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Medicinal Value and Critical Analysis of Mango Kernel (Mangifera indica Seed): A Brief Study

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Abstract: Mango (*Mangifera indica* L.) is one of the most valued tropical fruits and occupies a significant position in global horticulture, food trade, and nutritional security. Although the pulp is widely consumed in fresh and processed forms, the seed kernel is commonly discarded during domestic consumption and industrial processing, thereby contributing to substantial agro-industrial waste. Recent scientific investigations indicate that mango kernel is a chemically valuable biomass rich in starch, dietary fiber, proteins, lipids, phenolic compounds, flavonoids, tannins, tocopherols, and essential minerals. Such constituents have drawn increasing attention because of their potential medicinal and functional relevance.

Traditional systems of medicine have employed mango seed preparations in the management of diarrhea, dysentery, skin irritation, inflammation, and digestive disturbances. Contemporary studies further suggest that mango kernel exhibits antioxidant, antimicrobial, anti-inflammatory, antidiabetic, gastroprotective, and lipid-lowering properties. These observations support its possible utility in pharmaceutical, nutraceutical, cosmetic, and functional food sectors. However, despite promising laboratory evidence, many reported outcomes remain dependent upon extraction methods, cultivar variation, dosage conditions, and experimental design. Clinical validation and safety standardization are still limited.
The present study critically examines the medicinal value of mango kernel through an integrated review of its phytochemical profile, therapeutic applications, scientific limitations, and future industrial prospects. It also emphasizes the transformation of mango seed from neglected waste into a potentially valuable natural resource for sustainable health-oriented innovations [1]–[6].
Keywords: Mango Kernel, *Mangifera indica*, Medicinal Value, Phytochemicals, Antioxidant, Therapeutic Uses, Critical Analysis.

Introduction - Mango (*Mangifera indica* L.), frequently described as the “king of fruits,” has been cultivated for several millennia and remains among the most commercially important fruits of tropical and subtropical regions. It is extensively grown in Asia, Africa, Latin America, and selected subtropical zones of other continents. India continues to hold a leading position in mango cultivation owing to favorable climatic diversity, large varietal resources, and strong domestic demand. Beyond its sensory appeal, mango contributes significantly to nutrition through carbohydrates, vitamins, carotenoids, organic acids, and diverse antioxidant compounds [1], [2].

The growing demand for mango pulp, juices, concentrates, dried products, and confectionery items has simultaneously increased the generation of processing residues such as peel and seed. In many industrial operations, these by-products are treated as waste despite containing considerable quantities of bioactive compounds and nutritionally relevant materials. The mango seed itself constitutes an appreciable proportion of the fruit mass, while the enclosed kernel contains starch, edible fat, proteins, polyphenols, and micronutrients. Therefore, scientific reassessment of mango kernel is necessary from both environmental and biomedical perspectives [3], [4].

In recent years, global interest in plant-derived therapeutics has accelerated due to concerns regarding synthetic drug side effects, antimicrobial resistance, chronic metabolic disorders, and the demand for sustainable natural ingredients. Under this changing research landscape, fruit by-products have emerged as important reservoirs of low-cost pharmacologically active molecules. Mango kernel is particularly notable because several studies have associated its extracts with antioxidant defense, microbial growth inhibition, glucose regulation, gastrointestinal protection, and inflammatory control. Such findings suggest that an agricultural residue may possess substantial therapeutic significance when systematically processed and validated [5], [7].

Nevertheless, current literature also reveals limitations. Many investigations remain confined to in vitro models,

small animal studies, or non-standardized extraction protocols. Differences among cultivars, geographic origin, maturity stage, and analytical methodology often produce variable outcomes. Consequently, a critical academic appraisal is required before broad medicinal claims can be accepted.

The present paper aims to examine the medicinal value of mango kernel through a concise yet systematic review of its composition, therapeutic potential, scientific evidence, and practical relevance. It further seeks to position mango kernel as a promising candidate for future pharmaceutical and nutraceutical development while identifying the research gaps that must be addressed.

Historical Background and Conceptual Overview: Mango (*Mangifera indica* L.) has occupied an esteemed place in South Asian civilization for centuries not merely as a fruit crop, but also as a culturally significant medicinal plant. Classical household practices in India, Sri Lanka, Bangladesh, and parts of Southeast Asia employed different portions of the mango tree—including bark, leaves, flowers, peel, and seed—for preventive and curative purposes. Among these components, the seed kernel, though less celebrated than pulp or leaves, maintained a discreet but practical role in folk therapeutics. Powdered kernel preparations were traditionally administered in cases of diarrhea, dysentery, intestinal irritation, and excessive gastric secretions owing to their astringent nature. In rural communities, external applications of kernel paste were also reported for minor skin irritation and inflammatory lesions [4], [7].

Within Ayurvedic understanding, mango is associated with multiple pharmacodynamic attributes depending upon maturity stage and plant part. Traditional texts and regional materia medica describe seed derivatives as absorbent, stabilizing, and useful in bowel irregularities. Indigenous health systems often utilized roasted or dried kernel powder with buttermilk, honey, or herbal adjuncts for digestive imbalance. Such practices were based on experiential therapeutics rather than modern biochemical evidence, yet many of these uses correspond with the presently recognized presence of tannins, phenolics, and antimicrobial constituents in the kernel [8], [9].

During the industrial era, commercial preference for mango pulp and processed beverages led to the relative neglect of peel and seed fractions. Considerable quantities of seeds were commonly discarded or used in limited low-value applications such as feed and composting. This perception has undergone substantial revision in recent decades. According to observations reported by numerous scholars, the expansion of circular bioeconomy approaches, sustainable resource recovery strategies, and renewed interest in plant-based therapeutics has elevated the scientific importance of mango kernel. Contemporary studies indicate that the kernel contains starch, edible lipids, antioxidant phenolics, and materials of possible pharmaceutical relevance. Hence, the developmental trajectory of mango kernel may be understood as a transition from an overlooked by-product to a medicinally and industrially significant bioresource [1]–[11].

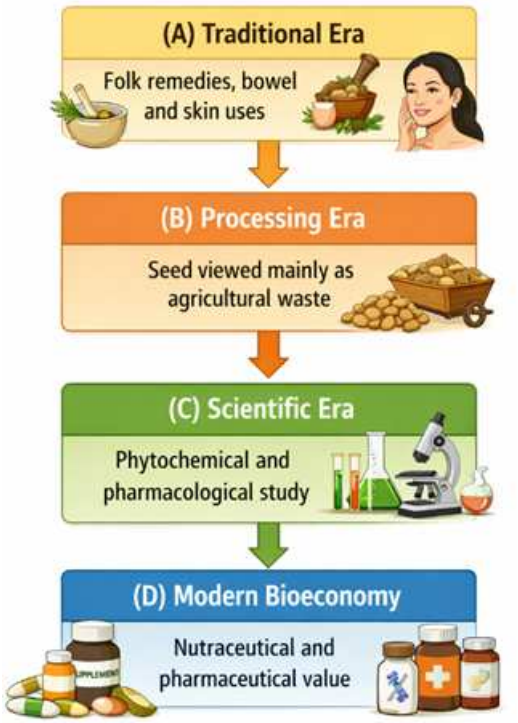


Figure 1. Historical transition of mango kernel utilization

Botanical Identity and Structural Composition of Mango Kernel

Taxonomical Position: Mango belongs to the family Anacardiaceae, a taxonomic group that includes several economically important tropical species. The cultivated mango, *Mangifera indica* L., is the most prominent species of the genus *Mangifera*. It is an evergreen tree characterized by a deep root system, dense canopy architecture, leathery leaves, and drupe-type fruit. The seed-bearing stone within the fruit encloses the kernel, which serves as the embryonic storage tissue rich in reserve nutrients required for germination [2].

Table 1. Taxonomical classification of mango

Rank	Classification
Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Sapindales
Family	Anacardiaceae
Genus	*Mangifera*
Species	*Mangifera indica* L.
Common Name	Mango

Seed Structure and Kernel Portion: The mango fruit is botanically classified as a drupe consisting of epicarp (outer peel), mesocarp (edible pulp), and endocarp (hard stone). Inside the lignified endocarp lies the seed kernel. Depending

on cultivar, maturity, and growing region, the seed may account for approximately 10–25% of total fruit weight, while the kernel itself may represent nearly 45–85% of seed mass. This variation strongly influences industrial recovery potential.

The kernel is generally cream to pale yellow in color, compact in texture, and rich in starch-lipid reserves. Structurally, it contains cotyledonary tissue that supports embryo development. Because of its dense biochemical reserves, the kernel has become an important focus for extraction of flour, starch, butter-like fat, and antioxidant compounds [12], [13].

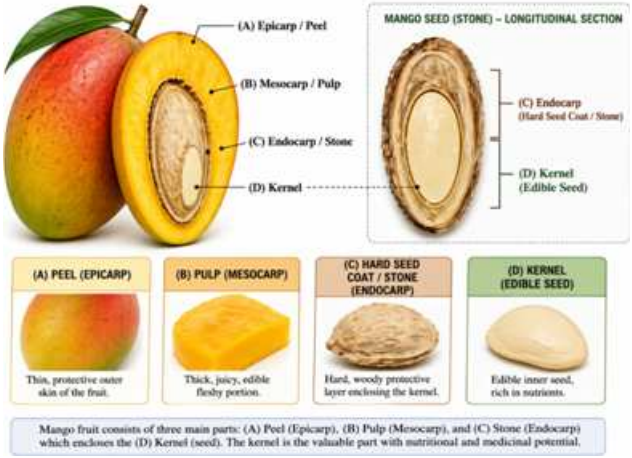


Figure 2. Structural parts of mango fruit and seed

Nutritional Composition: Mango kernel possesses a concentrated nutritional profile that differs markedly from the juicy pulp. Owing to its low moisture and reserve-tissue nature, the kernel contains appreciable carbohydrate fractions, moderate proteins, functional lipids, fiber, and mineral matter. Composition varies with cultivar, maturity stage, and post-harvest treatment; nevertheless, carbohydrates remain the dominant macronutrient, primarily as starch and related polysaccharides. This makes mango kernel flour a promising energy-rich ingredient for food and pharmaceutical applications [14], [15].

Protein fractions, though moderate in quantity, contribute nutritionally valuable amino acids. Lipids present in the kernel are particularly significant because they often contain stearic and oleic acid fractions, making mango kernel fat useful in confectionery and cosmetic industries. Dietary fiber and mineral constituents further enhance functional relevance.

Table 2. Approximate nutritional composition of mango kernel (per 100 g dry basis)

Component	Typical Range	Functional Significance
Carbohydrates	58–80 g	Energy source; starch recovery
Protein	6–13 g	Nutritional supplementation
Lipids	6–18 g	Edible fat; industrial applications
Dietary Fiber	2–5 g	Digestive support; bulk value
Ash (Mineral matter)	2–4 g	Indicates mineral presence
Moisture	Low after drying	Shelf-life advantage

Source: Dakareet al.(2012)

Major Mineral Elements Reported

Mineral	Reported Importance
Potassium	Electrolyte balance
Calcium	Bone and cellular functions
Magnesium	Enzyme activation
Phosphorus	Energy metabolism
Iron	Hemoglobin synthesis
Zinc	Immune and enzymatic roles

Source: A. Idris,(2012)

From an applied standpoint, the nutritional density of mango kernel supports its reconsideration as a value-added biomass rather than disposable residue. Its compositional strength also provides a biochemical basis for several medicinal claims explored in later sections of this study.

Phytochemical Constituents of Mango Kernel: Mango kernel is a chemically rich botanical fraction containing several nutritionally and pharmacologically relevant compounds. Unlike many fruit-processing residues, the kernel possesses concentrated secondary metabolites and stable lipid fractions that justify its growing scientific interest. The qualitative and quantitative composition varies according to cultivar, climatic conditions, maturity stage, storage environment, and extraction method; however, the overall phytochemical profile consistently indicates significant therapeutic promise.

Polyphenols: Polyphenols constitute one of the most important bioactive groups present in mango kernel. These compounds are associated with free-radical scavenging activity, oxidative stress reduction, and modulation of inflammatory pathways. Reported kernel extracts demonstrate substantial total phenolic content, indicating that mango kernel may serve as a functional natural antioxidant source [16], [17].

Flavonoids: Flavonoids detected in mango kernel include catechin-type derivatives, quercetin-associated compounds, and related phenolics. These molecules are widely recognized for vascular protection, cellular defense, and anti-inflammatory relevance. Their presence strengthens the nutraceutical significance of mango kernel preparations [18].

Tannins: Kernel tissues contain notable tannin fractions, especially hydrolysable tannins. Although excessive tannins may reduce palatability and require processing control in food use, properly standardized concentrations are associated with antimicrobial activity, antioxidant action, and protective gastrointestinal effects [19].

Mangiferin: Mangiferin is among the most studied compounds linked with the mango plant system. This xanthone glycoside has been associated with antioxidant,

anti-inflammatory, antidiabetic, hepatoprotective, and immunomodulatory effects in experimental studies. Its occurrence in mango kernel substantially elevates medicinal relevance [20], [21].

Gallic Acid and Phenolic Compounds: Gallic acid, ellagic derivatives, caffeic acid, ferulic acid, and related phenolics have been identified in kernel extracts. These compounds are frequently associated with cytoprotective, antimicrobial, and radical-neutralizing properties. Their synergistic interaction may be more important than isolated single-compound effects.

Fatty Acids and Bioactive Lipids: Mango kernel oil contains stearic acid, oleic acid, palmitic acid, and smaller quantities of linoleic acid. This composition contributes to oxidative stability and industrial usefulness. In addition, lipid-soluble micronutrients and minor unsaponifiable fractions may enhance cosmetic and pharmaceutical value [22].

Medicinal Value of Mango Kernel

Antioxidant Potential: Multiple investigations indicate that mango kernel extracts exhibit strong antioxidant capacity through phenolic hydrogen donation, metal chelation, and inhibition of lipid peroxidation. Such activity may support preventive health strategies against oxidative-stress-mediated disorders.

Antimicrobial Activity: Kernel extracts have demonstrated inhibitory effects against selected bacterial and fungal strains in laboratory studies. These observations suggest possible applications in natural preservation systems and supportive phytotherapeutic formulations.

Anti-inflammatory Effect: Polyphenolic constituents may regulate inflammatory mediators and reduce oxidative tissue injury. Preliminary evidence indicates usefulness in chronic low-grade inflammatory conditions, though human validation remains limited.

Antidiabetic Potential: Experimental findings suggest that mango kernel phytochemicals may assist glucose regulation through enzyme inhibition, insulin-sensitizing pathways, and reduction of oxidative pancreatic stress. This area remains promising but clinically underdeveloped.

Gastrointestinal Benefits: Traditional usage patterns and modern biochemical evidence both indicate relevance in diarrhea control, mucosal protection, and digestive stabilization. Tannins and phenolics may contribute to these effects when properly processed.

Skin Protective Uses: Kernel butter and extracts are increasingly examined for emollient, antioxidant, and barrier-supportive properties. Their inclusion in dermatological and cosmetic preparations reflects practical translational value.

Cardiometabolic Relevance: The combination of antioxidant phenolics and favorable fatty acid fractions suggests potential value in lipid balance, endothelial support, and broader cardiometabolic wellness strategies.

Critical Scientific Analysis: The current evidence base for mango kernel is encouraging but methodologically uneven. A substantial proportion of available studies are in vitro, where antioxidant, antimicrobial, or enzyme-modulating effects are easier to demonstrate than in living systems. Animal studies provide stronger biological relevance, yet translation to human therapeutic outcomes remains incomplete.

Another challenge lies in extraction variability. Solvent choice, temperature, drying process, cultivar identity, storage conditions, and analytical method significantly alter reported phytochemical values. Consequently, cross-study comparison is often difficult. Standardization of extract preparation is essential before reliable dose-response conclusions can be drawn.

Clinical evidence remains notably limited. Large randomized human trials evaluating efficacy, bioavailability, safety duration, and therapeutic endpoints are still scarce. Without such evidence, many claims remain promising rather than definitive.

Safety assessment also requires careful attention. Excess tannin exposure, contamination during waste recovery, oxidation of stored fats, and inconsistency in crude extracts may reduce suitability for direct consumption. Therefore, purified, tested, and regulated preparations are preferable.

Overall, mango kernel should be viewed as a high-potential medicinal resource whose scientific maturity is still developing.

Industrial and Applied Scope: Mango kernel possesses considerable applied value beyond laboratory investigation. Defatted flour and controlled extracts may be utilized as functional food ingredients due to fiber, starch, and antioxidant components. Herbal sectors may incorporate standardized extracts into wellness formulations. Kernel fat, often termed mango butter, has relevance in cosmetic preparations including moisturizers, soaps, and protective creams.

From an environmental perspective, utilization of seed waste supports circular bioeconomy models by converting agro-industrial residues into value-added products. In pharmaceutical manufacturing, mango kernel may also emerge as a sustainable source of selected excipients, lipid bases, and phytochemical raw materials.

Major Findings of the Study: Mango kernel contains multiple bioactive compounds including polyphenols, tannins, flavonoids, mangiferin, and useful lipids. Experimental studies indicate antioxidant, antimicrobial, anti-inflammatory, antidiabetic, gastrointestinal, and dermatological potential. Scientific evidence is expanding steadily, yet robust clinical confirmation remains insufficient. The kernel represents a valuable non-waste botanical resource with notable future healthcare and industrial relevance. Deeper standardization and human studies are necessary for validated therapeutic adoption.

Conclusion: Mango kernel should no longer be regarded merely as discarded seed residue. Contemporary evidence

demonstrates that it is a biologically active plant resource with meaningful medicinal, nutritional, and industrial significance. Its phytochemical richness and functional lipid composition position it as a promising candidate for natural therapeutics, functional foods, cosmetics, and sustainable product development. Nevertheless, responsible advancement requires standardized extraction systems, toxicological assurance, pharmacokinetic clarification, and well-designed clinical trials. With such scientific progression, mango kernel may transition from underutilized byproduct to validated contributor in future health-oriented industries.

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