

Distribution, Status, Pharmacological, and Traditional importance of *Peganum harmala* L.

Nissar Ahmad Khan¹, Aamir Raina², Nasir Aziz Wagay³, Younas Rasheed Tantray⁴

¹Department of Botany, faculty of life Sciences, Punjabi University, Patiala, Punjab(India)

²Mutation breeding Lab, Department of Botany, Aligarh Muslim University, Aligarh-U.P (India)

³Department of Botany, faculty of life sciences, Amravati University, Amravati- Mumbai (India)

⁴Department of Botany, faculty of life Sciences, Punjabi University, Patiala, Punjab (India)

ABSTRACT

Peganum harmala L. Commonly known as Syrian rue, Wild rue or Harmal 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. It is a multipurpose medicinal plant with antimicrobial, antifungal, anti-inflammatory, antidiabetic, anti cancerous, hypothermic and hallucinogenic activities. Phytochemical investigations has revealed the presences of a number of active alkaloids especially beta-carbolines such as harmalol, harmaline, and harmine. Seeds and roots contain the highest levels of alkaloids with low level in stem and leaves and absent in flowers. This emphasizes on the need of widespread study for covering the supplementary information on the medicinal importance of other species of genus *peganum*.

Keywords: Beta- carbolines, distribution, *Peganum harmula*, pharmlology, Toxicity.

I. INTRODUCTION

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 [1] (Table 1). The genus contains perennial herbs which are dispersed in the central Asia, Mexico and the Southern United States. It is a member of Zygophyllaceae, consisting of six species in China out of which three species, *P. harmala* Linn. *P. nigellastrum* Bunge. and *P. multisectum* (Maxim.) Bobr. are found mainly in arid and semi-arid areas in northwest China and are vital components of the desert vegetation. 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 [2]. *Peganum harmala* L. (2n=24) is a perennial flowering herb growing in Africa, the Middle East, India, Pakistan, Mexico, South America and several other countries [3]. It is native to arid and semi-arid regions of Northern African and Asian deserts that have spread to parts of the South Western United States and Northern Mexico [4]. 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 [5]. According to [6] *Peganum harmala* is native to eastern Mediterranean region and widely distributed in Middle East, India, Mongolia and China. *Peganum harmala* can grow in areas receiving as little as 100 mm annual precipitation [7, 8] and is considered drought tolerant [9]. The species grows with an altitudinal gradient

of 1590-3400 m as 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 [10].

II. BOTANICAL DESCRIPTION

Peganum harmala L. is a perennial herbaceous, branched into 5-13 stems, glabrous plant which grows upto 30-100cms in height. The leaves are palmatisected into 3-5 linear lobes which are 3-6 cms long and 1.5-3.0 mm wide. Flowers arise by 1-3 on apexes of branches which bear whitish-yellow petals in color. The fruits are globular capsule with 3 chambers, 0.9-1.3 cm in diameter and containing 35-45 angular blackish seeds [11]. The plant is not usually grazed by animals due to its bitter taste.

III. PHARMACOLOGICAL USES

Peganum harmala is a well-known and effective medicinal plant in Turkey, Iran and China, especially in Xinjiang and Mongolia [3,12, 13]. Carboline alkaloids obtained from different parts of the plant are used against number of diseases [14]. The seeds and the whole plant possess medicinal properties (Uighur Drug Standard of the Ministry of Public Health) and various reports suggest that the plant can be used to treat ailments such as rheumatism, hypertension, diabetes, asthma and jaundice. The seeds also possess hallucinogenic and hypothermic properties and are used as a medical remedy, incense, condiment with necrotic, sedative, aphrodisiac, stimulant and emetic properties. The Seeds are used for the treatment of fever, malaria, hysteria, neuralgia, rheumatism, asthma, syphilis an eye. [15, 16, 17, 18, 19, 20,] In addition, *P. harmala* is also an anti-parasitic agent. Moreover, the alkaloids identified in *P. harmala* exhibit some pharmacological action, such as antitumor and analgesic effects [18, 21, 22], vasorelaxant activity [23], antimicrobial properties [24, 25] and are strong inhibitors of monoamine oxidase. [26]. The seeds and whole plants of *P. nigellastrum* and *P. multisectum* are sometimes used as substitutes for *P. harmala* in medicinal market. Carboline alkaloids obtained from various parts of the plant are used against number of diseases [13]. The alkaloid extract of seeds from *Peganum harmala* is considered to have anti cancerous activity which could prove as a novel anticancer therapy [27]. 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) [28]. Results were encouraging and proved the antibacterial, antifungal, antipruritic and probably antiprotozoal effects of the extract.

IV. TOXICITY

The overdose ingestion of *Peganum harmala* for medicinal use is toxic and several cases of toxicity have been already reported. It causes headache, dizziness, nausea, convulsions, hallucinations, paralysis, euphoria, digestive problems, bronchodilator, hypothermia and bradycardia [5, 6, 17]. *Peganum harmala* is one of the most frequently used medicinal plants to treat hypertension and cardiac disease worldwide [29]. Many pharmacological studies suggest an antioxidant and free radical scavenging effect of *Peganum harmala* [30]. During in vivo study, intrapretoneal administration of *P. harmala* dose results in abnormal writhing, body tremors and slight reduction in locomotor activity. These reports have been also been ascertained in human



cases wherein seed extract infusion of *P. harmala* depicted neuro;sensorial symptoms, visual hallucination, elevation of body temperature, cardiovascular disorder, ataxia, diffuse tremors and vomiting. Elavated doses of *P. harmala* extract may lead to liver degeneration, spongiform alteration in CNS, hypothermia, convulsions and brady cardia. Besides, intercalation of *P. harmala* into DNA leads to mutagenic activity and results in genotoxic effects. The beta-carbolines of *P. harmla* interacts with various signalling pathways such as dopamine, benzodiazepine, imidazoline, and 5- hydroxytryptamine.

V. TRADITIONAL USES:

Peganum harmala has been traditionally used for the treatment of diabetes in folklore medicine in some parts of the world [31]. [32] 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 during marriage ceremony and plant is proverbial in traditional medicine since earliest times as a remedy for a wide range of complaints [33]. A red dye extracted from seeds of *peganum* is used in Turkey and Iran for coloring carpets [34]. In traditional medicine, the species has been used to cure some nervous system disorders such as Parkinson's disease [35] in psychiatric conditions [36].

VI. PHYTOCHEMISTRY

The common known phytochemical compounds from *P. harmala* are alkaloids, flavonoids and anthraquinones [37, 38, 39]. The total alkaloid content of *P. harmala* varies between 2 to 5%. Seeds and roots are the richest sources of alkaloids with low levels in stems and leaves and absent in flowers. The above ground parts of *Peganum harmala* produce four new flavonoids acacetin 7-0-rhamnoside, 7-0-[6-0-glucosyl-2-0-(3- acetyl rhamnosyl) glucoside and the glycoflavone 2-0-rhamnosyl-2-o-glucosylcytisoside. Various alkaloids have found especially in seeds and roots of *P. harmala* such as harmine, harmaline, harman and quinazoline derivatives; vasicine and vasicinone [3, 5, 40]. Roots contain harmine and harmol with 2.0 and 1.4% (w/w) respectively [41]. Harmaline was first isolated from the seeds and roots of p. harmala and is the major alkaloid of the plant [5]. Harmine is also present in the roots of *P.harmala* and pharmacologically resembles harmaline in its action, but is less toxic. Vasicine and Vasicinone the potential quinazoline alkaloids and were first discovered in flowers and stems of *P. harmala* [5]. [37] reported that in *Peganum harmala* the alkaloids harmine and harmaline are restricted in the roots and stem. The authors reported that these alkaloids were mainly investigated in seeds by using different methods (% yield, Rf values, melting points, UV and IR spectra) for their identification and isolation. [41] confirmed harmaline, harmine, harmalol, harmol and tetrahydroharmine and quantified as the main b-carboline alkaloids in *P. harmala* extracts. 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. The chemical analysis of various parts of *Peganum harmala* is given in Table 2.

VII. DISCUSSION

The objective of this paper has been to show the recent advances in the exploration of Species *Peganum harmala* as distribution, traditional usage, pharmacological usage, toxic effects and to illustrate its potential to be used in various novel drugs based on the most recent findings. There are about 6 species of genus *peganum* but only *peganum harmala* have been studied for chemical analysis. Simultaneously rest of the species have not been confirmed 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 [5, 42, 43,]. *Peganum harmala* widely distributed in North Africa, Mediterranean, the Middle East, Pakistan, India and Iran and has also been introduced in America and Australia [44, 45, 56].

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

Species	Continent	Country
<i>Peganum harmala</i>	Asia	India, China, Afghanistan, Pakistan, Mongolia, Kazakhstan, Uzbekistan, Iran, Iraq, turkey, Syria, Jordan, Israel, Greece, Arabia.
	Europe	Russia, south Europe
	North America	USA, north Mexico
	Australia	Australia
	Africa	North Africa
<i>Peganum multisectum</i>	Asia	China
<i>Peganum nigellestrum</i>	Europe	Russia
	Asia	China, Mongolia
<i>Peganum mexicanum</i>	North America	United states

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

Alkaloids	Root	Stem	Leaves	Flowers	Seeds	Percentage
Harmine	+	+	—	—	+	2.5-3%
Harmaline	+	+	—		+	2.5-3%
Dehydroharmine						
Quinazoline derivative de vasicine (Peganine)	—	+	—	+	+	2.5-3%
2,3 trimethylene	—	—	—	—		2.5-3%

4 quinazalone						
1,2,3 hydroxymethylene quinazalone (Harmalol)	–	+	–	–	+	2.5-3%
Harmalidine β caroline	–	–	–	–	–	2.5-3%
Harmaline	–	–	–	–	+	2.5-3%
Pegamine	+	+	+	–	+	–
Vascinones	+	+	+	–	+	–

VIII. ACKNOWLEDEMENTS

The authors are grateful to the University Grant commission, New Delhi for providing financial assistance under the DRS, SAP I, II & III, ASSIST Programme and Research associate to Nissar Ahmad Khan under IFFCO Project. The authors are thankful to Head, Department of Botany, Punjabi University, Patiala for providing necessary laboratory, herbarium and library facilities.

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