



Review Article

A Review on the Medicinal and Nutritional Potential of *Drynaria Quercifolia*

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Drynaria quercifolia J. Sm. (family Polypodiaceae), commonly known as oak leaf fern, is an epiphytic medicinal fern widely distributed in tropical and subtropical regions of Asia, including India, Sri Lanka, and Southeast Asia. The plant has a long history of use in traditional medical systems such as Ayurveda, Siddha, and folk medicine, particularly for the treatment of bone fractures, inflammatory disorders, wounds, and various chronic ailments. This review comprehensively compiles and critically analyzes the available literature on the ethnomedicinal uses, phytochemical constituents, and pharmacological activities of *D. quercifolia*. Phytochemical investigations have revealed the presence of several bioactive compounds, including flavonoids, phenolic acids, triterpenoids, steroids, tannins, glycosides, and essential minerals, which are believed to contribute to its therapeutic potential. Pharmacological studies have demonstrated a broad spectrum of biological activities such as antioxidant, anti-inflammatory, antimicrobial, anti-osteoporotic, analgesic, hepatoprotective, and wound-healing effects. Notably, experimental studies support its traditional use in bone health and fracture healing by enhancing osteoblastic activity and mineralization. Despite these promising pharmacological findings, most evidence is derived from in vitro and animal studies, with limited data on clinical efficacy, safety, and toxicity. This review identifies critical research gaps, emphasizing the need for standardized extracts, isolation of active constituents, mechanistic studies, and well-designed clinical trials. Overall, *Drynaria quercifolia* represents a valuable medicinal fern with significant potential for the development of novel therapeutic agents and its incorporation into evidence-based herbal medicine.

Keywords: *Drynaria quercifolia*, epiphytic medicinal fern, Nutritional Potential.

INTRODUCTION

Though less visible than more developed plants, medicinal ferns are a rich source of bioactive molecules having several medical uses [1, 2]. Found throughout South and Southeast Asia, the oak-leaf fern—officially known as *Drynaria quercifolia* J. Sm.—is a perennial epiphytic fern [3,4]. In Ayurveda, Siddha, Unani, and folk medicine, its rhizome has been traditionally used to treat a range of ailments including bone fractures, arthritis, inflammation, respiratory conditions, gastrointestinal problems, fever, jaundice, and wound healing [1–4]. Ethnopharmacological studies show that most of its medicinal effects come from flavonoids (naringin, naringenin, apigenin, kaempferol), phenolic acids

(gallic, ferulic, protocatechuic), triterpenoids, phytosterols, and other secondary metabolites [5–8]. Particularly osteogenic qualities among others, these bioactive compounds have a range of biological effects including antioxidant, anti-inflammatory, antibacterial, hepatoprotective, gastroprotective [9–12]. Even though there is a lot of preclinical data, clinical translation is still limited. Significant omissions include pharmacokinetic studies, toxicity profiling, and herbal product standardization. This review helps to guide future research and development of therapies based on *Drynaria quercifolia* by integrating information from plant science, phytochemistry, pharmacology, toxicology, and ethnomedicine



Taxonomy and Botanical Classification

Accurate taxonomy is vital for preventing adulteration and ensuring therapeutic efficacy. The

taxonomic hierarchy of *Drynaria quercifolia* is as follows:

Rank	Classification
Kingdom	Plantae
Division	Pteridophyta
Class	Polypodiopsida
Order	Polypodiales
Family	Polypodiaceae
Genus	Drynaria
Species	Drynaria quercifolia.

A synonym is *Aglaomorpha quercifolia*. Dimorphic fronds, scaly rhizomes, and pinnatisect fertile leaves are important diagnostic characteristics. Molecular techniques like DNA barcoding, which are crucial for quality control and standardizing herbal formulations, supplement morphology for authentic identification. Appropriate taxonomy is required to ensure medicinal efficacy and prevent adulteration. The following is the taxonomic hierarchy of *Drynaria quercifolia*: This is the same as *Aglaomorpha quercifolia*. Important diagnostic signals include morphological characteristics such as dimorphic fronds, scaly rhizomes, and pinnatisect fertile leaves. Molecular methods like DNA barcoding support morphological for precise identification, which is crucial for herbal preparation quality control and standardization.

Botany Morphology and Description

Rhizome

The wide, spreading rhizome is covered in brown peltate scales. It stores significant bioactive compounds and promotes epiphytic adhesion. Under a microscope, cortex and vascular bundle architecture serve as markers for pharmacognostic validation.

Fronds

Dimorphic fronds are a characteristic of the species: Sterile fronds: ^[12]. The nest-like, brown, oak-leaf-shaped structure helps nourish rhizomes by trapping moisture and organic debris ^[11,12].

- Spore production and dispersal are carried out by green, pinnatifid, fertile fronds with abaxial sori ^[13, 14].

Sporangia and reproduction

The sori are circular to elongated near the leaf veins, allowing spore reproduction and facilitating survival in epiphytic habitats ^[15].

Geographical distribution and ecology

Drynaria quercifolia is found in India, Sri Lanka, Nepal, Bangladesh, Myanmar, Thailand, Malaysia, Vietnam, and Indonesia ^[16,17].

Preferred habitats include:

- Moist deciduous and evergreen forests.
- Shady rocky area.
- They grow epiphytically on tree trunks.

Ecological adaptation:

- Dead leaves and moisture remain on the leaves of the nest.
- Rhizome scales protect against dehydration and herbivory.
- Promote invertebrate microhabitat formation and water retention ^[18-20]

Traditional and ethnomedicinal uses.

Ayurveda

Rhizome preparations classified as pasanaveda are used for:

- Promotes fracture healing.
- Reduce inflammation and pain
- Treatment of stomach diseases, asthma, chronic cough
- Supports liver function ^[21-23]

Milk or ghee is commonly used as a carrier to improve the bioavailability of flavonoids. Siddha and Unani

It is used in wound healing, fever, abdominal and urinary disorders by decoction, paste and topical application ^[24,25].

Traditional and tribal medicine

Used in Northeast India, South India and Sri Lanka for:

- Bone strengthening
- Gastrointestinal disorders
- Fighting snake bites ^[26-29]

Phytochemical Composition

Flavonoids and Polyphenols

Compound	Reported Activity
Naringin, naringenin	Osteogenic, antioxidant, anti-inflammatory
Apigenin	Anti-inflammatory, anti-apoptotic
Kaempferol	Antioxidant, hepatoprotective
Astragalin	Anti-inflammatory, cytoprotective

6.2 Phenolic Acids

Compound	Activity
Gallic acid	Free radical scavenging, antimicrobial
Ferulic acid	Antioxidant, cytoprotective
Protocatechuic acid	Anti-inflammatory, hepatoprotective



Triterpenoids and phytosterols

Triterpenoids such as polypodan, β -sitosterol, and stigmasterol contribute to anti-inflammatory, hepatoprotective, and osteoprotective effects [34-36].

Other components

Alkaloids, tannins, saponins, and glycosides contribute to antibacterial, anti-inflammatory, and wound healing effects [37-39].

Analytical methods and standardization

Pharmacological evaluation

Morphological and microscopic examination of rhizome scales and internal tissues is essential for authenticity determination

Chromatography and spectroscopy

- HPTLC of flavonoids
- HPLC for phenolic acids
- GC-MS of volatile substances
- FTIR of functional groups

Physicochemical analysis

Parameters include ash content, extraction properties, humidity, and pH according to WHO standards



9. Pharmacological Activities Table

Activity	Experimental Evidence
Anti-inflammatory	Carrageenan-induced paw edema, cytokine inhibition
Osteogenic/Bone healing	Increased ALP, collagen I,
Antioxidant	DPPH, ABTS, FRAP assays
Hepatoprotective	Reduced AST, ALT, ALP, restored SOD/CAT/GPx
Gastroprotective	Ethanol-induced ulcers, mucosal protection
Antimicrobial	E. coli, S. aureus, P. aeruginosa, Candida
Analgesic	Hot plate and writhing tests in mice

Comparative analysis: traditional data and modern data.

- Traditional Ayurvedic use in bone healing is consistent with experimental evidence of naringin-mediated bone formation
- Common use in wound healing corresponds to the antibacterial and anti-inflammatory properties of rhizome extracts
- Hepatoprotective and gastroprotective claims of Siddha medicine are supported by recovery of liver and gastric mucosal enzymes in animal models

Toxicity and Safety Profile

- Acute and subchronic studies have shown safety at therapeutic doses
- Mild gastrointestinal irritation only at high doses.
- No significant histopathological changes are observed in the liver or kidneys

FUTURE PROSPECTS

- Clinical validation of bone formation and anti-inflammatory effects.
- Development of nanoformulations to improve bioavailability.
- Pharmacokinetics, pharmacodynamics, and metabolomics studies.
- Isolation of new triterpenoids, flavonoids and glycosides.

- Creation of standardized, quality-controlled herbal products [36–40]

Nutritional and mineral ingredients

Drynaria quercifolia J. Sm., traditionally recognized for its pharmacological activity, also presents a remarkable nutritional and mineral profile, particularly concentrated in the rhizome, the main medicinal part of the plant [41,42]. This nutritional richness is thought to contribute synergistically to bone strengthening, anti-aging, and ethnomedicinal uses as a restorative agent, particularly in post-fracture and musculoskeletal treatments [43,44].

Approximate nutritional profile

Rough analysis *Drynaria quercifolia* exhibits a balanced macronutrient composition, including carbohydrates, proteins, crude fiber, and small amounts of lipids [45,46]. Carbohydrates are major macronutrients that provide readily available energy needed to support metabolic processes, promote cell proliferation, and support tissue regeneration during fracture healing [46, 47]. Proteins provide essential amino acids for collagen synthesis and extracellular matrix formation, which are essential for bone strength and connective tissue repair. Crude fiber supports gastrointestinal health by promoting nutrient absorption, and its minimal lipid content reduces the risk of oxidative stress during recovery

Mineral composition

The rhizomes of *Drynaria quercifolia* are particularly rich in minerals, with high amounts of calcium and phosphorus, supporting their traditional role in the treatment of bone fractures, osteoporosis, and other skeletal diseases Calcium is a major component of the

hydroxyapatite matrix of bone, providing structural integrity and mechanical strength, while phosphorus is required for osteoblast osteoid formation, energy metabolism (ATP) and phosphate signaling pathways [44,49]. In addition to calcium and phosphorus, rhizomes contain magnesium, potassium, sodium, iron, zinc, and manganese, each with different biological functions. Magnesium is essential for calcium homeostasis, bone mineralization, and enzymatic reactions in bone formation. Potassium and sodium support electrolyte balance and neuromuscular function, which are important for muscle contraction and skeletal coordination [46,50]. Iron is essential for the synthesis of hemoglobin and the delivery of oxygen to healing tissues, thereby supporting cell proliferation and metabolic needs during tissue repair. Trace minerals such as zinc and manganese are involved in many biochemical pathways, including collagen cross-linking, antioxidant defense, immunomodulation, and enzymatic bone remodeling. Zinc acts as a cofactor for alkaline phosphatase (ALP), which is essential for mineral deposition, and manganese supports glycosaminoglycan synthesis and antioxidant enzyme activity in osteoblasts [49, 50].

Synergistic effects on nutrition

The combined presence of these macronutrients and trace elements creates a synergistic effect that enhances the osteogenic, anti-inflammatory, and regenerative potential of rhizomes. This biochemical synergy is likely at the origin of the observed efficacy of *D. Quercifolia* in traditional preparations for bone healing, post-traumatic rehabilitation, and age-related treatment of the musculoskeletal system.

Relevance to modern nutritional supplement development

Given its nutrient-rich profile, *Drynaria Quercifolia* rhizomes may be included in nutritional supplements, functional foods, and herbal supplements for bone health, musculoskeletal support, and injury recovery. Standardization of mineral content, bioactive flavonoids, and triterpenoids may provide an evidence-based approach for developing evidence-based herbal treatments for osteoporosis, bone fractures, and skeletal degenerative diseases.



CONCLUSION

Drynaria quercifolia is a scientifically proven medicinal fern with wide ethnomedicinal authority. Its rhizomes are rich in flavonoids, phenolic compounds, and triterpenoids, which have anti-inflammatory, antioxidant, antibacterial, hepatoprotective, gastroprotective, and osteogenic properties. Future clinical trials, standardization, and

pharmacokinetic studies are needed to translate its therapeutic potential into evidence-based medicine.

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