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## REVIEW ARTICLE

## Distribution and Medicinal importance of *Peganum harmala*- A review

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### Abstract

*Peganum harmala* is native to arid and semi-arid regions of Northern African and Asian deserts that have spread to parts of the southwestern United States and northern Mexico. *Peganum harmala* is an important medicinal plant with antimicrobial, antifungal, anti-inflammatory, anti cancerous, antidiabetic, hypothermic and hallucinogenic activities. Phytochemical investigations of the species has revealed the presences of a number of important active alkaloids especially beta-carboline alkaloids such as harmalol, harmaline, and harmine. This emphasizes on the need of widespread study for covering the supplementary information on the medicinal importance of other species of *Peganum* genus.

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### Distribution

*Peganum* is a genus of five to six species distributed in the old world from the Mediterranean to Mongolia and in the New world from Texas to Mexico (Decraene et al., 1996). Although it belongs to the family Zygophyllaceae but its taxonomic position is still debatable and a separate family Nitrariaceae has been proposed for this genus (Shehan and Chase, 1996). *Peganum* constitutes five to six species distributed in old world from the Mediterranean to Mongolia and in the New World from Texas to Mexico (Table 1).

*Peganum harmala* L. (2n = 24) is a perennial herb growing in Africa, the Middle East, India, Pakistan, South America, Mexico and several other countries (Kartal et al., 2003). *Peganum harmala* is native to arid and semi-arid regions of Northern African and Asian deserts that have spread to parts of the southwestern United States and northern Mexico (Abbott et al., 2007). It is a drought tolerant plant in arid parts of Central Asia, North Africa and Middle East and has been introduced in America and Australia (Mahmoudian et al., 2002). According to Frison et al. (2008) *Peganum harmala* is native to eastern Mediterranean region and widely distributed in Middle East, India, Mongolia and China. The species covers a wide area of great Paleo-arctic desert complex, ranging from Morocco, Spain, and eastward across the Mediterranean region, the Middle East, Central Asia of Gobi Desert in the Mongolian People's Republic and northern China (Porter, 1974). *Peganum harmala* can grow in areas receiving as little as 100 mm annual precipitation (Mahmoud et al., 1983; Walter and Box, 1983) and is considered drought tolerant (Levitt, 1980). The species grows with an altitudinal gradient of 1590 to 3400 m asl indicating that the species can tolerate a broad range of environmental conditions. In India it is usually found in drier parts of Jammu and Kashmir, Punjab, Haryana, Rajasthan, Uttar Pradesh and Delhi (Hajra, 1977). The plant is known as "Espand" in Iran, "Harmel" in North Africa and "African Rue", "Mexican Rue" or "Turkish Rue" in the United States (Mahmoudian et al., 2002) and "Izband" in Kashmir.

### Pharmacological uses:

*Peganum harmala* is a medicinal plant with antimicrobial (Arshad et al., 2008), anti-inflammatory and analgesic properties (Monsef et al., 2004). Carboline alkaloids obtained from various parts of the plant are used against number of diseases (Sobhani et al., 2002). The seeds of *Peganum harmala* are known to possess hypothermic and hallucinogenic properties and it is used as a medical remedy, incense, spice or condiment with abortifacient, narcotic, aphrodisiac, stimulant, sedative, emmenagogue, and emetic properties, and employed for the treatment of syphilis, fever, hysteria, malaria, neuralgia, parkinsonism, rheumatism, colic, asthma and eye complaints (Abdel

Fattah et al., 1995; Astulla et al., 2008; Berrougui et al., 2006; Elbahri and Chemli, 1991; Farouk et al., 2008; Monsef et al., 2004; Shahverdi et al., 2008). The alkaloid extract of seeds from *Peganum harmala* is considered to have anti cancerous activity which could prove as a novel anticancer therapy (Lamchouri et al., 1999).

El-Rifaie and Saad (1981) reported uses of *Peganum harmala* in certain dermatosis. The extract of *Peganum harmala* containing the alkaloids harmaline and harmine was topically used to treat certain (human) dermatoses of inflammatory nature (impetigo, pityriasis alba, cutaneous and leishmaniasis). Results were encouraging and proved the antibacterial, antifungal, antipruritic and probably antiprotozoal effects of the extract.

Overdose ingestion of *Peganum harmala* for medicinal use or as a recreational psychoactive product is toxic and several cases of toxicity have been already reported. It produces paralysis, euphoria, convulsions, hallucinations, digestive problems (nausea, vomiting), bronchodilator, hypothermia and bradycardia (Elbahri and Chemli, 1991; Frison et al., 2008; Mahmoudian et al., 2002). *Peganum harmala* is one of the most frequently used medicinal plants to treat hypertension and cardiac disease worldwide (Tahraoui et al., 2007). Many pharmacological studies suggest an antioxidant and free radical scavenging effect of *Peganum harmala* (Hamden et al., 2008).

### **Traditional uses:**

Hussain (1966) reported the burning of seed of *Peganum harmala* after child birth in northwestern India and West Pakistan. The seeds are placed on burning charcoal and the fumes are allowed to permeate the rooms for several days where a baby has been born. The seeds are also burnt where a marriage ceremony is taking place. The plant is proverbial in traditional medicine since earliest times as a remedy for a wide range of complaints (Shi et al., 2000). A red dye obtained from its seeds is widely used in Turkey and Iran for coloring carpets (Baytop, 1999). *Peganum harmala* has been traditionally used to treat diabetes in folk medicine of some parts of the world (Bnouham et al., 2002). In traditional medicine, *P. harmala* has been used among societies to treat some nervous system disorders such as Parkinson's disease (Leporatti, 2009), in psychiatric conditions (González et al., 2010) such as nervousity.

### **Phytochemicals**

The chemical analysis of various parts of *Peganum harmala* is given in Table 2

The aerial parts of *Peganum harmala* yield four new flavonoids acacetin 7-O-rhamnoside, 7-O-[6-O-glucosyl-2-O-(3-acetyl rhamnosyl) glucoside and the glycoflavone 2-O-rhamnosyl-2-O-glucosylcytisiside. *Peganum harmala* contains several alkaloids, which are found especially in the seed and the roots. These alkaloids include B-carbolines such as harmine, harmaline (identical with harmidine) harmalol and harman and quinazoline derivatives; vasicine and vasicinone (Mahmoudian et al., 2002; Kartal et al., 2003; Zayed and Wink, 2005).

Bukhari et al. (2008) reported that in *Peganum harmala* the harman alkaloids (harmine and harmaline) are mainly located in the roots and stem. The authors reported that Harman alkaloids (harmine and harmaline) were mainly investigated in seed by using different methods (% yield, Rf values, melting points, UV and IR spectra) for their identification and isolation.

Herraiz et al. (2010) identified harmaline, harmine, harmalol, harmol and tetrahydroharmine and quantified as the main b-carboline alkaloids in *P. harmala* extracts. Seeds and roots contained the highest levels of alkaloids with low levels in stems and leaves, and absence in flowers. Harmine and harmaline accumulated in dry seeds at 4.3% and 5.6% (w/w), respectively, harmalol at 0.6%, and tetrahydroharmine at 0.1% (w/w). Roots contained harmine and harmol with 2.0% and 1.4% (w/w), respectively.

### **Discussion**

The aim in preparing this paper was to give an idea about the traditional usage and pharmacological effects of *P. harmala* and to illustrate its potential to be used as a novel source for the development of new drugs based on the most recent associated studies. There are about 5 species of genus *peganum* but only *peganum harmala* have been subjected to chemical analysis. Other species have not been broadly subjected to chemical characterization and other biological studies as evident from perusal of the review of literature during the present study. Different plant parts of *Peganum harmala* contain several phenolic compounds and other alkaloids such as harmine, harmaline, harmalol, vasicine, vasicinone etc. with antimicrobial, antifungal, anti-inflammatory, anti cancerous hypothermic and hallucinogenic activities besides being medicinally important, also possess strong inhibitory activity on growth and germination of other plants (Sodaezadeh et al., 2009; Mohamoudian et al., 2002; Panhwar and Abro, 2007). *Peganum harmala* commonly known as African Rue is widely distributed in North Africa,

Mediterranean, the Middle East, Pakistan, India and Iran and has been introduced in America and Australia (Asghari and Lockwood, 2002; Ehsanpour and Saadat, 2002; Yousefi et al., 2009).

**Table 1: World distribution of different species of the genus Peganum**

Species	Continent	Country
Peganum harmala	Asia	China, India, Afghanistan, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Tajikistan, Turkmenistan, Uzbekistan, W. Asia, Iran, Iraq, Syria, Turkey, Jordan, Israel, Greece, Arabia.
	Europe	Russia, S. Europe
	N. America	USA, northern Mexico
	Africa	N. Africa
	Australia	Australia
Peganum multisectum	Asia	China
Peganum nigellestrum	Asia	China, Mongolia
	Europe	Russia
Peganum mexicanum	N. America	USA

Source: Flora of China (2008) and (Hooker, 1875)

**Table 2: Chemical profile of Peganum harmala (Chopra et al., 1949 and Anonymous 1966)**

Alkaloids	Root	Stem	Leaves	Flowers	Seeds	%age
Harman alkaloids (Harmine)	+	+	-	-	+	2.5-3%
Harmaline Dehydroharmine	+	+	-	-	+	2.5-3%
Quinazoline derivative de vasicine (Peganine)	-	+	-	+	+	2.5-3%
2,3trimethylene 4 quinazolone	-	-	-	-	-	2.5-3%
1,2,3-hydroxytrimethylene quinazolone(Harmalol)	-	+	-	-	+	2.5-3%
Harmalidine $\beta$ carboline	-	-	-	-	+	2.5-3%
Harmaline	-	-	-	-	+	2.5-3%
Pegamine	+	+	+	-	+	-
Vascinones	+	+	+	-	+	-

+ indicate presence, - indicate absence

## Conclusion

The plant species is used both in mainstream as well as in traditional system of medicine as a remedy for number of diseases. Based on this information, this review provides the evidence for other researchers to introduce P. harmala as a safe and effective remedial source in the future. Since there is a need to widen this study for other

species as well, which may establish vital importance and could lead to development of new and novel remedial products as well, as only *Peganum harmala* was being subjected to phytochemical analysis.

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