ama'a*, *kharish*, *zakhm-e-ama'a*, *fasid ratubat-e-rahem* (Ibn Baitar, 1985), *ishal*, *zaheer*, *nazfuddam*, *qurooh-e-lissa*, *khuruj-e-maqad* (Hussain, 2004), *kasrat-e-haiz*, *sailanur rahem*, *qula'a* (Kabiruddin, YNM), *bawaseer*, *kharish tar wa khushk*, *fataque* and *badbu-e-dahan* (Abdul Hakim, 1999).

*Gulnar's* oil (*tila*) is useful in primary inflammations because of having *rade mawad* property. The powder of *Gulnar* is therapeutically used in inflammations, bleeding gums, haemoptysis and *safravi wa damvi ishal*, while its *humool* (tampon) locally used in cases of *sailanur rahem* and menorrhagia because of its *habisuddam* and *qabiz* properties (Kabiruddin, YNM). Fresh *Gulnar* juice is instilled in nasal cavity to relieve epistaxis. The powder of *Gulnar* relieves cough in a dose of 250-375 mg (2-2.5 *ratti*). Its tooth powder is used to relieve the bleeding gums and to strength teeth and gums. If *Gulnar* is engulfed in a dose of 3 pieces for 7 days, there will be no eye pain for one year. Some physicians have described that if 7 pieces of *Gulnar* is engulfed without touching hand, there will be no pain in eye and no eruption of *phode phunsi* for one year. While Ibn Zohar stated that if only one *Gulnar* is engulfed there will be no pain in eye for one year (Najmul Ghani, 2011). Its decoction is useful in *khuruj-e-maqad*. Its powder is sprinkled on wound to heal (Lubhaya, 1982). It's oral or local application is used in hernia and gastric discomfort (Khan, YNM).

#### **Muzir (Adverse effect)**

*Punica granatum* has adverse effect on head and cause headache and obstruction (Kabiruddin, YNM).

Dried root bark and seeds contain toxins. More than 80 gm powder is fatal. It showed uterine stimulant activity in animals. It is contraindicated during pregnancy due to its emmenagogue and possible abortifacient effects (Khare, 2004).

#### **Musleh (Corrective)**

Bark and calyx (Kali) of *Anar* is used as corrective. *Juft Baloot* (Kabiruddin, YNM) and *Kateera* (Abdul Hakeem, 1999) are also used as corrective.

#### **Pharmacological Actions**

##### **(As described in ethnobotanical and traditional literature)**

The drug *Punica granatum* is described in detail in ethnobotanical and scientific literature and various actions have been reported to possess by it. Some pharmacological actions and therapeutic uses are as follows:

Fruits are abortive in nature (Anonymous, 1987). The fruit rind of the plant possesses antidiarrheal (Khare, 2004) and anthelmintic properties (Chatterjee & Pakrashi, 1994). Unripe fruit is a good appetizer and

tonic (Chatterjee & Pakrashi, 1994). The fruit pulp and the seeds are stomachic (Prajapati *et al.*, 2003). Ripe fruit is tonic, astringent to bowel, aphrodisiac (Chatterjee & Pakrashi, 1994), laxative, diuretic, fattening, enrich the blood (Kirtikar & Basu, 1991). Fruit juice is cooling and refrigerant (Chatterjee & Pakrashi, 1994; Chopra *et al.*, 1956). It is given in dyspepsia (Agarwal, 1986). Bark, fruit, pulp and flowers possess antifungal activity (Khare, 2004). Seeds are stomachic and laxative. Dry seeds known as *Anardana* is digestive (Agarwal, 1986). Pulp and seeds possess stomachic and cardiac properties (Chatterjee & Pakrashi, 1994; Kirtikar & Basu, 1991). They are refrigerant and used in fevers (Lindley, 1984). Rind, flowers and leaves possess antibacterial property (Khare, 2004). The bark and seeds are possessing astringent and anthelmintic properties (Prajapati *et al.*, 2003). They have emmenagogue and possible abortifacient activity (Khare, 2004). The decoction of the bark acts as an anthelmintic agent if followed by purgatives (Kirtikar & Basu, 1991). The bark extract possesses narcotic and antibacterial activities (Agarwal, 1986). Stem and root have anthelmintic activity (Khare, 2004; Chatterjee & Pakrashi, 1994). The bark of root and stem are astringent and anthelmintic especially in tape worm (Chopra *et al.*, 1956). The root bark is also possesses emetic and purgative actions (Lindley, 1984). Bark, root and stem are also insecticidal (Agarwal, 1986).

#### Therapeutic uses

The drug pomegranate (*Punica granatum* Linn.) was used in folk medicines for worm infestations especially tapeworm, diarrhea and dysentery. Externally it is used in cases of haemorrhoids and as a gargle in sore throat. It is also used for gastrointestinal disturbances in homeopathic system. Chinese use pomegranate to treat chronic diarrhea, dysentery, blood in stool, warm infestation and anal prolapse, whereas in Indian system of medicine it is used in diarrhoea, dysentery, vomiting and eye pain (Anonymous, 2000). In Unani system of medicine, pomegranate fruit in form of syrup (*Sharbat*) is prescribed in chronic diarrhoea, biliousness and vomiting. Its jawarish is recommended in hepatitis, anorexia, nausea, vomiting and bilious diarrhoea. Its tablet (*Qurs*) is given in haemorrhages, haematemesis and haemoptysis (Khare, 2004).

Unripe fruit is used in vomiting (Kirtikar & Basu, 1991) thirst, burning sensation of body, fever, heart diseases, sore throat and stomatitis (Kirtikar & Basu, 1991). The rind of the fruit is ground in water and is used as anti-diabetic (Prajapati *et al.*, 2003). It is combined with aromatics like cloves etc. and is used in diarrhea and dysentery (Chopra *et al.*, 1956). The fruit together with the juice of *Cynodon dactylon* leaves is used for running nose and cold. Juice of the fruit is used to treat jaundice and diarrhea (Prajapati *et al.*, 2003). Ripe fruit is useful in brain diseases, spleen complaints, chest trouble, scabies, bronchitis and earache (Kirtikar & Basu, 1991).

Flowers are useful in rectal prolapse, diarrhea, gum ulcer (Hussain, 2004) and epistaxis (Prajapati *et al.*, 2003). The dried flowers are used in hematuria, hemorrhoids, haemoptysis and dysentery. The powdered flower buds are used in bronchitis (Ross *et al.*, 2001). Flower juice is recommended as a gargle for sore throat. It is also therapeutically used in leucorrhoea, hemorrhages and ulcers of the uterus and rectum (Ali & Sharma, 2006). The flowers are styptic to gums, check vomit; useful in biliousness, sore eyes, ulcers, sore throat and for hydrocele (Kirtikar & Basu, 1991).

The bark strengthens the gums, used in piles, prolapse and colic. According to Shushruta the bark and fruit combined with other drugs are prescribed for the treatment of snake-bite and also prescribed for scorpion stings, but Mhaskar and Caius refused and stated that the bark and fruit are not antidotes to scorpion venom (Kirtikar & Basu, 1991). The bark is useful in intestinal worms especially tape worm (Anonymous, 1984). Root bark is also used to cure worms (Lindley, 1984).

The bark and seeds are useful in bronchitis (Kirtikar & Basu, 1991) and seeds are specially used in liver and kidney disorders (Kirtikar & Basu, 1991). Decoction of seeds is used to treat syphilis (Prajapati *et al.*, 2003). Dried seeds are used as condiments (Agarwal, 1986).

Bark and fruit of the plant is prescribed in combination with other medicines to relieve dysentery and abdominal pain. An infusion of rind and root was used for leucorrhoea by early colonist as an injection (Kirtikar & Basu, 1991).

#### Phytochemistry

Plant contains protein, glucose, calcium, phosphorus and iron like body tonic particles (Ansari, 2009). Tannin and saponin occur in all parts of tree, particularly in fruit pulp, stem & root bark and leaves (Hussain, 2004; Khare, 2004). Fruit gave fluoride, magnesium, vitamin C and phosphate (Khare, 2004). Nicotinic acid, pectin, riboflavin, thiamine, delphinidin diglycoside, aspartic acid, citric acid ellagic acid, gallic acid and malic acid also present in fruit (Chatterjee & Pakrashi, 1994). Fruit rind has an ellagitannin named granantin B, punicalagin, punicalin and ellagic acid (Khare, 2004). Fresh rind of fruit contains wax 0.8, resin 4.5, mannitol 1.8, non-crystallized sugars 2.7, gums 3.2, inulin 1.0, mucilage 0.6, tannin 10.4, gallic acid 4.0, calcium oxalate 4.0 and pectin 2.4% (Khare, 2004). Peels of plant have tannins, namely punicalin and punicalagin (Chatterjee & Pakrashi, 1994). Bark contained the alkaloids isopelletierine, pseudopelletierine, pelletierine as well as isoquercetin, friedelin, D-mannitol and estrone (Khare, 2004). 9-methyl-9-azabicyclo (3.3.1) nonan-3-one (granatam-3-one); 1-(2-piperidinyl)-2-propanone, and betulinic acid are also derived from the bark (Chatterjee & Pakrashi, 1994). Flowers gave pelargonidin-3, 5-diglucoside, sitosterol, ursolic acid, maslinic acid, asiatic acid, sitosterol- $\beta$ -D-glucoside, gallic acid (Khare, 2004)

and pelargonidin-3,5-diglucoside (Chatterjee & Pakrashi, 1994). Rind contains pentose glycoside of malvidin and pentunidin (Khare, 2004). Seeds contain malvidin pentose glycoside (Khare, 2004), estrone and punicic acid (Chatterjee & Pakrashi, 1994). Leaves gave an unstable alkaloid, *viz.*, (1-propenyl)- $\Delta^1$ -piperidine-[2,3,4,5-tetrahydro-6-(1-propenyl)]-pyridine<sup>†</sup>, punicafolin and punicalolin (Chatterjee & Pakrashi, 1994; Rastogi & Mehrotra, 1993). Elligatannins- granatins A and B are also present in leaves (Khare, 2004). Stem has carbohydrates, carotene, insulin and D-mannitol (Chatterjee & Pakrashi, 1994).

### Pharmacological Studies

A number of studies have been carried out on flowers of *Punica granatum* Linn (*Gulnar*) in recent years showing that it possesses diverse pharmacological effects. Some of the important pharmacological effects are as follows:

#### Analgesic

A study was carried out to measure the analgesic effect of flower extracts of *Punica granatum* in mice using the acetic acid induced writhing test. Petroleum ether, dichloromethane and methanol fractions were found to inhibit the writhing in a dose of 200 mg/kg (Sarker *et al.*, 2012).

Different extracts of *Punica granatum* flowers were investigated for analgesic activity in mice using hot plate method. The result shows that various extracts of flowers possesses significant analgesic activity at a dose of 50 mg/kg body weight (Chakraborty, 2008).

#### Antiatherosclerotic

Supplementation of pomegranate juice, pomegranate fruit liquid extract, pomegranate polyphenol powder extract or pomegranate ground flowers extract for 3 months in an atherosclerotic mouse model resulted in a significant reduction in the atherosclerotic lesion area as compared to the water treated group (Aviram *et al.*, 2008). The largest decrease in a lesion area (70%) was observed in mice supplemented with pomegranate ground flower extract, which has a highest content of total dietary fiber (30.2%) among all fruit parts. It also led to the concomitant decrease in serum glucose and cholesterol levels, compared to the placebo group (Aviram *et al.*, 2000; Kaplan *et al.*, 2001).

#### Antibacterial

A study was carried out to investigate the antibacterial activity of the extracts prepared from different parts of *Punica granatum* (pericarp, leaves, flowers, seeds) against *Pasteurella haemolytica* that is resistant to all studied antibiotics. The result suggested that alcoholic extracts of different parts possess high antibacterial activity. Pericarp extract was the best, whereas the water and petroleum ether extracts have no antibacterial activity (Al-Laham & Al-Fadel, 2013).

#### Antidiabetic

The flowers of *Punica granatum* significantly reduced the blood glucose level of type 2 diabetes in animals with different possible mechanism including enhancement of mRNA expression, improvement of insulin receptor sensitivity, increment of peripheral glucose utilization etc. (Wang *et al.*, 2010).

The methanol extract of *Punica granatum* flower, in a dose of 500 mg/kg, inhibited glucose loading induced increase of plasma glucose levels in Zucker diabetic fatty rats. The study further suggested that its antidiabetic activity may result from improved sensitivity of the insulin receptor. Phytochemical investigation demonstrated that gallic acid in the methanol extract of flowers is mostly responsible for this activity (Tom *et al.*, 2005).

Oral administration of aqueous extract of flower in a dose of 250 and 500 mg/kg for 21 days, resulted in a significant reduction in fasting blood glucose, TC, TG, LDL-C, VLDL-C and tissue LPO levels coupled with elevation of HDL-C, GSH content and antioxidant enzymes in comparison with diabetic control group. The result suggested that it can be used as a dietary supplement, in the treatment and prevention of chronic diseases characterized by atherogenous lipoprotein profile, aggravated antioxidant status and impaired glucose metabolism (Bagri *et al.*, 2009).

Administration of aqueous ethanolic extract of flowers by oral route led to significant blood glucose lowering effect in normal, glucose-fed hyperglycemic and alloxan-induced diabetic rats. This effect may be due to increased peripheral glucose utilization. Retardation of intestinal glucose absorption may also be partly responsible for inhibition of hyperglycemia in glucose fed rats (Jafri *et al.*, 2000).

It was also reported in a study that the extract of *Punica granatum* flowers improved postprandial hyperglycemia in type 2 diabetic and obese animal model, and this effect at least partially resulted from inhibiting intestinal  $\alpha$ -glucosidase activity (Li *et al.*, 2005).

The anti-diabetic effect of the hydro-ethanolic extract of the *Punica granatum* flower was investigated in streptozotocin-induced diabetic rats. The results showed that the extract significantly reduced the serum glucose, cholesterol, triglycerides, LDL, urea, uric acid, creatinine, alanine amino transferase and aspartat amino transferase enzymes level, while increase serum HDL level in comparison to control diabetic rats (Eidi, 2014).

Recent study has shown that pomegranate flowers and juice may prevent diabetic sequelae via peroxisome proliferator-activated receptor-gamma binding and nitric oxide production. Pomegranate compounds associated with antidiabetic effects include oleanolic, ursolic and gallic acids (Katz *et al.*, 2007).

### Antiinflammatory

The anti-inflammatory activity of flower extracts of *Punica granatum* was assessed using the carrageenan induced rat paw edema model. Petroleum ether, dichloromethane and methanol fractions were found to reduce significantly the formation of edema in a dose of 100 mg/kg and showed inhibition of oedema volume at the end of 4 hours as its components inhibit both the COX and LOX enzymes and decline the prostaglandin release from cells (Sarker *et al.*, 2012).

A study carried out to investigate the anti-inflammatory activity of 50% ethanolic extracts of fruit rind, flowers and leaves of *Punica granatum* by oral route. The result exhibits anti-inflammatory effect of all three types of extracts (Bagria *et al.*, 2010).

### Hepatoprotective

A study was designed to investigate the hepatoprotective activity of *Punica granatum* flower extract *in vivo* in FEN-TA induced hepatotoxicity model. A weeklong pretreatment with extract significantly prevented FEN-TA induced oxidative stress and also inhibited hepatic injury and the liver retained almost normal hepatic architecture with much less pathological changes (Kaur *et al.*, 2006).

### Myocardial Infarction

A study was designed to investigate the effect of aqueous extract of the *Punica granatum* flower against the isoproterenol induced myocardial infarction in rats. The

results demonstrate that the extract markedly inhibited isoproterenol induced ECG alterations. Thus, the flower was found to be most effective in restoration of biochemical and ECG alterations in isoproterenol induced mice (Khatib *et al.*, 2011).

### Obesity

A study was designed to investigate the effects of pomegranate extract (6% punicalagin) in female rats following exposure to a diet containing 20% of the extract for 37 days. A significant decrease in feed consumption and body weight of the animals during the early part of the study was noted (Cerda *et al.*, 2003).

*Punica granatum* flower extract given to obese hyperlipidemic mice for five weeks caused significant decrease in body weight, percentage of adipose pad weights, energy intake, and serum cholesterol, triglyceride, glucose and total cholesterol/HDL ratios. Decreased appetite and intestinal fat absorption were also observed (Lei *et al.*, 2007).

### Wound healing

The flower of *Punica granatum* has potential in the management of wound healing because it significantly increased the rate of wound contraction and collagen turnover. Result of a study demonstrated that the ethanolic extract showed significant wound healing activity when topically administered in rats (Pirbalouti *et al.*, 2010).





## CONCLUSION

The flower of *Punica granatum* Linn (*Gulnar*) has been in use since times immemorial to treat wide range of indications. It has been subjected to quite extensive phytochemical, experimental and clinical investigations. Experimental studies have demonstrated their analgesic, antiatherosclerotic, antibacterial, antidiabetic, anti-inflammatory, hepatoprotective, myocardial infarction and effect on obesity and wound healing. The scientific studies have proved most of the claims of traditional medicines. However, further, detailed clinical research appears worthwhile to explore the full therapeutic potential of this plant in order to establish it as a standard drug.

## ACKNOWLEDGEMENT

The authors are extremely grateful to **Prof. Ghufan Ahmad**, Department of Ilmul Advia, Faculty of Unani Medicine, AMU, Aligarh for valuable guidance and moral encouragement for the study.

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