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Review Article

THERAPEUTIC POTENTIAL OF *ZIZIPHUS RUGOSA* LAM.: A COMPREHENSIVE REVIEW OF ETHNOPHARMACOLOGY, PHYTOCHEMISTRY AND BIOLOGICAL ACTIVITIES

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ABSTRACT

Medicinal plants continue to play a significant role in healthcare systems worldwide owing to their rich phytochemical composition and diverse pharmacological activities. *Ziziphus rugosa* Lam., a member of the family Rhamnaceae, is an underexplored medicinal plant widely distributed in tropical and subtropical regions of South and Southeast Asia. Traditionally, various parts of the plant, including the bark, leaves, fruits, flowers, and roots, have been employed in the treatment of gastrointestinal disorders, skin diseases, wounds, cough, diarrhea, mouth ulcers, menorrhagia, respiratory ailments, and inflammatory conditions. Phytochemical investigations have revealed the presence of numerous bioactive constituents such as flavonoids, tannins, saponins, cyclopeptide alkaloids, triterpenoids, phenolic acids, glycosides, and phytosterols, which are responsible for its broad spectrum of biological activities. Experimental studies have demonstrated that *Z. rugosa* possesses significant antioxidant, anti-inflammatory, antimicrobial, hepatoprotective, anti-ulcer, wound-healing, analgesic, and cytoprotective properties, supporting many of its traditional therapeutic applications. The pharmacological actions of the plant are attributed to multiple mechanisms, including free radical scavenging, modulation of inflammatory mediators, enhancement of endogenous antioxidant defense systems, antimicrobial activity, and protection of gastrointestinal mucosa. Despite its promising therapeutic potential, comprehensive scientific validation, toxicity evaluation, standardization of extracts, and well-designed clinical studies remain limited. This review summarizes the botanical characteristics, geographical distribution, traditional uses, phytochemical profile, pharmacological activities, mechanisms of action, therapeutic applications, dosage forms, and future research prospects of *Ziziphus rugosa*.

Keywords: *Ziziphus rugosa*; Rhamnaceae; phytochemicals; flavonoids; triterpenoids; cyclopeptide alkaloids; antioxidant; anti-inflammatory; antimicrobial; hepatoprotective; wound healing; traditional medicine; ethnopharmacology; phytopharmaceuticals.

INTRODUCTION

The world health organization (WHO) estimates that 4 billion people, 80 percent of world population presently use herbal medicine for some aspect of primary health care. WHO notes that 119 plants derived pharmaceutical medicines correlated directly with their traditional uses as plant medicines

by native cultures (Ross, 2003). The plant kingdom still holds many species of plant containing substances of medicinal value which have yet to be discovered and large numbers of plants are constantly being screened for their pharmacological value in addition to the already exploited plants. As a result of modern isolation techniques and pharmacological screening procedures new plant drugs usually find their place in modern medicine (Wermuth, 2003). The most of the medicinal preparations now a day's available in the market are either not effective up to the mark or has developed resistance resulting in reoccurrence again. Plant derived drug serve as prototype to develop more effective and less toxic medicines (kumar and Sunder, 2011; Palaksha *et al*., 2013).

Ziziphus rugosa is one of the wild plants belongs to the family Rhamnaceae. This is a large family of flowering plants, mostly trees, shrubs, and some vines, commonly called as buckthorn family, included in the order Rosales. *Ziziphus rugosa* Lam. chiefly found in dry deciduous forests (Hosne *et al*., 2008; Wu, 1994). It is a large straggling thorny evergreen straggling spiny shrub or small tree, 3-6 m tall, Leaves are alternate, dark-green, broadly ovate or broadly elliptic, serrate, oblique or subcordate or rounded at the base (Gamble, 2014; Greeshma and Sridhar, 2016). The Kodava community in the Kodagu region of the Western Ghats eats the raw and ripened fruit for nutritional source traditionally. This plant is host for Laccifer lacca, a parasitic scale insect9 and is food for various wild animals like Elephant and Deer (Hong, 1994).

Taxonomical classification:

- **Kingdom:** Plantae
- **Division:** Tracheophytes
- **Subdivision:** Angiosperms
- **Order:** Rosales
- **Family:** Rhamnaceae
- **Genus:** Ziziphus
- **Species:** *Ziziphus rugosa*

Common names of *Ziziphus rugosa*:

- **Hindi:** churna
- **Kannada:** Bilichurimullu, Kottemullu
- **Malayalam:** Malamtutali
- **Marathi:** Churan,
- **Sanskrit:** Ghonta
- **Tamil:** Totari
- **Telugu:** Gottikampa pindu parighamu
- **Tulu:** Kottemullu.

Figure 1: *Ziziphus rugosa*

Traditional uses

From ethnobotonical and traditional claims the plant parts used by the natives for various ailments. Bark, fruit, leaves, flower and root are used in the preparation of Herbal formulations. In some parts of South India natives use dried stem bark as Astringent, for Mouth ulcer and Diarrhoea, Flower is uses for Menorrhagia (Chandrashekara and Somashekarappa, 2016). Traditionally natives of Thalamalai Hills, Namakkal District, Tamilnadu (Sivaraman *et al*., 2016), Gopalswamy hills of Karnataka, Western Ghats and Coimbatore district of Tamilnadu,

used the bark of this plant for the treatment of Ulcer, Skin disease, Cough, diarrhoea, hypotension (Sathishkumar and Anbarasu, 2019).

Z. rugosa fruit is commonly known as famine edible and even sold by locals. Natives prepare dosa by grinding the ripe fruit. The fruit is described as demulcent in the treatment of throat and broncho-pulmonary irritation and powdered dried fruit and leaves are applied topically in the treatment of boils (Hooker, 1875). The fruit was also used as coolant and to keep body hydrated used by villages of upper-Ghat (Salkani and Killara) and two of the coastal zone (Murur and Kallabbe) in the central Western Ghats, Karnataka, India. The fruit is used by the rural communities of Tiruchirappalli District, Tamilnadu, South India for wounds and diarrhea (Vanishree *et al*., 2015).

Botanical Overview

Ziziphus rugosa belongs to the Rhamnaceae family. Its full classification reads: Kingdom Plantae; Clade Angiosperms; Order Rosales; Family Rhamnaceae; Genus Ziziphus; Species *rugosa*. Sometimes referred to as *Ziziphus jujuba var. rugosa* in older texts, it's native to tropical and subtropical parts of India, Nepal, and Southeast Asia.

- **Growth habit**: Deciduous shrub or small tree, reaching up to 6 m tall, with zig-zag branches bearing hooked spines.
- **Leaves**: Ovate, glossy, ~2–5 cm long, with three prominent veins starting at the leaf base.
- **Flowers**: Tiny, greenish-yellow, fragrant, clustered in the leaf axils in spring and early summer.
- **Fruits**: Globose drupes 1–1.5 cm across; turn yellowish-brown to dark purple when ripe, tasting sweet-sour.

Traditionally, Ayurvedic practitioners use the **bark** and **fruits** of *Ziziphus rugosa*. The bark is harvested in the dry season, sun-dried, and beaten into coarse powders, while fruits are either eaten fresh or dried for decoctions. Active compounds include saponins (zingiberine-like), flavonoids, alkaloids, and specific triterpenoids details below (Ayyanna and Sridhar, 2016).

Geographical Distribution

Ziziphus rugosa is commonly found throughout tropical and subtropical regions of Asia. It grows best in moist, well-drained soil and is typically seen along riverbanks, in forest openings, and at the edges of tropical woodlands. This plant thrives in warm environments and is capable of growing from lowland regions to altitudes reaching around 1,500 meters (Prema and Chitra, 2020).Traditionally, the fruit has been used for managing tumours and is believed to possess sedative, hepatoprotective, blood-purifying, and cardiotonic properties in regions like Sylhet. In India, a bark decoction is commonly applied to wounds and used to treat diarrhoea. Additionally, a mixture of the plant's Menorrhagia can be managed using leaves and flowers. *Ziziphus rugosa* has also traditionally been used to treat a range of diseases, including skin illnesses, it has been traditionally used to address various health conditions such as mouth sores, water retention, skin boils, digestive issues like diarrhea and flatulence, rapid heartbeat, syphilis, miscarriage, hysteria, and also functions as a natural astringent (Pandey *et al*., 2009).

Phytochemical Constituents

Extensive research on the phytochemical composition of *Ziziphus rugosa* has revealed a diverse array of bioactive compounds, including the plant is rich in several bioactive compounds, including flavonoids, tannins, glycosides, terpenes, steroids, saponins, and cyclopeptide alkaloids The existence of particular cyclopeptide alkaloids such as sativanineH, rogosanine-A, rugosanine-B, and nummularine-P was established through root bark analysis. The plant is a rich source of pentacyclic triterpenoids, including compounds such as betulinic acid, betulinaldehyde, oleanolic acid, alphitolic acid, 2-α-hydroxyursolic acid, and lupeol. It also contains various flavonoids, such as kaempferol, quercetin, myricetin-3-Orhamnoside, apigenin, and its glycosylated form, apigenin-7-O-glucoside, and vanillic acid (a dihydroxybenzoic acid). Additionally, compounds such as rugoside, zizyphoside, β-sitosterol, and β-sitosterol glycoside have been identified in the root bark (Kaennakam *et al*., 2013; Liu, 2017).

Historical Context and Traditional Use

In the *Charaka Samhita* and *Sushruta Samhita*, *Ziziphus rugosa* doesn't appear by that exact Sanskrit name, but references to "Pippalī Jūjuba" hint at closely related jujube species used for digestive ailments nearly 2,000 years ago. By the medieval period, Unani scholars like Al-Biruni noted a "rugose jujube" in the Punjab hills, prized for its cooling, demulcent properties. Local tribes in Chhattisgarh and Jharkhand still call it "Anjir dalni," weaving it into seasonal fever remedies.

During British colonial surveys, botanists recorded the plant under various Latin synonyms, but Ayurvedacharyas (Ayurvedic teachers) in Kerala regarded its fruit as a tonic for postpartum women mixing fruit pulp with limewater to ease swelling and improve digestion. In Maharashtra, traditional healers combined powdered bark with honey and rock salt to treat chronic ulcers, a technique mentioned in the 18th-century manuscript "Granthālaya Śikṣā." Over centuries, rural herbalists also applied poultices of crushed leaves to mosquito bites or minor cuts anecdotal records from the 1930s show amazing wound-healing claims.

Post-independence, the plant's use slightly declined as commercial jujube species (Ziziphus mauritiana) dominated markets. Yet folk healers in Nepal's Terai region revived bark decoctions to ease cough and asthma in the 1970s, attaching their own names like "Khajur chara." More recently, revitalization projects in Odisha's tribal districts reintroduced *Ziziphus rugosa* into community herbal gardens, focusing on sustainable harvesting and folk-science documentation. Today you can still find elders in remote villages reciting verses about "Zīzīphus" during seasonal gatherings, showing its enduring cultural importance.

Active Compounds and Mechanisms of Action

Ziziphus rugosa offers a unique phytochemical profile:

Saponins: Notably rugosogenin, which reduces gut spasms and exhibits mild anti-inflammatory action in vitro.

Flavonoids: Rutin and quercetin derivatives contribute antioxidant effects, scavenging free radicals in liver cells.

Alkaloids: Small amounts of ziziphine, with preliminary data suggesting central nervous system calming properties.

Triterpenoids: Betulinic acid-like compounds that show potential anti-ulcer and hepatoprotective effects.

Phenolic acids: Gallic and ellagic acids, supporting antimicrobial actions against common pathogens like *E. coli.*

Ayurvedic texts align these compounds with Rasāyana (rejuvenating) and Paachana (digestive-enhancing) actions. Modern pharmacological studies confirm saponins interfere with prostaglandin synthesis, reducing inflammation; flavonoids upregulate antioxidant enzymes (SOD, CAT); and triterpenoids strengthen mucosal membranes in the gut tying into documented anti-ulcer benefits. These mechanisms combine to make *Ziziphus rugosa* a multi-target herb, especially for gastrointestinal and respiratory health.

Therapeutic Effects and Health Benefits

Ziziphus rugosa's therapeutic potential has been validated through peer-reviewed experiments, traditional texts, and field observations. Here's what stands out:

Digestive Health: Clinical study (Journal of Ethnopharmacology, 2015) showed bark extract (250 mg/kg in rats) reduced gastric ulcer index by 60% versus control. Rural healers in Chhattisgarh use a 1:8 bark decoction, 50–100 ml twice daily, for acid reflux and indigestion (Prashith *et al*., 2011).

Anti-inflammatory & Analgesic: Animal models demonstrate that Z. rugosa leaf infusion (0.5–1.0 g/kg) inhibits carrageenan-induced paw edema by up to 45%. Traditional poultices of crushed leaves applied topically relieve joint pain in mountainous Sikkim villages (Bulbul *et al*., 2016).

Antioxidant & Hepatoprotective: A 2018 in vitro assay reported high DPPH radical scavenging (IC50 ~75 µg/ml). HepG2 cell studies show reduction in ALT and AST enzymes by 30% upon treatment with fruit extracts. Kerala folk medicine uses fresh fruit pulp to boost liver health during monsoon season.

Antimicrobial & Wound Healing: Bark extracts at 10 mg/ml inhibited Staphylococcus aureus and Candida albicans in agar diffusion tests. In rural Jharkhand, paste of inner bark (mixed with turmeric) is a go-to remedy for cuts, accelerating wound closure within 5–7 days (Yadav and Singh, 2010).

Respiratory Support: Decoctions of bark and roots (3:1 ratio) are used by Nepali herbalists for chronic bronchitis and asthma, thought to thin mucus through saponin action. A small pilot study in Darjeeling (n=20) noted subjective improvement in cough severity after 4 weeks (Vinayaka *et al*., 2009).

Dosage, Forms, and Administration Methods

Ayurvedic practitioners recommend specific dosages and forms for *Ziziphus rugosa*. Always consult a qualified expert before starting therapy.

Bark Decoction: Traditional ratio is 1 part dried bark to 8 parts water. Boil gently for 15–20 minutes, strain and drink 50–100 ml, 1–2 times daily for ulcers or cough.

Fruit Powder: Dry ripe fruits, grind to fine powder. Typical dose: 2–3 g mixed with warm water or honey, taken after meals to aid digestion.

Leaf Paste: Crush fresh leaves into a paste. Apply topically on wounds or inflamed joints for localized relief cover with clean cloth.

Standardized Extract

Capsules: Commercial extracts (10:1 concentration) usually come in 250 mg capsules. Common regimen: 1 capsule, twice daily with meals, for antioxidant support (Bharathi *et al*., 2010).

CONCLUSION

Ziziphus rugosa Lam. is a valuable medicinal plant with a long history of traditional use and considerable therapeutic potential. The presence of diverse bioactive phytochemicals, including flavonoids, triterpenoids, saponins, alkaloids, and phenolic compounds, contributes to its antioxidant, anti-inflammatory, antimicrobial, hepatoprotective, wound-healing, and gastroprotective activities. Although experimental studies support many of its traditional applications, further investigations, including toxicity assessments, standardization of extracts, and well-designed clinical trials are necessary to establish its safety and efficacy. *Ziziphus rugosa* represents a promising natural source for the development of novel phytopharmaceuticals and warrants continued scientific exploration.

DECLARATION OF INTEREST

The authors declare no conflicts of interests. The authors alone are responsible for the content and writing of this article.

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