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Mimusops elengi Linn. (Bakul) - A Potential Medicinal Plant, Ethnobotany, Phytochemical and Pharmacological approach

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Abstract:

Mimusops elengi, or Bakul, holds immense cultural, historical, and pharmacological significance. Revered in Indian scriptures, it serves roles in architecture, rituals, and medicine, reflecting its cultural importance. The tree adapts well to varied ecosystems, showcasing ecological resilience, and its nutritional richness positions it as a sustainable food source.

Bakul's secondary metabolites demonstrate potent pharmacological properties, including antioxidant, antibacterial, antifungal, antidiabetic, anticancer, hypotensive, and diuretic effects. Bridging Ayurveda and modern science, Bakul is a candidate for evidence-based healthcare practices. Further research could unlock its full therapeutic potential, advancing sustainable healthcare through a fusion of traditional wisdom and contemporary science.

Its adaptability to diverse ecosystems highlights its ecological resilience. Nutritional analyses reveal Bakul as a sustainable food source, while its secondary metabolites exhibit antioxidant, antibacterial, antifungal, antidiabetic, anticancer, hypotensive, and diuretic properties. Integrating Ayurvedic wisdom with modern science, Bakul bridges tradition and innovation, holding great promise for evidence-based healthcare. Further research is encouraged to explore its full therapeutic potential.

Mimusops elengi (Bakul), an ornamental evergreen tree from the Sapotaceae family, is cultivated in India for its fragrant flowers. Traditionally used in Ayurveda and folk medicine, its bark, fruit, and seeds offer properties such as astringent, tonic, and febrifuge effects. Chemical analyses reveal that the bark contains tannin, caoutchouc, wax, starch, and ash; flowers have volatile oils, and seeds contain fixed fatty oils.

Preclinical studies highlight its phytochemicals' medicinal benefits, including analgesic, antibiotic, antihyperlipidemic, anti-inflammatory, antimicrobial, antioxidant, antipyretic, cytotoxic, and hypotensive activities, as well as their potential against gingival bleeding, gastric ulcers, and congestive conditions. Bakul holds promise for both traditional and modern therapeutic applications

Keyword: Herbal; Sapotaceae; Mimusops elengi L., phytochemicals Anti-diabetic activity,biodiesel, traditional uses.

1. INTRODUCTION

Natural products play a crucial role in pharmaceutical biology, with plants being significant medicinal sources for thousands of years. The World Health Organization reports that 80% of people still depend on traditional medicine.

Mimusops elengi (Bakul), sacred to Hindus, holds a notable place in ancient Sanskrit literature and religious texts. Its fragrant flowers are celebrated in the Puranas and symbolized as love and beauty in Kalidasa's works. Associated with Krishna's mythological lore, the tree is commonly cultivated across the Deccan Peninsula and Andaman Islands as an ornamental and shade tree.

Beyond its cultural value, Mimusops elengi contributes to science and modern research due to its extensive medicinal properties.

Mimusops elengi, a medium-sized evergreen tree of the Sapotaceae family, is steeped in cultural and historical importance. Native to India's Western Ghats, it carries numerous vernacular names such as Spanish cherry, Medlar, and Bullet wood in English, and Bakul across Indian languages, showcasing its deep-rooted cultural ties. Revered in ancient Indian epics like Ramayana, Mahabharata, and Abhijnana Shakuntala, Bakul reflects prehistoric reverence and symbolizes beauty, love, and sanctity.

Although historically consumed by humans, the dietary significance of Mimusops elengi fruits has waned over time. Today, its fruits primarily provide sustenance for wildlife, including bats, parrots, crows, squirrels, monkeys, goats, and cows, emphasizing its ecological role and integration into natural habitats.

Mimusops elengi (Spanish Cherry) is a tropical evergreen shrub prevalent in South Asia, recognized for its significance in traditional medicine, particularly in Ayurveda. Its various components—leaves, bark, and flowers—exhibit diverse pharmacological attributes. Historically, the plant has been used as an astringent and tonic to treat diarrhea and dysentery, tightening tissues and enhancing their tone.

Recent research highlights its antioxidant-rich leaves, which help neutralize harmful free radicals, potentially combating aging and disease. Studies suggest its anti-diabetic properties, aiding in blood sugar regulation, and reveal its anti-neoplastic capabilities, which may inhibit cancer cell growth. Moreover, floral extracts have been applied to silver nanoparticles, imparting antibacterial effects.

Mimusops elengi exhibits a spectrum of pharmacological activities including anthelmintic (anti-parasitic), antidotal (detoxifying), cardiotonic (heart health-promoting), anti-inflammatory, analgesic (pain-relieving), and antipyretic (fever-reducing) effects. Despite its promising applications in both traditional and modern medicine, further research is required to fully understand its therapeutic potential. Always consult healthcare professionals before using herbal remedies for medical purposes.

1 Taxonomic rank of Mimusops elengi

Domain	Eukarya
Kingdom	Plantae
Division	Spermatophyta
Class	Magnoliopsida
Order	Sapindales
Family	Sapotaceae
Genus	Mimusops
Species	Elengi

2. Plant Profile

Mimusops elengi: A Botanical Marvel

Mimusops elengi, commonly known as Bakul, is more than just a tree—it embodies utility, beauty, and cultural significance. This evergreen giant reaches heights of up to 20 meters, with a trunk diameter of 1 meter. Its rugged dark brown bark and straight branches support a dense canopy of glossy green leaves with wavy edges. Measuring 5–16 cm long and 3–7 cm wide, these meticulously designed leaves are vital for photosynthesis, offering refreshing shade.

Beneath the bark lies deep red heartwood, renowned for its hardness and intricate grain patterns. This wood has been used to create exquisite carvings in South Indian temples and palaces, showcasing the tree's enduring artistic contribution.

Between March and June, the Bakul displays a breathtaking bloom of star-shaped yellowish-white flowers. These fragrant blossoms, clustered in groups, continue to release their divine aroma even after wilting. Woven into temple garlands, they symbolize devotion and spirituality, adding cultural richness.

After pollination, the tree produces ovoid-shaped fruits within eight to ten weeks. Starting as green, they ripen into vibrant shades of yellow, orange, and red, illustrating the sun's influence. Unripe fruits are astringent, while ripe ones offer sweetness, attracting humans and wildlife alike. Each fruit encases one or two seeds, ensuring the cycle of life.

The Bakul is a testament to interconnectedness—its impressive stature commands respect, its wood nurtures creativity, and its fruits sustain life. This botanical wonder seamlessly integrates into ecosystems and cultures, reminding us of the beauty and unity of the natural world.

Table 1 : Names of Mimusops elengi Linn in various languages

Language	Names
English	Spanish cherry, Medlar and Bullet wood
Sanskrit	Bakula, Bramarananda, Stri-mukhamadhu, Anankantha, Madhuparijara
Hindi	Maulseri, Molchari, Maulsiri, Bakula
Bengali	Bakul
Kannada	Karak, Bakula, Pagade, Ranja
Konkani	Omval
Malayalam	Elengi, Ilanni, Ilenji
Manipuri	Bokul lei
Marathi	Bakula, Barsoli, Avalli
Telgu	Kesari, Pogada, Vagula, magadam
Tamil	Alagu, Kesaram, Magilam, Mogadam, Nakum, Magizham
Urdu	Molsari, Kirakuli
Gujarathi	Bolsari, Barsoli

3 OCCURANCE

Mimusops elengi: Geographic Distribution

Mimusops elengi is native to regions such as India (including the Andaman Islands), Sri Lanka, Myanmar, and Indo-China. Its adaptability and aesthetic appeal have led to its cultivation far beyond its native range. It is commonly grown as an ornamental tree in tropical regions, including countries like Ghana, Tanzania, Mozambique, and Mauritius.

Additionally, Mimusops elengi thrives in various parts of Australia (Western Australia, Queensland, and Northern Territory), and is widespread in South Asian countries such as Bangladesh and Bhutan. Within Southeast Asia, it flourishes in Indonesia (Jawa, Kalimantan, Lesser Sunda Islands, Maluku, Sulawesi, and Sumatera) and Malaysia (Sarawak, Sabah, and Peninsular Malaysia).

Its presence across diverse regions highlights its ecological adaptability and significance as a tropical ornamental species.

4 Botanical Description of Mimusops elengi

Mimusops elengi is an evergreen tree that grows up to 15 meters tall, with a thick globular head formed by a short, dark, rough trunk and wide-spreading branches. The branches rise at their ends, contributing to the dense globular canopy. The tree's dark grey bark appears in sections of 15–25 cm long and 10–15 cm wide, characterized by vertical lenticels, cracks, and longitudinal fissures, making its surface rough. Dried bark is thin and curls into quills.

The spherical berries, measuring about 2.5 cm long, turn vibrant yellow upon ripening and offer a sour and sweet flavor. These fruits emerge during the rainy season and contain one or two seeds when fully ripe. The leaves, which are glossy and dark green, measure 6.3–10 cm in length and 3.2–5 cm in width. They are variable in shape, ranging from elliptic to oblong or oblanceolate, with short or long acuminate and undulate margins. Close but faint venation adds subtle texture.

New leaves appear primarily in February, giving the tree a striking vivid green appearance. The petioles supporting these leaves are 1.2–2.5 cm in length, completing the elegant structure of this versatile tree.

5 Traditional Medicinal Uses of Mimusops elengi

Mimusops elengi (Bakul) has a wide range of traditional medicinal applications:

- **Bark**: Acts as a cooling agent, cardio tonic, alexipharmic, stomachic, anthelmintic, tonic, and astringent. It is used to treat biliousness, gum and teeth diseases.
- **Flowers**: Cooling and astringent to the bowels, they are used for blood disorders, biliousness, liver complaints, nasal diseases, and headaches. Their smoke is beneficial for asthma.
- **Fruits**: Astringent to the bowels, they are good for dental health but may cause flatulence.
- **Seeds**: Used to fix loose teeth and treat head-related issues. They yield oil, highly sought after by painters.
- **Roots**: Aphrodisiac, diuretic, and astringent to the bowels, they are effective for gonorrhea and as a gargle for gum relaxation.
- **Flowers (Additional Uses)**: Fragrant and aromatic, they bloom twice a year. Distilled water from the flowers is odoriferous and culturally significant.
- **Leaves**: When burned, they produce a crackling sound in flames.

This tree's multifaceted uses highlight its importance in traditional medicine and cultural practices.

6 Phytochemical Constituents of Mimusops elengi

Stem Bark

The stem bark of Mimusops elengi contains a diverse range of phytochemicals:

- **Triterpenoids**: Taraxerone, taraxerol, betulinic acid, and spinasterol, along with fatty acid esters of alpha-spinasterol, sodium salts of betulinic and ursolic acids.

- **Unique Compounds**: A new pentacyclic triterpene (mimusopfarnanol, farnan-2-one-3 beta-ol) has been identified, along with farnan-3-one, olean-18-en-2-one-3-ol, and lup-20(29)-en-3 beta-ol. Additionally, 3β-hydroxy-lup-20(29)-ene-23,28-dioic acid, beta amyrin, and lupeol were isolated.
- **Volatile Organic Matter**: Steam distillation yielded 0.18% volatile organic compounds, including alpha-cadinol, tau-muurolol, hexadecanoic acid, diisobutyl phthalate, and octadecadienoic acid.
- **Gallic Acid Esters**: New gallic acid esters, characterized as phenyl propyl gallate.

Fig-:1 Mimusops elengi

Fig-:2 Mimusops elengi Leaf

Fig- 3 Mimusops elengi stem

fig-4 Mimusops elengi fruit

fig-5 Mimusops elengi seed

7 Chemical Constitution

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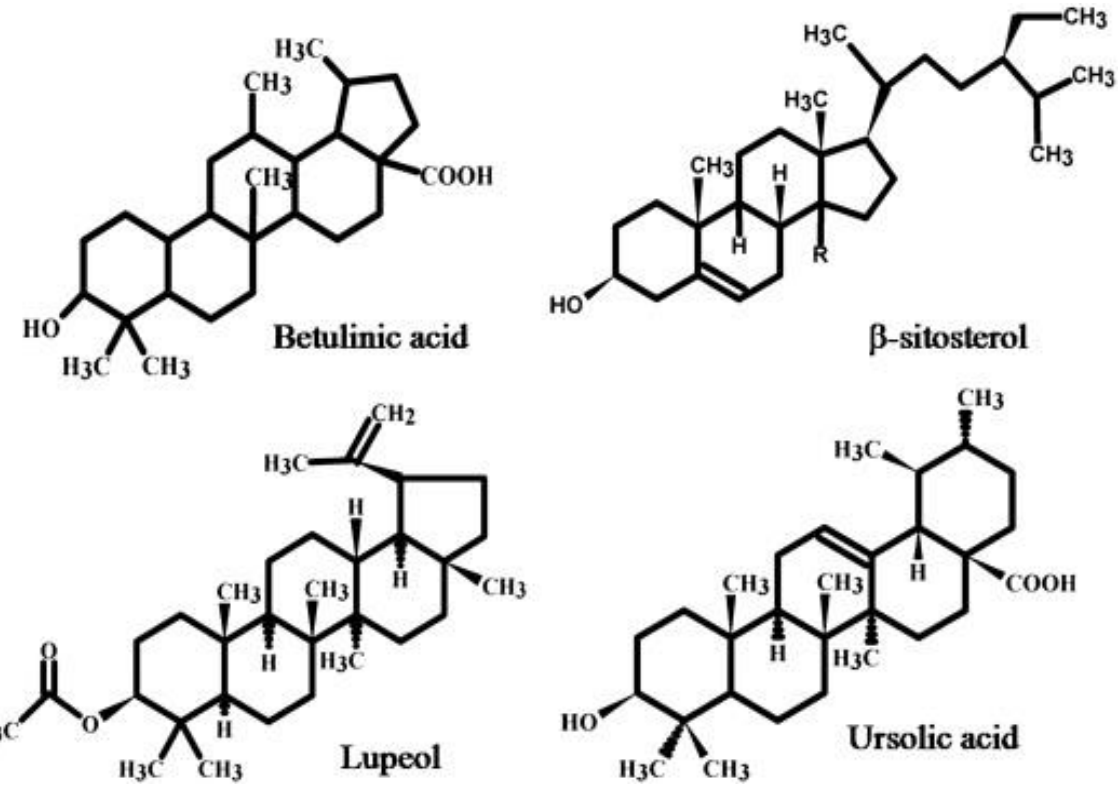
Table 2 : Phytochemical screening of ethanol extract of Mimusops elengi Linn flower

Phytochemical Test	Reagents used (test performed)	Inference	Result
Saponins	Froth test	Formation of Froth	Absent
Triterpenoids & Steroids	Antimony chloride test	Pink colour	Absent
Alkaloids	Mayer's test Drangendroff's test Wagner's test	Yellow colour ppt Orange-Red ppt Reddish brown colour	Present Pesent Present
Anthroquinones	Borutrager's test	Pink or deep Red colour	Absent
Flavonoid test	Shinoda test Ammonia test	Red colour Yellow spot	Present Present
Phlobatannins	Phlobatannins test	Red precipitates	Present
Steroids	Libermann Burchard test	Green colour	Absent
Tannins	Modified Prussian blue test	Blue colour formation	Present
Terpenoids	Salkowski test	Reddish brown colour	Present

Table 3 : Result of preliminary phytochemical screening of different extract of leaves

Test	Pet. ether extract	Chloroform extract	Methanol extract	Aqueous extract
Steroids	+	+	+	+
Amino acids	-	-	+	+
Proteins	-	-	-	-
Carbohydrates	-	+	+	+
Glycosides	+	-	+	+
Flavonoids	-	+	+	+
Tannins	-	+	+	+
Triterpenoids	-	-	+	+
Saponins	-	-	+	+



8 Use in traditional medicine

Mimusops elengi has long been revered in Ayurveda for its diverse therapeutic applications. Its medicinal potential extends beyond traditional formulations, finding relevance in modern healthcare practices.

- **Oral Health**: Historically, powdered bark and tender stems were used for oral hygiene. Today, Bakul decoctions are recommended for soothing gums, reducing inflammation, and treating dental ailments.
- **Wound Healing & Inflammation**: Decoctions from bark and leaves serve as cleansing agents for wounds, help alleviate gum inflammation and bleeding, and may possess anti-ulcer and fertility-enhancing properties.
- **Heart Health**: Studies suggest Mimusops elengi may support cardiovascular function, offering potential benefits for heart health.
- **Respiratory Relief**: Dried flower preparations are traditionally used to treat respiratory conditions, relieve headaches, and promote wound healing.
- **Digestive Benefits**: Bakul fruit plays a role in digestive health; unripe fruits are used as a natural remedy for loose teeth, while ripe fruits are thought to improve general well-being.

This tree's multifaceted medicinal value underscores its importance in both traditional and modern healthcare. Its potential applications invite further research into its pharmacological benefits and therapeutic uses.

I Antioxidant Effects of Mimusops elengi (Bakul Tree)

The Bakul tree (Mimusops elengi) has gained attention for its powerful antioxidant properties, found across its various components, including leaves, fruits, and stem bark. These bioactive compounds combat free radicals, reactive oxygen species (ROS), and reactive nitrogen species (RNS), which otherwise cause cellular damage to DNA, lipids, and proteins. Inhibiting their formation or neutralizing their harmful effects is crucial for maintaining good health.

II Leaf Extracts as Potent Antioxidants Scientific studies have demonstrated that methanolic extracts of Mimusops elengi leaves exhibit substantial free radical scavenging activity. At higher concentrations, their antioxidant potential surpasses that of some well-known antioxidants, indicating that the leaves may serve as a valuable source of natural antioxidants with therapeutic potential.

III Fruit Ripening and Antioxidant Capacity The antioxidant efficacy of Bakul fruits is highly dependent on their ripening stage. Extracts from immature fruits demonstrated the highest free radical scavenging activity, followed by mature and ripe fruits. However, when analyzed for individual components, mature fruits displayed the strongest antioxidant activity, likely due to the presence of specific bioactive compounds that play a key role in preventing oxidative stress.

IV Stem Bark Contributions to Antioxidant Activity While Bakul stem bark also exhibits antioxidant properties, its efficacy has been found to be relatively lower than certain commercially available

antioxidants. Nonetheless, this finding underscores another aspect of the tree's overall antioxidant profile, reinforcing its potential role in herbal medicine and nutraceutical applications.

V Future Prospects The Bakul tree emerges as a promising source of natural antioxidants, offering immense potential for combating oxidative stress-related diseases. From its potent leaf extracts to the intriguing changes in fruit antioxidant activity during ripening, Mimusops elengi presents a valuable arsenal against free radical damage. As research continues, deeper exploration of its bioactive components and their applications in human health may unlock innovative therapeutic interventions.

9 Antibacterial Potential of Mimusops elengi (Bakul Tree)

The rise of antibiotic-resistant bacteria has driven scientific interest in natural antimicrobial agents, with Mimusops elengi emerging as a promising candidate. Various parts of the tree—including leaves, bark, fruits, and seeds—demonstrate antibacterial properties, showing selective and broad-spectrum activity against bacterial strains.

I Leaf Extracts and Selective Activity Studies reveal that extracts from Bakul leaves are effective against specific bacterial strains, particularly Gram-positive organisms. Their bioactive compounds offer potential in combating resistant infections, presenting an alternative to conventional antibiotics.

II Stem Bark as a Broad-Spectrum Antimicrobial Extracts from the tree's stem bark have shown broad-spectrum antibacterial effects, indicating their ability to target a wide range of bacterial pathogens. This suggests that the bark may contain powerful antibacterial compounds beneficial for therapeutic use.

III Fruit and Seed Extracts with Promising Action Research highlights selective antibacterial activity in extracts from Bakul fruits and seeds. Certain isolated compounds from seeds exhibit significant potency against specific bacterial strains, positioning them as potential candidates for drug development.

IV Future Research and Applications Although findings suggest Mimusops elengi could contribute to novel antibacterial solutions, further studies are essential to isolate, characterize, and evaluate its bioactive compounds. Understanding its full therapeutic potential could open new avenues in combating bacterial resistance and improving treatment options in modern medicine.

10 Antifungal Potential of Mimusops elengi (Bakul Tree)

Opportunistic fungal infections pose a growing health challenge, particularly for immunocompromised individuals. While existing antifungals like fluconazole and itraconazole remain effective, their systemic side effects necessitate the search for safer alternatives. The Bakul tree (Mimusops elengi) has emerged as a promising candidate with potential antifungal properties, though research in this area remains limited.

Preliminary Findings Early studies evaluated petroleum ether, ethyl acetate, and methanolic extracts from Bakul bark, fruits, and leaves against fungal strains such as Penicillium sp., Aspergillus niger, and Candida albicans. While demonstrating antifungal activity, the extracts were found to be less potent than fluconazole, suggesting the need for further optimization to harness Bakul's full potential.

Research Directions for Therapeutic Use To maximize its antifungal efficacy, several research approaches should be explored:

1. **Expanding In Vitro Studies**: Future studies must assess Bakul's antifungal properties against a broader panel of pathogens, including emerging drug-resistant fungi, to evaluate its clinical relevance.
2. **Optimizing Extract Concentration & Delivery**: Determining the minimum inhibitory and fungicidal concentrations (MIC and MFC) will refine its use. Advanced delivery mechanisms, such as nanoparticles or liposomes, could enhance extract bioavailability.
3. **Isolating & Characterizing Bioactive Compounds**: Techniques like bioassay-guided fractionation and mass spectrometry will help identify the key antifungal components and understand their mechanisms of action for potential drug development.

Holistic Medicinal Potential Beyond its antifungal effects, Bakul exhibits antioxidant, antibacterial, and anti-inflammatory properties, further strengthening its therapeutic significance. This multifaceted pharmacological profile warrants deeper investigation into its medicinal applications.

While Bakul's antifungal potential is promising, further rigorous research is essential to validate its efficacy and optimize formulations for medical use. Exploring its capabilities could pave the way for novel antifungal treatments with improved safety profiles. Let me know if you'd like insights into its mechanisms of action or synergistic potential with existing antifungal drugs

Antidiabetic Potential of Mimusops elengi (Bakul Tree)

Diabetes mellitus, a chronic disorder characterized by hyperglycemia, has become a global epidemic, prompting the search for novel therapeutic interventions. Preclinical studies indicate that Mimusops elengi (Bakul) may possess significant antihyperglycemic properties, making it a potential candidate for diabetes management.

Preclinical Findings Studies utilizing aqueous bark extract and methanolic stem bark extract in diabetic animal models demonstrated dose-dependent reductions in blood sugar levels and glycosylated hemoglobin. Simultaneously, the extracts enhanced serum insulin levels and positively influenced hepatic carbohydrate metabolism. These results suggest that Bakul extracts may stimulate insulin secretion, improve insulin sensitivity, and promote glycogen synthesis, contributing to stable and long-lasting glycemic control—persisting for up to 24 hours in some instances. Importantly, no systemic or neurological side effects were observed, suggesting a favorable safety profile.

Future Research Directions Given its promising potential, Bakul warrants further investigation to refine its therapeutic applications. Key research areas include:

1. **Isolation of Bioactive Compounds**: Identifying specific phytochemicals responsible for antihyperglycemic effects will be crucial for optimizing its therapeutic use.
2. **Mechanism Exploration**: Studying how Bakul modulates insulin secretion and glucose metabolism will provide valuable insights for drug development.

3. **Delivery Optimization**: Enhancing bioavailability through advanced formulations such as nanoparticles or extracts could improve its clinical efficacy.

Anticancer Potential of Mimusops elengi (Bakul Tree)

Chemotherapy remains the cornerstone of cancer treatment, but its adverse effects and high costs drive the search for safer, more affordable alternatives. The Bakul tree (Mimusops elengi) has shown promise as a potential antineoplastic agent, offering selective cytotoxic effects against cancer cells.

In Vitro Studies on Cytotoxic Activity Scientific investigations have revealed that ethanolic extracts from Bakul flowers exhibit concentration-dependent cytotoxic effects against cancer cell lines. Importantly, these extracts display selectivity, targeting cancerous cells while sparing normal ones. Further research is essential to isolate and characterize the bioactive components responsible for this cytotoxicity, paving the way for targeted anticancer therapies.

Mechanisms and Future Applications Understanding Bakul's mechanisms of action will be crucial for developing effective and accessible cancer treatments. Its bioactive compounds may stimulate apoptosis (programmed cell death) or inhibit tumor growth, providing a novel approach to cancer therapy. Future studies should focus on optimizing extract formulations, refining delivery methods, and conducting in vivo trials to validate its efficacy.

Beyond Cancer: Bakul's Role in Food Security Beyond its potential in oncology, Bakul also demonstrates antifungal activity, offering eco-friendly alternatives to synthetic fungicides. Crop-damaging fungi compromise food security by contaminating agricultural produce and reducing nutritional value. Studies indicate that aqueous, methanolic, and ethanolic extracts from Bakul leaves effectively combat fungal infestations, with methanolic extracts showing particularly strong antifungal potential.

Sustainable Solutions for Agriculture Further fractionation has identified an alkaloid fraction with potency surpassing conventional fungicides, suggesting Bakul extracts may serve as a sustainable solution for crop protection. Developing plant-based antifungal agents could reduce dependency on chemical treatments, minimizing environmental impact.

A Multifaceted Medicinal Resource Mimusops elengi presents exciting possibilities in both healthcare and agriculture. Its anticancer and antifungal properties warrant comprehensive investigation, from isolating bioactive compounds to optimizing therapeutic applications. If fully harnessed, Bakul may emerge as a valuable natural resource for improving human health and food security.

Hypotensive Effects of Mimusops elengi (Bakul Tree)

Hypertension, a chronic condition marked by elevated blood pressure, is a major contributor to cardiovascular disease worldwide. With millions affected, the search for new therapeutic strategies is critical. Preclinical studies indicate that Mimusops elengi (Bakul) may hold antihypertensive potential, showing promising hypotensive effects in animal models.

Preclinical Findings and Mechanisms Methanolic extracts from Bakul leaves have demonstrated a dose-dependent reduction in blood pressure. Interestingly, this effect appears independent of commonly targeted pathways in conventional hypertension treatment. However, co-administration of calcium channel blockers significantly reduced the extract's hypotensive effect, suggesting that calcium channel modulation may play a role in Bakul's activity.

Future Research Considerations To fully harness its potential, several critical areas require further investigation:

1. **Bioactive Compound Identification**: Understanding which specific phytochemicals contribute to calcium channel blocking activity could refine its therapeutic applications.
2. **In Vivo Studies for Long-Term Efficacy**: Evaluating prolonged effects, safety, and dosage optimization is crucial for developing reliable treatments.
3. **Oral Bioavailability & Formulation Development**: Exploring ways to enhance absorption and delivery, such as nanoparticle formulations or herbal supplements, will improve its clinical viability.

With deeper scientific exploration, Bakul may emerge as a novel, natural antihypertensive agent. By identifying its mechanisms and optimizing formulations, researchers can unlock new possibilities for hypertension management, offering a potentially safer, more accessible alternative to existing treatments

Diuretic Potential of Mimusops elengi (Bakul Tree)

Diuretics are essential for managing fluid overload in conditions like heart failure, lung edema, and hypertension. Recent studies suggest Mimusops elengi (Bakul) may exhibit promising diuretic properties, particularly through its bark extracts.

Preclinical Findings

Researchers investigated the diuretic activity of various Bakul bark extracts—ethyl acetate, ethanol, methanol, and aqueous—in animal models. Rats were administered either saline (control), different Bakul extracts orally, a standard diuretic (furosemide) via abdominal injection, or mannitol intravenously. Urine output and sodium excretion were monitored over 24 hours.

Compared to the control group, all Bakul extracts significantly increased urine production and sodium elimination. Interestingly, the aqueous extract displayed the most potent diuretic effect, surpassing mannitol but remaining less effective than furosemide. This suggests that Bakul's aqueous extract could serve as a natural alternative to mannitol, albeit with potentially lower potency than furosemide.

Safety Profile and Future Directions

Encouragingly, a high single dose of the aqueous extract did not cause toxicity or adverse effects, indicating its favorable safety profile. However, additional research is required to evaluate:

1. **Long-Term Safety & Efficacy**: Assessing prolonged usage to ensure no adverse renal or systemic effects.
2. **Identification of Active Components**: Isolating bioactive compounds responsible for its diuretic action could refine its medicinal applications.
3. **Optimization for Clinical Use**: Enhancing bioavailability through formulation techniques may improve therapeutic effectiveness.

Gastroprotective Effects of Mimusops elengi (Bakul Tree)

Peptic ulcers, caused by an imbalance between aggressive factors (gastric acid, pepsin) and protective mechanisms (mucus, bicarbonate secretion), remain a prevalent gastrointestinal disorder. While proton pump inhibitors (PPIs) and H2 receptor antagonists are widely used, concerns about relapse, side effects, and drug interactions fuel the search for alternative therapies.

Preclinical Studies and Findings

Scientific investigations have explored the antiulcer potential of a **50% alcoholic extract** of Mimusops elengi in various rat models, including **ethanol-induced ulcers, pylorus-ligated ulcers, and water-immersion stress ulcers**. Results demonstrated **broad-spectrum gastroprotective effects**, significantly reducing ulcer severity across all models.

Further fractionation identified a **potent ethyl acetate fraction**, which exhibited **dose-dependent gastroprotective activity**, effectively mitigating ulcer formation even at lower doses.

Mechanisms of Action

The gastroprotective effects of Bakul appear to follow a **dual mechanism**:

1. **Reduction in Gastric Acid Secretion**: The extract decreased total gastric acid secretion, acidity, and pepsin activity, limiting ulcer formation.
2. **Enhancement of Mucosal Defense**: It increased **mucosal glycoprotein and mucin levels**, reinforcing the gastric barrier against acid-induced damage.

Additionally, the **ethyl acetate fraction** displayed **dose-dependent protection** against **stress-induced ulcers**, further strengthening its therapeutic viability.

Future Research Directions

To fully harness Bakul's antiulcer potential, several critical research areas should be pursued:

1. **Isolation of Key Bioactive Compounds**: Identifying specific phytochemicals responsible for its therapeutic action will enable precision medicine applications.
2. **Optimizing Delivery Methods**: Enhancing bioavailability using advanced formulations can improve efficacy.

3. **Long-Term In Vivo Studies**: Evaluating sustained efficacy and safety will be crucial for its clinical translation.

Table 4. Pharmacological activities of Mimusops elengi L

Pharmacological activities	Plant part and Extracts
Cytotoxicity activity	Whole plant and Leaves; AgNPs
Anthelminthic activity	Stem and bark
Wound healing activity	Whole plant and stem and bark
Larvicidal activity	Stem and bark; AgNPs
Anti-anxiety activity	Stem and bark
Anticonvulsant activity	Stem and bark
Anti-hyperlipidemic activity	Stem and bark
Anti-inflammatory activity	Whole plant, flower, stem and bark
Antiplatelet activity	Flower
Anti spermatic activity	Seeds and fruit
Cognitive enhancing activity	Flower
Antidiuretic activity	Whole plant
Anti-atherosclerotic Activity	Whole plant
Hypotensive activity	Whole plant
Antioxidant activity	Fruits, Leaves, stem and bark
Anti-diabetic activity	Leaves, stem and bark

11 CONCLUSION

Mimusops elengi, or Bakul, stands as a botanical entity of immense **historical, cultural, ecological, and pharmacological** importance. Its deep-rooted presence in ancient Indian scriptures—Ramayana and Mahabharata—reflects its enduring reverence in traditional beliefs. Additionally, its adaptability across diverse geographic regions underscores its ecological resilience.

Beyond its structural contributions to architecture and religious ceremonies, Bakul's **nutritional and medicinal potential** continues to garner academic interest. Chemical analyses highlight its nutritional richness, with **essential sugars, fiber, and minerals**, while its bioactive compounds—such as **triterpenes and flavones**—present new avenues for pharmacological exploration. Ayurvedic texts have long recognized its versatility, applying Bakul in **dental care, wound healing, neurological disorders, and cardiovascular health**.

Modern research reinforces its **broad-spectrum pharmacological potential**, demonstrating **antioxidant, antibacterial, antifungal, antidiabetic, anticancer, hypotensive, and diuretic effects**. With growing interest, a more refined understanding of its bioactive constituents provides a foundation for future studies. To fully integrate Bakul into evidence-based healthcare, research must focus on **elucidating its molecular pathways, assessing long-term safety, and optimizing delivery methods**.

As scientific inquiry advances, Bakul may emerge as a **valuable natural resource**, offering sustainable solutions for nutrition, medicine, and holistic well-being.

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REFERENCES

1. Baby J, Raj SJ. **Pharmacognostic and Phytochemical Properties of Aloe Vera Linn – An Overview**. International Journal of Pharmaceutical Sciences Review and Research, 2010; 4(2):106-110.
2. Mitra R. **Bakula – A Reputed Drug of Ayurveda, Its History and Uses in Indian Medicine**. Indian Journal of History of Science, 1981; 16(2):169-180.
3. Anonymous. **The Wealth of India: A Dictionary of Raw Material and Industrial Products**. Council of Scientific and Industrial Research (CSIR), New Delhi, 1956; 276-77.
4. Nadkarni KM. **Indian Materia Medica**. 3rd Ed. Popular Prakashan, Mumbai, 1996; 596-599.
5. Sharma PC, Yelne MB, Dennis TJ. **Database on Medicinal Plants Used in Ayurveda**. Vol. I, Central Council for Research in Ayurveda and Siddha, Government of India, 2000; 65-72.
6. Manjeshwar SB, Ramakrishna JP, Harshith PB, Princy LP, Rekha B. **Chemistry and Medicinal Properties of the Bakul (Mimusops elengi Linn): A Review**. Food Research International, 2011; 44:1823–1829.
7. Raghunathan K, Mitra R. **Pharmacognosy of Indigenous Drugs**. Vol. I, Central Council for Research in Ayurveda and Siddha, Government of India, 2000; 158-183.
8. Kirthikar KR, Basu BD. **Indian Medicinal Plants**. 2nd Ed, Vol. II, Popular Publications Dehradun, India, 1999; 1224-1227.
9. Rajkumara S, Pandiselvi A, Sandhiya G. **Isolation of Chemical Constituents from Mimusops elengi Bark and Evaluation of Anti-Inflammatory Activity**. International Journal of Phytopharmacy, 2012; 3(1):9-15.
10. Nazarudeen A. **Nutritional Composition of Some Lesser-Known Fruits Used by the Ethnic Communities and Local Folks of Kerala**. Indian Journal of Traditional Knowledge, 2010; 9(2):398-402.
11. Saxena VK, Shrivastava K. **New Steroidal Saponins from the Roots of Mimusops elengi**. Fitoterapia, 1988; 59(5):418.
12. Mishra G, Mitra CR. **Constituents of Leaves, Heartwood, and Root of Mimusops elengi Linn**. Phytochemistry, 1968; 7:501-502.

13. Jana GK, Dhanamjayarao M, Vani M. **Evaluation of Anthelmintic Potential of Mimusops elengi Linn (Sapotaceae) Leaf**. Journal of Pharmacy Research, 2010; 3(10):2514-2515.
14. Ganu G, Garud A, Agarwal V, Suralkar U, Jadhav S, Kshirsagar A. **Anti-Anxiety Activity of Mimusops elengi Barks Extract in Experimental Animals**. Research Journal of Pharmaceutical, Biological, and Chemical Sciences, 2011; 2(3):405.
15. Ghaisas MM, Kadam AH, Kshirsagar BD, Dhote VV, Deshpande AD. **Evaluation of Antihyperlipidemic Activity of Mimusops elengi L. in Triton WR-1339 Induced Hyperlipidaemia in Rats**. Journal of Natural Remedies, 2008; 8(2):132-137.
16. Prakash D, Koti BC, Vijay T, Chandrakala, Katagi MS. **Antiulcer Activity of Mimusops elengi Bark Extracts Against Serotonin-Induced Ulcer in Rats**. International Research Journal of Pharmacy, 2011; 2(8):173-176.
17. Shah PJ, Gandhi MS, Shah MB, Goswami SS, Santani D. **Study of Mimusops elengi Bark in Experimental Gastric Ulcers**. Journal of Ethnopharmacology, 2003; 89(2):305-311.
18. Ganu G, Garud A, Agarwal V, Talele S, Jadhav S, Kshirsagar A. **Anticonvulsant Activity of Mimusops elengi in Experimental Animals**. Journal of Pharmacy Research, 2011; 4(9):2938-2940.
19. Karmakar UK, Sultana R, Biswas NN. **Antioxidant, Analgesic, and Cytotoxic Activities of Mimusops elengi Linn Leaves**. Indian Journal of Pharmaceutical Sciences Research, 2011; 2(11):2791-2797.
20. Purnima BC, Koti AH, Thippeswamy MS, Jaji AH, Swamy YV, Kurhe AJ et al. **Antiinflammatory, Analgesic, and Antipyretic Activities of Mimusops elengi Linn**. Indian Journal of Pharmaceutical Sciences, 2010; 72(4):480-485.
21. Rao KS, Munjuluri PR, Keshar NK. **In Vitro Antioxidant Activity and Total Phenolic Content of Mimusops elengi Bark**. Indian Journal of Pharmaceutical Education and Research, 2011; 45(4):317-323.
22. Shaik J, Khasim SM, Naidu PB. **Protective Activity of Ethanolic Leaf Extract of Mimusops elengi Linn on Lipid Peroxidation and Antioxidant Enzymes in Experimental Diabetic Rats**. PHARMANEST – International Journal of Advances in Pharmaceutical Sciences, 2011; 2(2):264-275.
23. Ashok P, Koti BC, Vishwanathswamy AH. **Antiurolithiatic and Antioxidant Activity of Mimusops elengi Linn**.
24. **Kulkarni AA, Deshpande RR, Panvalkar P, Mahajan P, Kale A, Ruikar A et al.** Comparative Evaluation of Antibacterial Properties of Different Extracts of Mimusops elengi (Bakul) & Juglans regia (Walnut) Against Salivary Microflora. Research Journal of Pharmaceutical, Biological, and Chemical Sciences, **2011**; **2(3):635**.
25. **Shahwar D, Raza MA.** In Vitro Antibacterial Activity of Extracts of Mimusops elengi Against Gram-Positive and Gram-Negative Bacteria. African Journal of Microbiology Research, **2009**; **3(8):458-462**.
26. **Rangama BNLD, Abayasekara CL, Panagoda GJ.** Antibiotic Activity of Tephrosia purpurea (Fabaceae) and Mimusops elengi (Sapotaceae) Against Some Clinical Bacterial Isolates. Proceedings of the Peradeniya University Research Sessions, **2007**; **12(1):55-56**.
27. **Murudkar SS, Mundhada PA, Tatke.** Antibacterial Activity of Mimusops elengi Linn Bark Against Dental Pathogens. Indian Journal of Pharmaceutical Education and Research, **2007**; **41(2):114-120**.

28. **Nair R, Chanda SV.** Antibacterial Activities of Some Medicinal Plants of the Western Region of India. Turkish Journal of Biology, **2007**; **31:231-236**.
29. **Mamatha MK, Thomas T, Yogesh HS, Pramod HJ.** Antidiabetic Activity of Mimusops elengi Leaves on Alloxan-Induced Diabetic Rats. International Journal of Pharmaceutical Sciences, **2011**; **3(2):1358-1362**.
30. **Jerline M, Jothi G, Brindha P.** Effect of Mimusops elengi Linn Bark Extract on Alloxan-Induced Hyperglycemia in Albino Rats. Journal of Cell and Tissue Research, **2009**; **9(3):1985-1988**.

- **Ganu GP, Jadhav SS, Deshpande AD.** Antioxidant and Antihyperglycemic Potential of Methanolic Extract of Bark of Mimusops elengi Linn in Mice. Research Journal of Pharmaceutical, Biological, and Chemical Sciences, **2010**; **1(3):67-77**.
- **Boonyuen C, Wangkarn S, Suntornwat O, Chaisuksant R.** Antioxidant Capacity and Phenolic Content of Mimusops elengi Fruit Extract. Kasetsart Journal of Natural Science, **2009**; **43:21-27**.
- **Saha MR, Hasana SMR, Aktera R, Hossaina MM, Alamb MS, Alam MA, et al.** In Vitro Free Radical Scavenging Activity of Methanol Extract of the Leaves of Mimusops elengi Linn. Bangladesh Journal of Veterinary Medicine, **2008**; **6(2):197–202**.
- **Satishchandra, Sumithra M.** Synergistic Effect of Mimusops elengi and Moringa oleifera on High Fat Diet-Induced Atheroma in Rats. International Journal of Advanced Pharmaceutical Research, **2011**; **2(6):293–300**.
- **Jebashree HS, Kingsley SJ, Sathish ES, Devapriya D.** Antimicrobial Activity of Few Medicinal Plants Against Clinically Isolated Human Cariogenic Pathogens—An In Vitro Study. ISRN Dentistry, **2011**; **67-72**.
- **Prabhat, Ajaybhan, Navneet, Chauhan A.** Evaluation of Antimicrobial Activity of Six Medicinal Plants Against Dental Pathogens. Report Opinion, **2010**; **2(6):37-42**.
- **Deshpande RR, Ruikar A, Panvalkar PS, Kulkarni AA, Khatiwora E, Adasul V et al.** Comparative Evaluation of Different Concentrations of Mimusops elengi (L) Extract as an Antimicrobial Agent Against Salivary Microflora. Journal of Biomedical Science and Research, **2010**; **2(3):151-154**.
- **Rangama BNLD, Abayasekara CL, Panagoda GJ, Senanayake MRDM.** Antimicrobial Activity of Tephrosia purpurea (Linn.) Pers. and Mimusops elengi (Linn.) Against Some Clinical Bacterial Isolates. Journal of the National Science Foundation Sri Lanka, **2009**; **37(2):139-145**.
- **Ali MA, Mozid MA, Yeasmin S, Khan AM, Sayeed MA.** An Evaluation of Antimicrobial Activities of Mimusops elengi Linn. Research Journal of Agriculture and Biological Sciences, **2008**; **4(6):871-874**.
- **Hazra KM, Roy RN, Sen SK, Laskar S.** Isolation of Antibacterial Pentahydroxy Flavones from the Seeds of Mimusops elengi Linn. African Journal of Biotechnology, **2007**; **6(12):1446-1449**.
- **Lalitha V, Kiran B, Raveesha KA.** In Vitro Evaluation of Mimusops elengi Plant Extract for Antibacterial Activity and Phytochemical Analysis. Pharmacophore, **2011**; **2(1):78-85**
- **Sahu, N. P.** Triterpenoid Saponins of Mimusops elengi. Phytochemistry, **1996**; **41:883−886**.
- **Sahu, N. P., Koike, K., Jia, Z., & Nikaido, T.** Novel Triterpenoid Saponins from Mimusops elengi. Tetrahedron, **1995**; **51:13435−13446**.
- **Sahu, N. P., Koike, K., Jia, Z., & Nikaido, T.** Triterpenoid Saponins from Mimusops elengi. Phytochemistry, **1997**; **44:1145−1149**.

- **Sen, S., Sahu, N. P., & Mahato, S. B.** Pentacyclic Triterpenoids from Mimusops elengi. Phytochemistry, **1995**; **38:205−207**.
- **Sánchez-Moreno, C., Larrauri, J. A., & Saura-Calixto, F.** Free Radical Scavenging Capacity and Inhibition of Lipid Oxidation of Wines, Grape Juices, and Related Polyphenolic Constituents. Food Research International, **1999**; **32:407−412**.
- **Satish, S., Raghavendra, M. P., Mohana, D. C., & Raveesha, K. A.** Antifungal Activity of a Known Medicinal Plant Mimusops elengi L. Against Grain Moulds. Journal of Agricultural Technology, **2010**; **1:1−13**.
- **Shahwar D, Raza MA.** In Vitro Antibacterial Activity of Extracts of Mimusops elengi Against Gram-Positive and Gram-Negative Bacteria. African Journal of Microbiology Research, **2009**; **3:458–462**.
- **Shah, P. J., Gandhi, M. S., Shah, M. B., Goswami, S. S., & Santani, D.** Study of Mimusops elengi Bark in Experimental Gastric Ulcers. Journal of Ethnopharmacology, **2003**; **89:305−311**.
- **Slots, J., & Rams, T. E.** Microbiology of Periodontal Disease. In J. Slots & M. A. Taubman (Eds.), Contemporary Oral Microbiology and Immunology, **1992**; **425−443**. Mosby Year Book.