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A VALUABLE MEDICINAL PLANT

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Abstract: Peganum harmala L. (Syrian Rue) is a perennial herbaceous plant of the family Nitrariaceae, widely distributed in arid and semi-arid regions of Eurasia and North Africa. This plant has been traditionally used in folk medicine across many cultures due to its pronounced bioactive properties. This article provides a comprehensive overview of the biological and ecological characteristics of P. harmala, as well as an in-depth analysis of its medicinal properties, attributed to its rich phytochemical composition, particularly the presence of β-carboline alkaloids. The chemical composition, pharmacological action, traditional uses, and potential for modern pharmacology are discussed.

Keywords: Folk medicine, phytochemical composition, pharmacology, ethnobotanical properties, pharmacological properties.

Introduction. For millennia, plants have served as the primary source of medicinal remedies for humanity. Among them, Peganum harmala L. (Syrian Rue) holds a special place, known for its unique ethnobotanical and pharmacological properties. Historical records attest to its use in various cultures as a ritual plant, a dye, and a potent medicinal agent. Modern scientific research confirms many of these traditional applications, revealing a complex phytochemical profile and diverse biological activities.

Biological and Ecological Characteristics. Peganum harmala L. belongs to the order Sapindales, family Nitrariaceae (previously often classified under Zygophyllaceae). It is a

perennial, branched, herbaceous plant, reaching up to 1 meter in height. It is characterized by a deep and extensive root system, which allows it to survive in drought conditions. The leaves are alternate, pinnately dissected, and grayish-green. The flowers are solitary, white or yellowish-white, located in the leaf axils. The fruit is a spherical capsule containing numerous black, angular seeds. The distribution range of P. harmala covers a wide spectrum of arid and semi-arid zones, including Central and Middle Asia, the Middle East, North Africa, and parts of Southern Europe and India. The plant prefers open, sunny locations and is often found in pastures, roadsides, desert and semi-desert areas, on saline soils and sandy soils. Its ability to adapt to extreme conditions is due to its developed root system and metabolic resilience. In ecosystems where Peganum harmala grows, it can play both positive and negative roles. On the one hand, its deep root system contributes to soil stabilization and erosion prevention. On the other hand, in some regions, it is considered an invasive weed that competes with cultivated plants for resources, and its toxicity can pose a danger to livestock if consumed excessively.

Compound Class Examples and Properties

1 Quinoline alkaloids: Peganine (vasicine) and its derivatives.

2 Flavonoids: Rutin, quercetin, and others, possessing antioxidant properties.

3 Phenolic compounds: Coumarins, lignans.

4 Other components: Resins, fatty acids, proteins, minerals.

5 β-carboline alkaloids: The most studied and biologically active components are harmine, harmaline, harmalol, harman, and tetrahydroharmine.

Medicinal properties of P. harmala are due to a complex of secondary metabolites, among which β-carboline alkaloids dominate.

Monoamine oxidase (MAO) inhibitors: Harmine and harmaline are reversible MAO-A inhibitors, which explains their psychoactive properties (mild euphoric, hallucinogenic effects at high doses) and potential antidepressant action.

Antitumor activity:In vitro and in vivo studies show that harmine and harmaline can inhibit the growth of various cancer cells, induce apoptosis, and suppress angiogenesis. Mechanisms include DNA intercalation, topoisomerase inhibition, cell cycle modulation, and activation of apoptotic pathways.

Antimicrobial activity: P. harmala extracts and its alkaloids exhibit a wide range of antibacterial, antifungal, and antiviral activity against various pathogens.

Anti-inflammatory activity: Noted ability to reduce the production of pro-inflammatory cytokines and modulate the activity of enzymes involved in inflammatory processes.

Neuroprotective activity: Some studies indicate potential in protecting neurons from oxidative stress and other damaging factors, which may be relevant in neurodegenerative diseases.

Antiparasitic activity: Traditionally, Peganum harmala has been used to treat parasitic infections. Modern research confirms its effectiveness against some types of helminths and protozoa.

Traditional Use and Ethnobotany. Peganum harmala has deep roots in the traditional medicine and culture of many peoples.

In the Middle East and North Africa: Harmala seeds were used to treat fever, rheumatism, pain, intestinal parasites, diarrhea, and skin diseases. Smoke from burning seeds was used to disinfect rooms and ward off evil spirits.

In Central Asia: Widely used to treat nervous disorders, depression, insomnia, and also as an anti-inflammatory and antibacterial agent. Seeds are used as a dye for carpets and fabrics.

In India (Ayurveda): Known as "Haoma" and used as a tonic, sedative, and antispasmodic agent.

Ritual Use: Some cultures used harmala in rituals, linking its psychoactive properties with spiritual insight.

Despite its numerous beneficial properties, P. harmala is a potentially toxic plant, especially when taken in high doses. β-carboline alkaloids can cause:

Gastrointestinal disturbances: Nausea, vomiting, diarrhea.

Neurological effects: Dizziness, tremors, hallucinations, convulsions.

Cardiovascular effects: Changes in blood pressure and heart rate.

Development of new antitumor drugs: β-carboline alkaloids can serve as a basis for the synthesis of new, more selective, and less toxic anticancer agents.

Antimicrobial agents: The search for new antibiotics and antifungal drugs based on harmala components is becoming increasingly relevant in the face of growing antibiotic resistance.

Agents for the treatment of neurodegenerative diseases: The neuroprotective properties of alkaloids can be used to develop drugs against Parkinson's disease, Alzheimer's disease, and other diseases.

Psychiatric drugs: MAO modulation and other neuroactive properties may lead to the development of new antidepressants or anxiolytics, but require careful study of safety and dosage.

Natural pesticides: Investigation of insecticidal and fungicidal properties for environmentally friendly pest control methods in agriculture.

Conclusion. Peganum harmala L. is a unique plant with a deep history of traditional use and significant potential for modern medicine. Its rich phytochemical profile, particularly the presence of β-carboline alkaloids, determines a wide range of pharmacological actions, including antitumor, antimicrobial, anti-inflammatory, and neuroprotective properties. However, like any powerful medicinal plant, harmala requires a cautious approach to its use due to potential toxicity and the risk of interactions with other

substances. Further in-depth research, including clinical trials, is necessary to fully unlock the therapeutic potential of P. harmala and develop safe and effective drugs based on it.

References:

1. Korsun V. F. Atlas of effective medicinal plants. — Moscow: Eksmo, 2010. — 383 p. — (Medical Atlas). Cipher 42; Author's mark K695; B 2307980-SB

2. Korsun V. F. Medicinal plants in gastroenterology: a guide to clinical phytotherapy. — Moscow: Practical Medicine, 2008. — 458 p.

3. Medicinal plants: family healer: reference book. — Moscow: Onyx: Center for Universal Human Values, 2008. — 443, [1] p. — (Home Medicine). 2308387-KH

4. Srivastava, J. P., & Singh, J. (2012). Ethnomedicinal uses and pharmacological aspects of Peganum harmala L. – A review. Journal of Medicinal Plants Studies, 1(4), 1-5.

5. WHO databases and monographs on medicinal plants (e.g., PubMed, ScienceDirect, WHO Monographs on Selected Medici).