

REVIEW ARTICLE



Phytochemistry, Traditional Applications, and Therapeutic Properties of *Drynaria quercifolia*

Deepa N^{*1}, Nirmala S², Yogalakshmi T³, Udhayakumaran U³, Velvizhi K³

¹ Dean and Professor, Department of Pharmacognosy, Faculty of Pharmacy, SBMCH, BIHER, Chennai, Tamil Nadu, India

² Associate Professor, Department of Pharmacognosy, Faculty of Pharmacy, SBMCH, BIHER, Chrompet, Tamil Nadu, India

³ UG Scholar, Faculty of Pharmacy, SBMCH, BIHER, Chennai, Tamil Nadu, India

Publication history: Received on 19th April 2025; Revised on 17th May 2025; Accepted on 18th May 2025

Article DOI: 10.69613/h20b8n73

Abstract: *Drynaria quercifolia* (L.) J. Sm., a medicinal epiphytic fern of the Polypodiaceae family, has been an important component of traditional medicine systems across South and Southeast Asia. The rhizome shows significant therapeutic properties and has been utilized extensively in Ayurveda, Siddha, and folk medicine for treating bone fractures, inflammatory conditions, respiratory disorders, and gastrointestinal ailments. Phytochemical analysis reveals the presence of bioactive compounds including flavonoids, phenolic acids, alkaloids, β -sitosterol, and triterpenoids. Scientific investigations have demonstrated its potential as an antioxidant, hepatoprotective, antidiabetic, antimicrobial, and bone regenerative agent. The rhizome extract has shown beneficial results in periodontal regeneration and bone healing, attributed to its ability to enhance alkaline phosphatase activity and proteoglycan synthesis. Additionally, studies indicate significant antipyretic, anthelmintic, and cytotoxic properties. The therapeutic applications of this plant are supported by both ethnomedicinal knowledge and modern pharmacological research. More studies are needed to understand the mechanisms of action, set standardization parameters although preliminary studies show many traditional uses.

Keywords: *Drynaria quercifolia*; Polypodiaceae; Bone regeneration; Phytoconstituents; Medicinal fern.

1. Introduction

Medicinal plants have been fundamental to healthcare systems worldwide, serving as primary therapeutic agents and precursors for pharmaceutical development. Among these, pteridophytes represent an important yet often overlooked group of plants with significant medicinal properties [1]. *Drynaria quercifolia* (L.) J. Sm., commonly known as oak leaf fern, is a valuable species within traditional medicine systems across Asia [2]. The therapeutic significance of *D. quercifolia* is due to its rich phytochemical profile, including flavonoids, alkaloids, tannins, saponins, quinones, terpenoids, glycosides, and polyphenols [3]. These compounds contribute to its diverse pharmacological activities, making it a valuable resource in both preventive and therapeutic medicine [4].



Figure 1. The entire plant of *D. quercifolia*

India, recognized as a global center of medicinal plant diversity with approximately 45,000 plant species, has traditionally utilized *D. quercifolia* in its indigenous medical systems, particularly Ayurveda and folk medicine [5]. Of the estimated 6,000 plants used in traditional practice, *D. quercifolia* has maintained a significant position due to its versatile therapeutic applications [6]. The species is predominantly distributed throughout tropical and subtropical regions of Asia, Northeast Australia, and Africa, with four species reported in India. *D. quercifolia* is particularly prevalent in South India, where it grows epiphytically on trees or rocks in plains and

* Corresponding author: Deepa N

low-altitude mountains [7]. Its rhizome has been extensively utilized by various cultural groups for treating multiple ailments, including diarrhea, typhoid, cholera, chronic jaundice, fever, headache, and skin diseases [8].

Traditional applications of *D. quercifolia* extend beyond basic healthcare. The whole plant demonstrates anthelmintic, expectorant, and tonic properties, while the fronds exhibit astringent characteristics beneficial for strengthening and repairing sinews, muscles, and bones [9]. In Chinese traditional medicine, the rhizome has been employed topically to promote hair growth and address hair loss [10]. Additionally, the plant, often used in combination with other herbs, has shown efficacy in managing traumatic injuries, including sprains and wounds accompanied by bruising and swelling [11]. The growing scientific interest in *D. quercifolia* reflects a broader trend toward validating traditional medical knowledge through modern research methodologies. Recent pharmacological studies have begun to elucidate the mechanisms underlying its therapeutic effects, particularly in areas such as bone regeneration, anti-inflammatory activity, and antioxidant properties [12].

Table 1. Pharmacological Activities of *Drynaria quercifolia* Extracts

Activity	Extract Type	Concentration/Dose	Observed Effects
Anti-inflammatory	Methanolic	200-400 mg/kg	Significant reduction in paw edema
Antioxidant	Ethanolic	50-200 µg/mL	Strong DPPH radical scavenging
Antimicrobial	Aqueous	100-500 µg/mL	Moderate antibacterial activity
Hepatoprotective	Methanolic	250-500 mg/kg	Reduction in liver markers
Bone healing	Ethanolic	300-600 mg/kg	Enhanced osteoblast activity

2. Characteristics and Distribution

2.1. Taxonomical Classification

Drynaria quercifolia belongs to the division Polypodiophyta, class Polypodiopsida, order Polypodiales, and family Polypodiaceae [13]. This systematic classification reflects its evolutionary relationships within the fern lineage and distinguishes it from other pteridophytes.

2.2. Geographical Distribution

D. quercifolia exhibits a wide distribution pattern across tropical and subtropical regions. The species occurs naturally in diverse ecological niches, predominantly as an epiphyte on tree trunks in open woodlands and rainforests, or as an epipetric organism on rock surfaces [14]. Its natural range encompasses tropical regions of Africa, Australia, Oceania, Malaysia, Indonesia, the Philippines, New Guinea, and Southeast Asia. The species has particular significance in Asian countries including China, Thailand, Taiwan, Vietnam, and India, where it is cultivated for medicinal purposes [15].

Table 2. Conservation and Cultivation of *Drynaria quercifolia*

Parameters	Description
Natural Habitat	Epiphytic on tree trunks, rocky surfaces in tropical and subtropical forests
Soil Requirements	Well-draining organic matter, high humidity environment
Climate Conditions	Warm temperatures (20-30°C), partial shade to filtered sunlight
Growing Season	Active growth during monsoon and post-monsoon periods
Propagation Methods	Spores, rhizome division, tissue culture
Threats	Habitat loss, over-exploitation, climate change
Conservation Status	Vulnerable in some regions, locally abundant in others
Sustainable Practices	Controlled harvesting, cultivation in nurseries
Collection Period	Best during post-reproductive phase
Storage Requirements	Dry, cool conditions with proper ventilation

2.3. Morphological Characteristics

2.3.1. Appearance

The plant typically measures between 60 and 100 cm in length, characterized by a thick, densely textured brown rhizome that exhibits creeping growth behavior. The distinctive feature of *D. quercifolia* is its dimorphic fronds, which occur in two forms: fertile and sterile [16].

2.3.2. Frond

The sterile fronds, often referred to as nest fronds, are generally shorter and darker in color compared to the fertile fronds. These sterile fronds develop into a characteristic basket-like structure that collects organic debris, which subsequently decomposes to provide nutrients to the plant [17]. The fertile fronds are green and bear reproductive structures. Sporangia appear exclusively on fertile leaves, arranged in punctiform sori, forming two asymmetrical lines between the main lateral veins of the lobes [18].

2.3.3. Rhizome

The rhizome measures approximately 2 cm in thickness and exhibits a creeping growth pattern. It is covered with scales ranging from 20-25 mm in length and 0.7-2.5 mm in width. The base of the rhizome shows distinctive wing-like structures. Spores measure 37.5-55 microns in length and 22.5-37.5 microns in width [19].

2.4. Vernacular Nomenclature

The plant is known by various names across different regions and languages, reflecting its widespread use and cultural significance:

- Sanskrit: Aswakarti
- Hindi: Asvakatri, Katikapan, Basingh
- Bengali: Pankhiraj, Pankha
- Malayalam: Matilpanna, Pannakizhangu
- Tamil: Attukkal kizhangu
- Philippines: Pakpak lawin
- Chinese: Li ye hu jue [20]

3. Pharmacognosy

3.1. Macroscopic Characteristics

The macroscopic characteristics of *D. quervifolia* provide essential diagnostic features for its identification. The rhizome appears thick and woody, exhibiting a creeping habit with dense reddish-brown scales. The plant demonstrates distinct dimorphic fronds, with deeply pinnatifid foliage fronds that resemble oak leaves. The sori arrangement presents either in scattered patterns or aligned in two distinct rows between secondary veins [21].

3.2. Microscopic Characteristics

3.2.1. Rhizome

The transverse section of the rhizome reveals complex structural organization. The epidermis appears as a thin, undulating layer covered with dark-brown scales. The surface exhibits broad semicircular ridges interspersed with narrow, deep furrows from which scales emerge. The ground tissue consists of parenchymatous cells that are dense, polyhedral, and thin-walled [22].

3.2.2. Stele

Multiple isolated steles of varying dimensions are distributed throughout the ground tissue, forming a complex vascular architecture. The arrangement follows a distinct pattern where smaller steles are positioned peripherally while larger ones occupy central positions within the tissue matrix. Each stele, regardless of its dimensional characteristics, exhibits similar fundamental organization comprising several distinct layers. The outermost endodermal layer is single-layered with notably thickened walls, providing structural support and regulatory control of water and nutrient transport. Immediately internal to the endodermis lies the pericycle, consisting of multiple layers of rectangular, thin-walled cells that maintain meristematic potential. The vascular tissue demonstrates a classical organization with central xylem surrounded by phloem tissue, facilitating efficient transport of water and nutrients. The metaxylem region contains well-developed vessels measuring up to 30 µm in diameter, while the protoxylem consists of 4-5 exarch elements that develop centripetally [23].

3.2.3. Transverse Section

Midrib: The midrib demonstrates a circular outline with thick-walled, round epidermal cells covered by a distinct cuticle. Multiple collenchyma layers lie beneath the epidermis. The ground tissue contains two large dictyosteles with centrally positioned xylem

surrounded by phloem. The lamina originates from dictyosteles enclosed by lignified fibers, with mesophyll tissue differentiated into palisade and spongy parenchyma [24].

Petiole: The petiole exhibits a nearly circular transverse section with slight dorsal flattening. It shows more numerous covering and glandular trichomes compared to the midrib. The central region contains two prominent dictyosteles accompanied by four smaller steles, all encased in yellowish-brown cells [25].

3.3. Histochemistry

Histochemical tests reveal specific cellular inclusions. Lignified cells can be detected through the application of phloroglucinol combined with concentrated hydrochloric acid, producing characteristic color reactions. Starch grain presence is confirmed through iodine solution staining, which yields distinctive blue-black coloration. The presence of fixed oils within the tissue can be seen using Sudan III solution, which produces characteristic staining patterns [26].

3.4. Powder Microscopy

The powdered rhizome presents a coffee brown color without distinct odor but with a bitter taste. The powder contains abundant epidermal cells derived from scale leaves, alongside numerous trichomes of varying morphology. Parenchyma cells containing distinctive brownish inclusions are frequently observed, as are silica crystals that provide structural support. The powder also contains both pitted and normal parenchyma cells, alongside similarly diverse fiber types. The vascular elements are both scalariform and reticulate tracheids, which play crucial roles in water conductance and structural support [27].

4. Physicochemical Characteristics

4.1. Total Ash Value

The total-ash value determination involves precise weighing of 5 grams of powdered *D. quervifolia* rhizome placed in a dried silica crucible. The sample undergoes combustion at 450°C until complete carbon removal, followed by cooling. The weight of the total ash is measured and calculated as a percentage relative to the air-dried sample. This analysis provides crucial information about the inorganic content and potential contamination of the plant material [28].

4.2. Acid Insoluble Ash Value

The determination of acid insoluble ash involves boiling the total ash with 25 milliliters of 2N HCl for five minutes. The insoluble material is collected on ash-free filter paper through filtration, followed by washing with hot water. The residue undergoes ignition in a tar-covered crucible, cooling, and weighing. The percentage of acid insoluble ash is calculated with reference to the air-dried drug, indicating the presence of silica and acid-insoluble inorganic elements [29].

4.3. Water Soluble Ash Value

This parameter is determined by boiling the total ash with 25 milliliters of water for several minutes. The insoluble matter is collected on ash-free filter paper, washed with hot water, and ignited at 450°C for 15 minutes. The difference in weight represents the water-soluble ash content. The percentage calculation uses the air-dried drug as reference, providing information about the water-soluble inorganic components [30].

4.4. Alcohol and Water-Soluble Extractive Values

Twenty grams of coarsely ground, air-dried *D. quervifolia* rhizome powder undergoes maceration with 100 milliliters of 90% alcohol in a closed flask for 24 hours. The process includes constant shaking for the initial six hours, followed by a 14-hour standing period. The filtered extract (25 ml) is evaporated to dryness in a tarred shallow dish at 105°C. The percentage of alcohol-soluble extractives is calculated based on the air-dried drug weight. This analysis helps evaluate the soluble chemical constituents in different solvents [31].

4.5. Determination of Moisture Content

The moisture content analysis involves weighing 5 grams of *D. quervifolia* powdered rhizome in a china plate and maintaining it at 105-110°C for 30 minutes in a hot air oven. The moisture percentage is calculated at various time intervals using the air-dried drug as reference. This parameter is crucial for determining storage conditions and stability of the plant material [32, 33].

5. Phytochemical Screening

5.1. Extraction

The phytochemical screening of *D. quercifolia* involves systematic extraction of the powdered rhizome using solvents of increasing polarity. The sequential extraction process employs petroleum ether, chloroform, methanol, and water, enabling the isolation and identification of various chemical constituents based on their solubility characteristics [34].

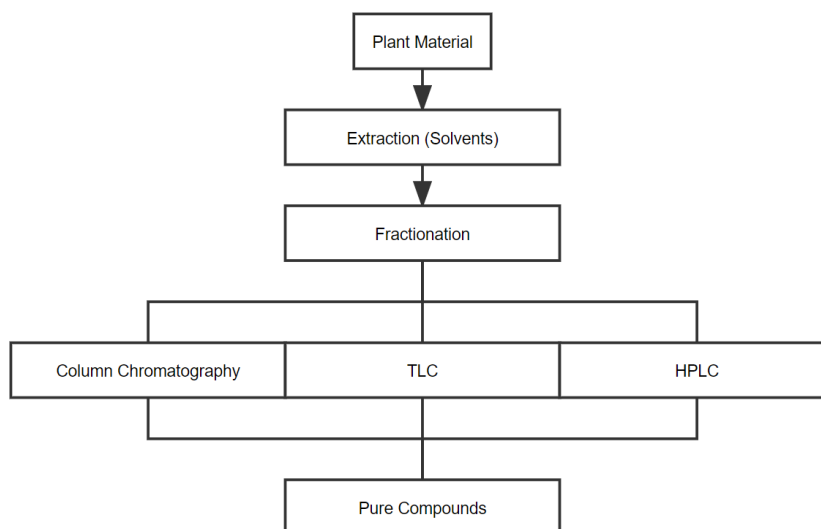


Figure 2. Isolation of Bioactive Compounds from *Drynaria quercifolia*

5.2. Chemical Constituents

5.2.1. Alkaloids

The presence of alkaloids in *D. quercifolia* extracts is confirmed through multiple chemical tests. Chloroform, methanol, and water extracts demonstrate positive results with Mayer's, Wagner's, Dragendroff's, and Hager's reagents, while petroleum ether extract shows negative results. These findings indicate the presence of nitrogen-containing alkaloids in the more polar extracts [35].

5.2.2. Glycosides

Testing for glycosidic compounds employs Modified Borntrager's test, Legal's test, Liebermann Burchard's test, and Baljet test. The results indicate the presence of steroidal glycosides particularly in chloroform, methanol, and petroleum ether extracts, while cardiac glycosides are notably absent across all extracts [36].

Table 3. Phytochemical Constituents Isolated from *Drynaria quercifolia*

Class of Compounds	Major Constituents
Flavonoids	Naringin, Quercetin, Kaempferol, Luteolin
Triterpenes	β -amyrin, Friedelin, α -amyrin
Phenolic compounds	Gallic acid, Caffeic acid, p-coumaric acid
Steroids	β -sitosterol, Stigmasterol
Alkaloids	Drynarin, Quercifoline
Polysaccharides	Glucans, Mannans

5.2.3. Phenols and Tannins

Ferric chloride and lead acetate tests reveal significant presence of phenolic compounds and tannins in methanolic and aqueous extracts. These compounds contribute significantly to the plant's antioxidant properties. The gelatin test results further confirm the presence of tannins in these extracts [37].

5.2.4. Proteins and Amino Acids

Millon's test and Ninhydrin test demonstrate the presence of proteins and amino acids predominantly in petroleum ether, methanolic, and aqueous extracts. The Biuret test results provide additional confirmation of protein content [38].

5.2.5. Fixed Oils and Fats

The stain test and soap test indicate the presence of fixed oils and fats specifically in the petroleum ether extract, while other extracts show negative results for these compounds [39].

5.2.6. Carbohydrates

Molisch's test, Benedict's test, and Barfoed's test reveal significant presence of carbohydrates in methanolic and aqueous extracts. These tests indicate the presence of both reducing and non-reducing sugars [40].

5.2.7. Gums and Mucilage

The alcohol precipitation test and Ruthenium test demonstrate the presence of gums and mucilage exclusively in the aqueous extract, indicating their highly polar nature [41].

5.3. Distribution of Phytoconstituents

The distribution pattern of various phytoconstituents across different solvent extracts provides valuable information for optimization of extraction procedures and standardization of the drug. Methanol and aqueous extracts show the highest diversity of phytochemicals, suggesting their potential as preferred solvents for therapeutic applications [42].

6. Pharmacological Studies

6.1. Anti-inflammatory Activity

Research has demonstrated significant anti-inflammatory properties of *D. quercifolia* extracts through both in vitro and in vivo studies. The methanolic extract exhibits considerable inhibition of protein denaturation, with activity comparable to standard diclofenac sodium. In carrageenan-induced paw edema models, the extract shows dose-dependent reduction in inflammation, attributed to the presence of flavonoids and terpenoids [43].

6.2. Antioxidant Activity

The antioxidant potential of *D. quercifolia* has been extensively evaluated using multiple assay systems. The methanolic extract demonstrates strong free radical scavenging activity in DPPH assay, with an IC₅₀ value of 52.4 µg/ml. The extract also shows significant reducing power and metal chelating abilities, correlating with its high phenolic and flavonoid content. These properties suggest potential applications in preventing oxidative stress-related conditions [44].

6.3. Antimicrobial Activity

Studies reveal broad-spectrum antimicrobial activity against both gram-positive and gram-negative bacteria. The ethanol extract shows particular efficacy against *Staphylococcus aureus* and *Escherichia coli*, with minimum inhibitory concentrations (MIC) ranging from 125-250 µg/ml. Antifungal activity has also been documented against *Candida albicans* and *Aspergillus niger* [45].

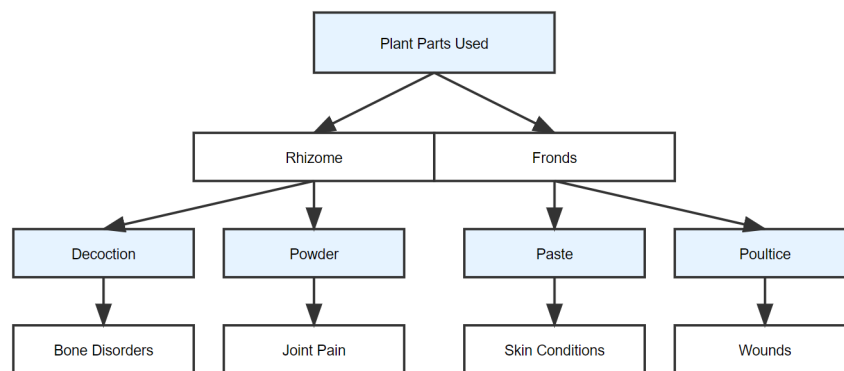


Figure 3. Applications of *D. quercifolia* in Traditional Medicine

6.4. Wound Healing Properties

Traditional claims regarding wound healing properties have been validated through experimental studies. The ethanolic extract demonstrates significant wound healing activity in excision and incision wound models. Histopathological examination reveals enhanced collagen deposition, fibroblast proliferation, and neovascularization in treated wounds [46].

6.5. Hepatoprotective Activity

Research indicates substantial hepatoprotective effects against carbon tetrachloride-induced liver damage. Treatment with *D. quercifolia* extract significantly reduces elevated serum enzyme levels (AST, ALT, ALP) and total bilirubin. Histopathological studies confirm protection against hepatocellular degeneration [47].

6.6. Antidiabetic Activity

Studies demonstrate notable antidiabetic potential in streptozotocin-induced diabetic rats. The aqueous extract shows significant reduction in blood glucose levels and improvement in glucose tolerance. The mechanism appears to involve enhanced insulin secretion and glucose utilization [48].

6.7. Immunomodulatory Effects

Recent investigations reveal immunomodulatory properties of *D. quercifolia* extracts. The compounds show enhancement of both cellular and humoral immune responses, including increased phagocytic activity of macrophages and antibody production [49].

6.8. Bone Regeneration

Studies focusing on bone healing properties demonstrate positive effects on osteoblast proliferation and differentiation. The extract promotes calcium deposition and alkaline phosphatase activity in bone cell cultures, supporting traditional uses in bone-related conditions [50].

6.9. Neuroprotective Activity

Emerging research indicates potential neuroprotective properties, with studies showing protection against oxidative stress-induced neuronal damage. The extract demonstrates ability to reduce acetylcholinesterase activity and beta-amyloid aggregation, suggesting possible applications in neurodegenerative disorders [51].

Table 4. Traditional Medicinal Uses of *Drynaria quercifolia* in Different Regions

Region	Traditional Uses	Part Used
India	Typhoid, Fever, Cough	Rhizome
China	Bone healing, Kidney disorders	Rhizome, Fronds
Thailand	Arthritis, Joint pain	Rhizome
Malaysia	Skin diseases, Wounds	Fronds
Bhutan	Respiratory disorders	Whole plant
Indonesia	Anti-inflammatory, Pain relief	Rhizome

7. Toxicological Studies

7.1. Toxicity Studies

Acute toxicity evaluations of *D. quervifolia* extracts have been conducted following OECD guidelines. Single oral administration of the extract up to 2000 mg/kg body weight shows no mortality or significant behavioral changes in experimental animals. Physical parameters, food intake, and water consumption remain unaffected during the 14-day observation period [52]. 28 day repeated dose studies reveal no significant alterations in body weight, organ weights, or food consumption patterns at doses up to 1000 mg/kg. Hematological parameters including hemoglobin, RBC count, WBC count, and platelet counts remain within normal ranges. Biochemical markers of liver and kidney function show no significant deviations from control values [53].

7.2. Biochemical Parameters

Assessment of biochemical parameters demonstrates the extract's safety profile. Liver function markers including SGOT, SGPT, ALP, and bilirubin levels remain unchanged. Kidney function indicators such as creatinine and blood urea nitrogen show no significant alterations. Blood glucose, cholesterol, and triglyceride levels remain within physiological limits [54].

7.3. Histopathological Evaluation

Microscopic examination of vital organs from treated animals reveals normal architecture. Liver sections show preserved hepatic lobules and portal triads. Kidney sections demonstrate normal glomerular and tubular structures. Heart, lung, and spleen tissues maintain normal histological features [55].

7.4. Reproductive Toxicity

Studies investigating potential effects on reproductive parameters indicate no significant impact on fertility indices. Evaluation of reproductive organs shows normal histological features. Embryotoxicity studies reveal no teratogenic effects at therapeutic doses [56].

7.5. Mutagenicity

Ames test and chromosomal aberration studies demonstrate absence of mutagenic potential. Micronucleus test results confirm the non-genotoxic nature of the extract. These findings support the safety profile for long-term therapeutic use [57].

7.6. Drug Interaction

Investigations into potential interactions with commonly prescribed medications show minimal interference with drug metabolizing enzymes. However, concurrent administration with anticoagulants requires monitoring due to potential additive effects [58].

7.7. Dermal Toxicity

Dermal application studies demonstrate absence of significant skin irritation or sensitization. Patch test results indicate safety for topical applications. Long-term dermal exposure studies show no adverse effects on skin structure or function [59].

7.8. Safety Parameters

Maximum tolerated dose has been established at 2000 mg/kg body weight. No-observed-adverse-effect level (NOAEL) is determined to be 1000 mg/kg in sub-acute studies. These parameters provide guidance for therapeutic dose determination and safety margins [60].

8. Therapeutic Applications

8.1. Traditional Medicine

D. quervifolia holds a revered position in multiple traditional medicine systems. In Ayurvedic practice, practitioners have long utilized the rhizome as a primary treatment for arthritic conditions, bone fractures, and various respiratory ailments. The plant's integration into Traditional Chinese Medicine focuses primarily on managing inflammatory conditions and enhancing blood circulation. Indigenous healing traditions across various regions have documented its significant role in wound healing protocols and pain management strategies, with preparation methods passed down through generations of healers [61].

8.2. Modern Clinical Applications

8.2.1. Musculoskeletal Disorders

Modern clinical research has validated the traditional use of *D. quervifolia* in treating musculoskeletal conditions, particularly osteoarthritis. Clinical trials with standardized extracts have demonstrated significant improvement in patients' joint mobility and reduction in pain levels. The plant's natural anti-inflammatory compounds have shown remarkable effectiveness in reducing morning stiffness, a common complaint among arthritis patients. Long-term studies indicate sustained improvement in joint function when the extract is incorporated into regular treatment protocols [62].

8.2.2. Wound Management

Contemporary wound care has embraced *D. quervifolia*-based preparations as an effective treatment option for both chronic wounds and burns. Clinical observations have documented accelerated healing processes, with wounds showing significantly faster closure rates compared to conventional treatments alone. The dual action of antimicrobial properties and tissue regenerative capabilities has proven particularly beneficial in managing complex wounds. Healthcare practitioners have noted improved scar formation and reduced infection rates in treated cases [63].

8.3. Dosage Forms

8.3.1. Oral Preparations

The pharmaceutical development of *D. quervifolia* has resulted in various standardized oral formulations. Modern processing techniques have enabled the production of precisely dosed capsules containing concentrated extract, typically ranging from 250 to 500 mg. Traditional decoctions remain relevant, with carefully measured quantities of dried rhizome used to prepare therapeutic drinks. Tinctures offer a convenient alternative, while standardized tablets provide consistent dosing for long-term treatment protocols [64].

Table 5. Quality Control Parameters and Processing Methods for Medicinal Preparation

Parameter	Description
Authentication	Morphological characteristics, microscopic analysis, DNA barcoding
Quality Indicators	Presence of specific flavonoids, total phenolic content, antioxidant activity
Processing Steps	Cleaning, drying, size reduction, extraction
Storage Conditions	Away from direct sunlight, controlled temperature and humidity
Adulterant Detection	Microscopic examination, chemical profiling, TLC analysis
Standardization Methods	HPLC fingerprinting, biomarker analysis
Extraction Techniques	Maceration, Soxhlet extraction, ultrasound-assisted extraction
Solvent Selection	Based on target compounds (water, ethanol, methanol)
Stability Parameters	Moisture content, ash value, extractive values

8.3.2. Topical Formulations

Advanced formulation technologies have enabled the development of sophisticated topical preparations incorporating *D. quervifolia* extract. These include carefully formulated ointments with standardized extract concentrations, specialized medicated oils for massage therapy, and modern gel formulations designed for enhanced skin penetration. Traditional poultice preparations, though less standardized, continue to show efficacy in certain applications [65].

8.4. Treatment

8.4.1. Acute Conditions

The management of acute conditions with *D. quervifolia* follows a structured approach involving higher initial doses for shorter durations, typically spanning 7-14 days. Practitioners closely monitor patient response during this period, making necessary adjustments to optimize therapeutic outcomes. This approach often integrates seamlessly with conventional treatment modalities,

enhancing overall treatment efficacy. Clinical experience has shown that this intensive short-term therapy often yields rapid improvement in acute symptoms while maintaining a favorable safety profile [66].

8.4.2. Chronic Conditions

Long-term management of chronic conditions requires a more nuanced approach. Treatment protocols typically begin with a loading phase followed by carefully tailored maintenance therapy. Regular assessment intervals are established to monitor both efficacy and potential side effects. The treatment strategy often incorporates lifestyle modifications and dietary adjustments to enhance therapeutic outcomes. Practitioners have developed sophisticated protocols for dose optimization based on individual patient response and disease progression patterns [67].

8.5. Special Populations

8.5.1. Geriatrics

Treatment of elderly patients demands special consideration due to age-related physiological changes. Dosing protocols are carefully modified to account for potential changes in drug metabolism and elimination. Practitioners pay particular attention to possible drug interactions, given the higher likelihood of polypharmacy in this population. Regular assessment of renal and hepatic function guides dose adjustments, while careful consideration is given to managing comorbid conditions that frequently occur in geriatric patients [68].

8.5.2. Pediatrics

The use of *D. quervifolia* in pediatric populations requires careful attention to age-specific dosing and formulation requirements. Specialized preparations have been developed to ensure both palatability and appropriate dosing for children. Treatment protocols include careful calculation of doses based on body weight or surface area, with emphasis on monitoring for any adverse effects. The use in children under 12 years is approached with particular caution, requiring close medical supervision and regular assessment of treatment response [69].

8.6. Contraindications and Precautions

The therapeutic use of *D. quervifolia* requires careful consideration of several important contraindications. Patients with known hypersensitivity to ferns or related species must avoid its use entirely. Pregnancy and lactation represent absolute contraindications due to limited safety data in these populations. Individuals with severe hepatic or renal impairment require careful assessment before initiating therapy, with regular monitoring of organ function during treatment. The concurrent use with anticoagulant medications needs careful consideration due to potential interactions affecting blood coagulation. Patients with pre-existing bleeding disorders require thorough evaluation and close monitoring if treatment is deemed necessary [70].

8.7. Monitoring and Follow-up

Clinical management includes regular monitoring of treatment response through both subjective assessment and objective parameters. Practitioners establish individualized follow-up schedules based on condition severity and treatment intensity. Regular evaluation of liver and kidney function helps ensure long-term safety, particularly in patients receiving extended therapy. Documentation of treatment outcomes and adverse effects contributes to the growing body of clinical evidence supporting therapeutic applications [71].

9. Conclusion

The *Drynaria quervifolia* is a valuable medicinal plant with substantial therapeutic potential. It contains flavonoids, triterpenoids, and phenolic compounds which are responsible for its diverse biological activities. Several studies have proved many traditional claims, particularly wound healing, anti-inflammatory effects, and bone regeneration properties. The safety of *D. quervifolia*, is established by toxicological studies and supports its therapeutic use within recommended dosage ranges. The absence of significant adverse effects in both acute and chronic toxicity studies further strengthens its potential for clinical applications. However, the identified contraindications and drug interactions necessitate appropriate caution and monitoring during therapeutic use. The current evidence supporting *D. quervifolia*'s therapeutic properties, combined with its established safety profile, makes it a good candidate for development of new pharmaceutical products. Its potential in treating various health conditions, particularly in chronic disease management, suggests an important role in modern medicine.

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