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Review Paper

Pharmacological Insights into *Ziziphus mauritiana*: A Comprehensive Review of Its Therapeutic Potential

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ABSTRACT

The Ber, or Indian Jujube (*Ziziphus mauritiana*), is a key genus in the Rhamnaceae family. This fruit is one of the most ancient and is native to India, thriving in tropical, subtropical, and arid regions. India has a rich diversity of this species. Due to its composition of various phytochemicals, bioactive compounds, vitamins, and other nutrients, *Ziziphus mauritiana* is known for its effectiveness in treating and preventing numerous health issues. It is characterized as a spiny evergreen shrub or small tree, reaching heights of up to 15 meters, with a trunk diameter of 40 cm or more, a spreading crown, stipular spines, and numerous drooping branches. This plant is recognized for its strong medicinal properties and contains a variety of biologically active compounds, including phenols, flavonoids, saponins, and alkaloids. It exhibits significant activities such as anti-cancer, antioxidant, wound healing, anti-fertility, anti-inflammatory, anti-ulcer, anti-diarrheal, antifungal, and analgesic effects. *Z. mauritiana* is considered an important plant for pharmacological purposes. This review paper critically examines and summarizes data on its pharmacological activities, Ayurvedic uses, morphology, and geographical distribution.

INTRODUCTION

Herbal remedies were the earliest forms of medicine utilized by humans, thanks to the numerous biologically active secondary metabolites that plants produce. These treatments are prevalent in various medical environments,

making them essential for primary care. Gaining insight into how herbal medicines are collected, processed, and standardized can assist healthcare providers in advising patients who are looking for the most effective and cost-efficient treatment options.[1]

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Medicinal plants are remarkable gifts from nature, brimming with diverse chemical compounds that naturally occur in various parts of the plant and are harnessed for healing purposes. These compounds, known as secondary metabolites, hold the potential to be transformed into innovative medications, demonstrating impressive efficacy in addressing serious health conditions. The World Health Organization (WHO) reveals that nearly 80% of the global population turns to these herbal remedies for essential healthcare, drawn by their proven effectiveness and the accessibility they offer. [4] Medicinal plants are rich in essential nutrients—carbohydrates, proteins, and fats—that are crucial for the body's physiological and metabolic functions. [2, 3] Plants are essential for discovering new medicinal compounds, including their phytochemical ingredients like antioxidants, substances that lower blood sugar, and those that reduce lipid levels. They serve as a rich source of medicines, with numerous pharmaceuticals being obtained directly or indirectly from plant materials. [31, 5] The ancient inhabitants of India harnessed the healing power of *Ziziphus mauritiana*, a revered plant noted in the Yajurveda. Herbal remedies, celebrated as some of humanity's oldest medicinal practices, continue to thrive in developing nations, cherished for their rich traditions and deep-rooted acceptance within communities. [29]

About 25% of today's prescription medications are derived from medicinal plants undergoing rigorous testing. One notable example is *Ziziphus mauritiana*, or Indian jujube, a resilient plant found in tropical and subtropical regions worldwide. This member of the Rhamnaceae family requires minimal maintenance, making it ideal for revitalizing resources in underdeveloped areas while showcasing the potential of nature for sustainable development. [7] *Ziziphus* leaves aid in treating diarrhea, wounds, inflammation, fever, asthma, liver issues, and gonorrhea. Secondary

metabolites, or bioactive compounds, are usually derived from plants. [8, 9] Traditional medicine has utilized various parts of the *Z. mauritiana* tree, including its fruits, seeds, leaves, bark, and roots, to address ailments such as fever, inflammatory conditions, sleep disorders, and skin problems. [10]. *Z. mauritiana* is classified as a tropical fruit tree. This species can grow into a small tree or a spiny perennial shrub, reaching heights of up to 15 meters. It has a broad crown and a trunk that can measure at least 40 centimeters in diameter. Notably, it is characterized by numerous hanging branches and stipular spines. The fruit varies in size and shape, appearing oval, obovate, oblong, or round, with lengths ranging from 1.25 to 2.5 inches (2.5 to 6.25 cm) depending on the variety. This plant thrives primarily in tropical or subtropical climates. Although it is native to India, its distribution has expanded to tropical regions worldwide, including Africa, Afghanistan, China, Malaysia, Australia, and certain Pacific islands. In places like Australia and Fiji, it can create dense colonies and exhibit invasive traits. In India, the fruit is commonly referred to as "Ber" in Hindi and "Badrah" in Sanskrit. Originally discovered in the Middle East and the Indian subcontinent, this species is now cultivated in tropical and subtropical regions due to its rich nutritional value. [11]

MORPHOLOGY AND DISTRIBUTION:

Ziziphus mauritiana is an evergreen shrub or small tree that can grow up to 15 meters tall and features a trunk that can reach over 40 centimetres in diameter. It has a wide-spreading crown, stipule spines, and numerous drooping branches. The bark is dark grey or dull black and has an irregularly fissured texture. In harsher climatic conditions, it often forms a more compact shrub that measures only 3 to 4 meters in height. The leaves are variable, arranged alternately in two rows, and have an oblong-elliptic shape, measuring 2.5-6 cm



long and 1.5-5 cm wide. The leaf tips are rounded or slightly notched, with finely wavy-toothed edges; the upper surface is shiny green and hairless, while the underside is densely covered with soft, whitish hairs.

The flowers are borne in axillary cymes measuring 1-2 cm in length, typically containing 7-20 blooms. Each flower is around 2-3 mm in diameter, greenish-yellow in color, and has a faint fragrance. The flower pedicels are 3-8 mm long, and the calyx features five deltoid lobes that are hairy on the outside and glabrous on the inside. The petals are five in number, subspathulate, concave, and reflexed.

The fruit is a drupe that can be globose to ovoid, reaching sizes of up to 6 x 4 cm in cultivated versions, but usually is much smaller in the wild.

Its skin can be smooth or rough, glossy, thin yet tough, and varies in color from yellowish to reddish or blackish. The flesh is white, crisp, juicy, and has a subacid to sweet taste, becoming mealy when fully ripe. Inside the fruit, the seed is a tuberculate stone with irregular furrows, containing 1-2 elliptic brown kernels that are about 6 mm long. [12, 13]

CLASSIFICATION:

Kingdom: Plantae

Phylum: Tracheophyta

Class: Magnoliopsida

Order: Rosales

Family: Rhamnaceae

Genus: Ziziphus

Species: mauritiana



COMMON NAMES:

English name (Indian jujube)

Hindi (Baer, ber)

Bengali (Kool, ber, boroi)

Marathi (Bar, bera)

Gujarati (Bor, bordi)

Telgu (Reegu, gangareegu, karakandharu)

Tamil (Elandai, yellande elladu)

Kanda (Yalachi, elanji)

Malalum (Eentha)

Oriya (Barkoli, bodokoi, bodori)

Rajasthan (Bor, bordi).

AYURVEDIC THERAPEUTICS:

In Ayurveda, the root of *Ziziphus mauritiana* (Badara) is recognized for its bitter and cooling properties, helping to alleviate conditions like kapha imbalances, biliousness, and headaches. A decoction made from the roots is utilized for treating fevers, while the powdered form is applied to old wounds and ulcers. The bark serves as a remedy for diarrhea and is effective in treating boils. The leaves possess a bitter and cooling nature and are known to relieve kapha, biliousness, and diarrhea. Additionally, the leaves are regarded

for their antipyretic and anti-obesity properties. The fruit has mucilaginous qualities, is considered beneficial for the respiratory system, acts as a styptic, and is thought to purify blood and enhance digestion. It also serves as a cooling aphrodisiac, anodyne, tonic, laxative, and invigorating agent. The preparation known as JOSHANDA, made from the fruit, is commonly used for respiratory issues. [14, 15]

PHARMACOLOGICAL ACTIVITIES:

ANALGESIC ACTIVITY:

Numerous studies have shown that extracts from the plant, particularly those obtained from its leaves and seeds, possess notable pain-relieving properties. The mechanisms contributing to these effects involve modulation of the central nervous system (CNS) and anti-inflammatory actions. To assess the efficacy of analgesic compounds against visceral pain, the writhing test is employed. Research indicates that extracts of *Ziziphus mauritiana* decrease the frequency of writhing caused by acetic acid in animals, suggesting the plant's ability to alleviate pain through anti-inflammatory mechanisms. At dosages of 250 and 500 mg per kg of body weight, the extract achieved writhing inhibition rates of approximately 42.92% and 59.67%, respectively, while the positive control, diclofenac sodium, resulted in a 77.71% inhibition at a dosage of 25 mg per kg. [16]

In a different study, the analgesic effects of a crude methanolic extract from the leaves of *Z. mauritiana* were assessed using the radiant heat tail-flick method. The results showed that the crude extract increased the reaction time in a dose-dependent manner. Specifically, at a dose of 400 mg/kg body weight, the methanolic extract significantly reduced pain sensation by 48.55%, 57.77%, and 61.44% at 30, 60, and 90 minutes, respectively, in comparison to standard morphine at a dosage of 10 mg/kg body weight. [17]

ANTIDIABETIC ACTIVITY:

Diabetes is a medical condition marked by high blood sugar levels, known as hyperglycemia. A study examined the potential impacts of various extracts from *Z. mauritiana* fruit on diabetes management. The researchers investigated extracts using petroleum ether, chloroform, acetone, and water. The antihyperglycemic extracts demonstrated hypoglycemic effects at two dosage levels (200 and 400 mg/kg), resulting in a modest yet significant reduction in blood glucose levels. [18]. The potential hypoglycemic effect of *Z. mauritiana* seed extract was evaluated in a study involving diabetic mice induced by alloxan. Mice were administered three different dosages per kilogram of body weight—100, 400, and 800 mg. The sub-acute studies indicated a decrease in mortality rates and weight loss after the extract was given. Among the groups, those receiving the combined treatment of 800 mg/kg seed extract and 10 mg/kg glyburide experienced the most significant improvements in blood glucose levels, weight reduction, and mortality rate. Additionally, the extract enhanced glucose tolerance in both normal and diabetic rats. The findings suggest that the extract lowers blood glucose levels in a synergistic fashion. [19].

ANTIMICROBIAL ACTIVITY:

The **disc diffusion method** has effectively demonstrated the **antimicrobial potential** of *Ziziphus mauritiana*, highlighting its activity against a broad spectrum of microorganisms, including both bacteria and fungi. The plant extract has a significant level of antibacterial activity against the gram-positive bacteria and gram-negative bacteria. [20, 25, 30]

ANTI-DIARRHOEAL ACTIVITY:

Castor oil, known to induce diarrhea by stimulating the intestinal lining, has been utilized



in studies to evaluate the antidiarrheal effects of *Ziziphus mauritiana*. The research indicated that the extract led to a dose-dependent reduction in the volume of fecal matter excreted by mice subjected to castor oil-induced diarrhea. Specifically, at doses of 25 and 50 mg/kg, there was a notable decrease in diarrhea, with inhibition rates of 38.23% and 44.11%, respectively. Thus, *Ziziphus mauritiana* demonstrates promising antidiarrheal potential, which is supported by both traditional usage and modern pharmacological research. Its diverse effects—including antibacterial, anti-inflammatory, antispasmodic, and astringent properties—suggest it could serve as an effective natural treatment for diarrhea. [21].

HEPATOPROTECTIVE ACTIVITY:

Damage to the liver's structural integrity is indicated by elevated serum transaminase levels, which are cytoplasmic enzymes that are released into the bloodstream following cell damage. In this study, a similar increase in SGOT, SGPT, and ALP levels was noted in rats treated with paracetamol. *Ziziphus mauritiana* appears to protect the liver cell membrane's structural integrity, as evidenced by a significant decrease in serum SGOT, SGPT, and ALP levels, thereby providing defence against liver toxicity caused by paracetamol. [22, 23].

WOUND HEALING:

An excisional wound model was utilized to investigate the wound healing properties in male albino rats. The findings indicated that *Z. Mauritiana* Lam. demonstrated notable wound healing potential in these rats. It was noted that the wound contraction capability of the test formulation was significantly higher compared to both the control and the reference standard ($p < 0.05$). [24]

ANTIULCER ACTIVITY:

The antiulcer effects of *Ziziphus mauritiana* are well-documented through both scientific studies and traditional practices. The plant is believed to be effective in ulcer treatment due to its properties as an antioxidant, anti-inflammatory, antimicrobial, and gastroprotective agent. Different concentrations of *Ziziphus mauritiana* have demonstrated a notable decrease in gastric lesions. [26]

ANTI-OXIDANT ACTIVITY:

The fruit, leaves, seeds, and other elements of *Ziziphus mauritiana* are imbued with a wealth of bioactive compounds, including flavonoids, alkaloids, saponins, and phenolic acids, all celebrated for their remarkable antioxidant properties. These powerful compounds work synergistically to neutralize free radicals, offering vital protection to our cells against oxidative stress—a perilous condition linked to a myriad of chronic diseases, from cancer and cardiovascular ailments to neurodegenerative disorders. Embracing *Ziziphus mauritiana* not only nourishes the body but also fortifies it against the silent threats of modern health challenges. [27]

ANTI-INFLAMMATORY ACTIVITY:

Chronic inflammation plays a significant role in various diseases, including arthritis, heart conditions, and diabetes. *Ziziphus mauritiana* has shown remarkable anti-inflammatory properties. The plant's extracts, especially those from its leaves, have been found to block pro-inflammatory cytokines and decrease the generation of inflammatory substances such as nitric oxide. The anti-inflammatory effects are linked to bioactive compounds like flavonoids and alkaloids. In a study, *Ziziphus mauritiana* extract was used to address carrageenan-induced

biochemical alterations in rat paw edema, resulting in a notable decrease in inflammation. [28]

CONCLUSION

Z. mauritiana is a significant species in forestry, known for its remarkable potency due to the presence of compounds such as flavonoids, alkaloids, saponins, terpenes, and other biologically active substances. This plant not only possesses beneficial biological properties and serves as a food source, but it also has economic advantages for society. The bioactive compounds in *Z. mauritiana* exhibit a range of biological effects. Additionally, it is rich in essential nutrients like proteins and carbohydrates, enhancing its nutritional value. Pharmacological studies have validated its traditional uses by demonstrating the connection between its biological activity and the composition of secondary metabolites, as well as its ethnopharmacological applications. *Z. mauritiana* shows promise in treating various ailments and has numerous medicinal properties, including analgesic, antibacterial, anti-diarrheal, antidiabetic, antiulcer, wound healing, and hepatoprotective activities, among others. The presence of important medicinal components such as flavonoids, alkaloids, and saponins underscores its potency. Literature reviews indicate that this plant is highly valuable and has vast potential for future medicinal applications. Always consult a professional before using any plant for medicinal purposes.

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