International Journal of Research in Pharmacology & Pharmacotherapeutics (IJRPP)

IJRPP |Vol.15 | Issue 1 | Jan - Mar -2026

www.ijrpp.com

ISSN: 2278-2648

DOI : https://doi.org/10.61096/ijrpp.v15.iss1.2026.283-300

Review

MEDICINAL IMPORTANCE AND PHYTOCHEMICAL CONSTITUENTS OF DRYNARIA QUERCIFOLIA: AN ANALYTICAL REVIEW

Dr. L. V. Vigneshwaran*, Mohammed Riyaskhan. M , Dharsini. V, Naveenkumar. R, Inbarasu. M, Sonia. A, Siva Ranjani. A

RKP College of Pharmacy, Krishnagiri, Tamil Nadu -635001

*Corresponding Author: Dr. L.V. Vigneshwaran
Email Id: vigneshwaran85@gmail.com

Published on: 04.03.2026

Published by: Futuristic Publications

Abstract

The botanical characteristics, geographic range, and ethnomedical uses of D. quercifolia were all covered in detail in this thorough analysis. Additionally, a phytochemical analysis of the rhizome was conducted, yielding values for water-soluble ash (50%), acid-insoluble ash (12.5%), and total ash (8%). The existence of important secondary metabolites such tannins, saponins, alkaloids, and sterols was verified by sequential solvent extraction and qualitative screening of petroleum ether, chloroform, methanol, and aqueous extracts. Eleven more bioactive chemicals were found by GC-MS analysis of the ethanolic extract, supporting the plant's medicinal potential and confirming its use in conventional and preventative medicine.

Keywords: annins, saponins, alkaloids, sterols

INTRODUCTION

The oak leaf fern or Drynaria quercifolia (L.) J. Sm., is an important species in Asian traditional medicine systems [1]. D. quercifolia's extensive phytochemical profile, which includes flavonoids, alkaloids, tannins, saponins, quinones, terpenoids, glycosides, and polyphenols, accounts for its medicinal importance [2]. These substances contribute to its wide range of pharmacological actions, making it an important tool for both therapeutic and preventive medicine[3]. D. quercifolia has long been used in India's traditional medical systems, including Ayurveda and folk medicine. India is known as a global center of medicinal plant variety with some 45,000 plant species[4].In South India, D. quercifolia is especially common,

growing epiphytically on trees or rocks in low-altitude highlands and plains . Many cultural groups have used its rhizome to cure a variety of illnesses, such as diarrhea, typhoid, cholera, chronic jaundice, fever, headaches, and skin conditions[5].

Furthermore, the plant has demonstrated effectiveness in treating traumatic injuries, such as sprains and wounds with bruising and swelling, when used in conjunction with other herbs.

A. Growing scientific interest in D. quercifolia is indicative of a larger movement to use contemporary research techniques to validate traditional medical knowledge. The processes behind its therapeutic actions have started to be clarified by recent pharmacological research, especially in areas like bone regeneration, antioxidant qualities and anti-inflammatory action[6].

FIGURE 01: [Drynaria Quercifolia]

The rhizomes are short, thick, fleshy creeping, up to 3 cm in diameter, closely adhered to the substratum, and covered in paleae. Paleae are either linear or lanceolate, peltate, short- stalked, red-brown, non-clathrate, gland-tipped, gland-deciduous, and have dented, age-ciliate borders. The fronds are seasonal, dimorphic, coriaceous or subcoriaceous of two sorts; the sterile fronds are small, somewhat concave, and turn dark with age. Their sizes range from

7.5 to 30 cm and 18 to 20 cm (w). They are lobate-pinnatified sessile, cordate oval, and have pronounced lateral veins that cover the rhizome. Friedelin, epifriedelinol, β-sitosterol, β- amyrin, 3, 4-dihydroxybenzoic acid, β-sitosterol 3-β-D-glucopyranoside, naringin, naringenin, and acetyl lupeol are among the phytoconstituents that were extracted from the plant [7].

Quercifolia Drynaria FAM: Polypodiaceae (Asvakatri) can be found on trees or rocks in South China, Malaysia, and Tropical Australia, as well as across India, particularly in the plains or extremely low in the mountains. Drynaria quercifolia is an epiphytic fern with a short, thick, fleshy creeping rhizome that is at least 2 cm thick. The immature sections of the fern are densely scaly, with dark brown scales that gradually narrow from the peltate base to the extremely narrow apes, which are pale, tightly spaced, and finely serrated. Nest leaves are 40 cm long by 30 cm wide, with broad, rounded lobes that are lobed at a depth of 2 to 5 cm. Stripes of foliage leaf, about 30 cm long; lamina, about 100 cm long and 40 cm wide, lobed to less than 1 cm from the mid rib; oblique, 25 cm long and 4.5 cm wide, somewhat acuminate, with thin but rigidly leathery texture; separated by rather shallow sinuses[8].

It is frequently applied both internally and externally in circumstances such as Jvara, Vata Rakta, Sandhi Sopha, Suryavarta, etc. The rhizome of Drynaria quercifolia has been shown in numerous studies to have anti-inflammatory, analgesic, antipyretic, antibacterial, antidiabetic, hypo-lipidemic, and wound-healing properties. Tribes in many areas of India utilize this medication extensively to cure conditions like diabetes, rheumatic disease, cough, throat

infection, and typhoid. Rhizome is used to cure fever, dyspepsia, cough, chest infections, and other conditions because of its bitter and astringent flavor. To alleviate swellings, fronds are ground into a paste and applied externally. For spermatorrhoea and urinary problems, peeled rhizome with sugar is advised. Flavonoids, triterpenes, alkaloids, glycosides, saponins, and amino acids have all been detected by phytochemical screening[9].

Locally known as "Marappanna-kizhangu" or "Attukalkizhangu," Drynaria quercifolia Rhizome [DQR] (L.) J. Smith. (Polypodiaceae) is an epiphytic medicinal pteridophyte that is widely spread in the evergreen forests of Kerala's Western Ghats [10].The common name for Drynaria quercifolia is basket fern or leaf fern.

Tribal groups in Kerala and Tamil Nadu are said to employ the rhizome to treat a variety of illnesses, including cough and dyspepsia. The leaves are used in conjunction with other medications to alleviate rheumatic pain, headaches, and body aches. The entire Drynaria quercifolia plant is used to treat skin conditions, anthelmintics, pectoral, and appetite loss. The plant is known to treat fever and tuberculosis. Because of its astringent and antibacterial qualities, the fronds are mashed and applied as a poultice for swelling. Typhoid fever is treated with rhizome and roots as a tonic. It is used very precisely to treat migraines. This medication is traditionally used to treat syphilis, typhoid, cholera, diarrhea, and jaundice.

Additionally, the rhizome is said to possess antifertility[11], anti-inflammatory, analgesic[12], anti-pyretic[13], antibacterial[14], and anti-ulcer[15] qualities.

BOTANICAL DESCRIPTION

Rhizome

The rhizomes have a thick brown covering, are creeping, and are 2 cm thick. Scales are available in a range of colors and measure 20–25 mm in length and 0.7–2.5 mm in width.

The lamina is not winged, but the rhizome's base is. Spores measure 22.5–37.5 microns in width and 37.5–55 microns in length [16].

FIGURE 02 [Rhizome Of Drynaria Quercifolia]

Leaves

Fertile foliage fronds and sterile nest fronds are the two types of fronds that define basket ferns. The massive, dark green leaf fronds measure 2-4 feet (0.61-1.22 meters) long, having long stalks. They have wings, are strongly lobed or pinnate, and have sori—structures that produce and hold spores—on their undersides [17]. The smaller, spherical leaves at the base of the foliage fronds are called nest fronds. They are persistent, do not shed after turning brown and dying, and do not bear sori[17]. They create a characteristic 'basket' that collect rubbish and organic detritus, hence the gathered material breaks down into humus, giving the plants the nutrition they would Otherwise, they would not have been suspended above the earth . Rhizomes are the source of both types of fronds, usually fastened to a rock or tree [18] [19].

FIGURE 03 [Leaves Of Drynaria Quercifolia]

Frond

In comparison to the fertile fronds, the sterile fronds also known as nest fronds are often shorter and darker in color. These sterile frond grow into a distinctive basket-like structure that gathers organic waste and breaks it down to provide the plant nourishment [20].

The green, fertile fronds have reproductive organs. Only fertile leaves have sporangia, which are grouped in

punctiform sori and form two asymmetrical lines between the lobes' main lateral veins[21].

FIGURE 04 [Fronds Of Drynaria Quercifolia]

GEOGRAPICAL DISTRIBUTION

D. quercifolia is widely distributed throughout tropical and subtropical areas [22]. Drynaria quercifolia can be either epipetric, growing on rocks, or epiphytic, growing on tree trunks in open woods and rainforests. They are known to have structures at the base or underside of the frond lobes that secrete nectar. They make nectar, which is high in carbohydrates and amino acids. Because of this, it has a significant economic impact in numerous nations. Tropical regions of Asia, Australia, Oceania, Western Australia, Southeast Asia, Malaysia, Indonesia, the Philippines, New Guinea, Africa, and India are its native habitats . Many Asian nations, including China, Thailand, Taiwan, and Vietnam, grow it and use it as medicine. They are terrestrial ferns that can be found epiphytically on tree trunks in open woods and rainforests, as well as amid rocks in cracks, shelves, or the soil around stones.

FIGURE 05 [Drynaria Quercifolia In China And Phillippines]

Parameter	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℃),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 and cool conditions with proper ventilation

TABLE 01 [Conservation And Cultivation Of Drynaria Quercifolia]

SYSTEMIC POSITION

The oak leaf fern or Drynaria quercifolia (L.) J. Smith, belongs to the Pteridophyta family Polypodiaceae and is abundantly found in India's evergreen woods. Native to tropical regions of Africa, Asia, and Australia, it is mostly grown for its therapeutic properties. In many nations, particularly in Asia, it has a significant ethno-medical significance.

FIGURE 06 [Photography Of Drynaria Quercifolia]

The plant has a thick, densely scaly brown rhizome and is short, measuring between 60 and 100 cm in length. There are two types of fronds: sterile, fertile, and dimorphic. Compared to fertile fronds, sterile fronds are typically significantly shorter and darker in color. The color of fertile fronds is green. Only fertile leaves exhibit sporangia in punctiform sori, which are non-indusiate and form two irregular rows across the vein plexuses between neighboring main lateral veins of the lobes. Spores are bilateral with extremely minute sparse echinations on the exine. Cordate gametophytes have peripheral club-shaped unicellular hairs[23].

Domain	Eukaryote
Kingdom	Plantae
Sub kingdom	Viridaeplantae
Phylum	Tracheophyta
Sub phylum	Pteridophytina
Infraphylum	Filices
Class	Filicopsida
Order	Filicales
Family	Polypodiaceae
Sub family	Vaccinioideae
Tribe	Androcdeae
Botanical name	Drynaria quercifolia

TABLE 02 [Taxonamical Classification]

MEDICO FOLKLORE [24]

Parts used	**Dosage form**	**Type of use**	**Aliments recovered**
Rhizome	Macerated paste	External application	Quickened wound healing
Rhizome	Hot aqueous extract	Internal use	Removes cough and acts as expectorant
Rhizome	Dried rhizome powder 20gms twice daily for 1month	Internal use	To remove impotency
Rhizome	10gm-15gm macerated with cow milk = 1dose	Internal use	Abdominal –renal colic pain relief
Rhizome	Aqueous extract prepared from grounded rhizome(50gms),made to volume 250ml/vol.	Orally administered once or twice daily for two days	Hectic and intermittent fever
Rhizome and sterile fronds	Macerated to paste	External application on scalp	Remove Baldness and hair falls

TABLE 04 [Medico folklore on Drynaria Quercifolia]

PHYTOCHEMICAL ANALYSIS

➢ DETERMINATION OF TOTAL ASH VALUE

Take five grams of powdered D. quercifolia rhizome are precisely weighed and put in a dried silicon crucible to determine the total-ash value. The sample is burned at 450°C until all carbon is removed, and then it is cooled. In relation to the air-dried sample, the weight of the total ash is measured and computed as a percentage. Important details regarding the inorganic content and possible contamination of the plant material are provided by this analysis [25].

➢ DETERMINATION OF ACID INSOLUBLE ASH VALUE

reference Boiling the entire amount of ash with 25 millilitres of 2N HCl for five minutes is how acid insoluble ash is determined. Filtration is used to gather the insoluble material on ash-free filter paper, which is then cleaned with hot water. In a crucible covered with tar, the residue is ignited, cooled, and weighed. The presence of silica and acid-insoluble inorganic elements is indicated by the percentage of acid- insoluble ash, which is computed in relation to the air-dried medication [26].

➢ DETERMINATION OF WATER-SOLUBLE ASH VALUE

Boiling the entire amount of ash with 25 millilitres of water for a few minutes yields this parameter. The insoluble material is gathered on ash-free filter paper, cleaned with hot water, and burned for 15 minutes at 450°C. The amount of water-soluble ash is indicated by the weight differential. The percentage computation provides details on the water-soluble inorganic components by using the air-dried medication as a [27].

S.NO	ASH VALUE	PERCENTAGE ASH (W/W)
1.	Total ash value	8%
2.	Acid insoluble ash value	12.5%
3.	Water soluble ash value	50%

TABLE 05 [Ash Value Of Drynaria Quercifolia]

➢ DETERMINATION OF ALCOHOL AND WATER-SOLUBLE EXTRACTIVE VAULE

Twenty grams of air-dried, finely crushed D. quercifolia rhizome powder are macerated for 24 hours in a closed flask with 100 millilitres of 90% alcohol. The first six hours of the procedure involve continuous shaking, after which there is a 14-hour standing phase. In a shallow dish covered with tar, the filtered

extract (25 ml) is evaporated to dryness at 105°C. The air-dried drug weight is used to compute the percentage of alcohol-soluble extractives. This examination aids in assessing the chemical components that are soluble in various solvent [28].

S.NO	NATURE OF EXTRACT	PERCENTAGE (W/W)
1.	Water soluble extractive value	2.2%
2.	Alcohol soluble extractive value	1.4%

TABLE 06 [Extractive Value Of Drynaria Quercifolia]

- **DETERMINATION OF MOISTURE CONTENT**

Weighing five grams of D. quercifolia powdered rhizome in a china plate and keeping it at 105–110°C for thirty minutes in a hot air oven are the steps involved in the moisture content analysis. Using the medicine that has been air-dried as a reference, the moisture percentage is computed at different intervals. This factor is essential for figuring out the plant material's stability and storage conditions [29] [30].

S.NO	TIME (mins)	MOISTURE CONTENT (%)
1.	30	12.82
2.	45	10.94
3.	60	7.84
4.	75	5.92
5.	90	5.53

TABLE 07 Moisture Content Of Drynaria Quercifolia]

EXTRACTION

The technique is based on the extraction of the drug's active ingredients utilizing a variety of solvents, from polar to non-polar. Water, methanol, chloroform, and petroleum ether are the solvents utilized. Different extracts of the rhizome of Drynaria quercifolia were prepared using a sequential solvent extraction technique. The materials were extracted successively using solvents in increasing order of polarity. In this procedure, the substance that is soluble in a solvent with a specific range of polarity was extracted in that solvent, and the residual portion was extracted using the subsequent solvent.

The two kg of powdered medication were extracted using a series of solvents. Petroleum ether, chloroform, methanol, and distilled water were the solvents used for the 18- hour extraction process, in increasing order of polarity.

TABLLE 08 [Physical Appearance And Yield Of Different

SOLVENT USED	COLOR AND CONSISTENCY	PERCENTAGE YIELD
Petroleum ether	Light brown color ,viscous and sticky	3.12%
Chloroform	Brownish black color and sticky	5.72%
Methanol	Brown color and sticky	19.67%
Distilled water	Dark brown and non-sticky	16.33%

Extracts Of Powered Drynaria Quercifolia Rhizome]

S.NO	EXTRACTS	CONSTITUENT
1.	Aqueous extract	Tannin,saponnin,flavaniods,quinones,cardioglycosides,phenol, Betacyanin
2.	Ethanolic extract	Tannin,saponnin,quinones,cardioglycosides,terpeniods,phenols, caumarin,steroids
3.	Petroleum ether extract	Phytosterols,cardioglycosides
4.	Chloroform extract	Sterols
5.	Methanolic extract	Glycoside,tannins,alkaloids,carbohydrates,and amino acids
6.	Hexane and CHCl3 combined extracts	Friedelin,epifriedelinol, β-amyrin, β-sitosterol

TABLE 09[Phytochemical Screening On Drynaria Quercifolia]

PREPARATION OF PETROLEUM ETHER EXTRACT

Using a Soxhlet apparatus, about 2 kg of dried rhizome powder of Drynaria quercifolia was extracted with 600 cc of petroleum ether for 18 hours at 60–80°C. In order to recover the solvent that may be utilized for further extractions, the extract was concentrated to 1/4 of its initial volume using distillation.

PREPARATION OF CHLOROFORM EXTRACT

The leftover dried marc was extracted using chloroform to create chloroform extract following pet ether extraction.

PREPARATION OF METHANOL EXTRACT

After chloroform extraction, the remaining dried marc was extracted with methanol to get methanol extract.

PREPARATION 0F AQUEOUS EXTRACT

Water extract was obtained by extracting the residual dried marc with water following the extraction of methanol. The aforementioned dried marc was macerated with distilled water for three days in order to prepare the aqueous extract. The residue was then filtered out and the filtrate was concentrated. By distilling the solvent and drying them out at a low temperature, all of the extracts were concentrated. After that, they were weighed, and the percentage of various extractive values was computed in terms of the plant material's air- dried weight.

PRELIMINARY PHYTOCHEMICAL SCREENING

The powdered rhizome was extracted in various solvents and tested for the presence of chemical constituents as part of a methodical phytochemical screening process.

QUALITATIVE CHEMICAL EXAMINIATION

DETECTION OF ALKALIODS

Each extract was dissolved separately in diluted hydrochloric acid before being filtered. Alkaloid reagents were used to properly test the filtrates.

MAYERS TEST

Mayer's reagent (potassium mercuric iodide) was applied to the filtrates. Alkaloids were detected by the development of a yellow cream precipitate.

WAGNERS TEST

After being treated with Wagner's reagent (iodine in potassium iodide), the filtrates were examined. Alkaloids were present when a brown or reddish brown precipitate formed.

DETECTION OF FLAVANIODS

LEAD ACETATE TEST

A few drops of a 10% lead acetate solution were added to the extracts. The presence of flavonoids was verified by the production of a yellow precipitate.

DETECTION OF PROTIENS AND AMINO ACIDS

MILLONS TEST

Two milliliters of Millons reagent were added to the extracts. The presence of proteins and amino acids was shown by the production of a white precipitate that turned red when heated.

BIURET TEST

The extract was heated after being treated with 1 milliliter of a 10% sodium hydroxide solution. To the aforementioned mixes, a drop of a 0.7% copper sulphate solution was added. The presence of proteins was shown by the production of a reddish violet tint.

NINHYDRIN TEST

After adding 0.25% ninhydrin reagent to the extracts, they were heated for a few minutes. The presence of an amino acid was shown by the formation of a blue color.

DETECTION OF GLYCOSIDES

MODIFIED BORNTRAGERS TEST

The extracts were placed on a boiling water bath for approximately five minutes after being treated with ferric chloride solution. After cooling, the mixture was shaken with an equal amount of benzene. After being separated, the benzene layer was treated with half of the ammonia solution's volume. Anthranol glycoside was detected by the ammonical layer turning rose pink or cherry red.

LEGALS TEST

Sodium nitroprusside in pyridine and methanolic alkali were used to treat the extracts. The development of a pink to crimson hue suggested the existence of cardiac glycosides.

BALJET TEST

When sodium picrate was added to the drug extract, a yellowish orange hue developed, indicating the presence of cardiac glycosides.

LIEBERMANN-BURCHARDS TEST

After being treated with chloroform, the extracts were filtered. A few drops of acetic anhydride were added to the filtrates, which were then heated and chilled. The test tube's sides were used to introduce concentrated sulfuric acid. The presence of steroidal or triterpenoid saponin glycosides was indicated by the formation of brown or pink rings at the junction, respectively.

KELLER KILLANI TEST

Two milliliters of glacial acetic acid with one drop of ferric chloride solution were used to dissolve 0.5 grams of dried extract. One milliliter of concentrated H2SO4 was then used to underlay this. The presence of a deoxysugar is indicated by a brown ring formed at the intersection of two liquids.

DETECTION OF SAPONINS

FROTHS TEST

The alcoholic and aqueous extracts were each diluted with 20 milliliters of distilled water before being shaken in a graduated cylinder for 15 minutes. The presence of saponins was suggested by the formation of a 1 cm-thick layer of foam.

DETECTION OF PHYTOSTEROLS

LIEBERMANN-BURCHARDS TEST

After being treated with chloroform, the extracts were filtered. A few drops of cooked and cooled concentrated sulfuric acid were introduced to the filtrates via the test tube's walls. The presence of steroids was verified by the creation of a brown ring at the intersection of two liquids.

DETECTION OF PHENOLIC COMPOUNDS AND TANNINS

FERRIC CHLORIDE TEST

A few drops of a 5% neutral ferric chloride solution were added to the extract. The presence of phenolic compounds was revealed by the production of a bluish black tint.

GELATIN TEST

A 1% gelatin solution containing sodium chloride

was added to the extract. The presence of tannins was shown by the production of a white precipitate.

LEAD ACETATE TEST

A few drops of a 10% lead acetate solution were added to the extracts. The presence of flavonoids was verified by the production of a yellow precipitate.

ALKALINE REAGENT TEST

A few drops of sodium hydroxide were applied to the extract individually. The presence of flavonoids was revealed by the formation of a bright yellow hue that went colorless when a few drops of diluted acid were added.

SHINODA TEST

A little amount of magnesium metal pieces were added to each extract separately, and then concentrated hydrochloric acid was added dropwise. The presence of flavonoids was revealed by the production of a magenta tint.

VANILLIN IN HYDROCHLORIC ACID TEST

A few drops of the vanillin hydrochloride reagent were added to the extracts. Tannins were detected by the development of a pinkish-red hue.

DETECTION OF FIXED OILS AND FATS

STATIN TEST

A tiny amount of extract was individually compressed between two filter sheets. The presence of fixed oil was detected by an oily spot on filter paper.

SOAP TEST

The extracts were heated using solutions of 0.5 N alcoholic potassium hydroxide in a water bath. The presence of fixed oils and fats was shown by the formation of soap.

DETECTION OF CARBOHYDRATES

Each extract was diluted separately in five milliliters of distilled water before being filtered. The presence of carbohydrates was tested using the filtrates.

MOLISCHS TEST

Two drops of alcoholic α-naphthol solution were used to treat the filtrates, and two milliliters of strong sulfuric acid were carefully applied along the test tube's walls.

Carbohydrates were present when a violet ring formed at the intersection. **BENEDICTS TEST**

Benedict's reagent was applied to the filtrates, which were then cooked in a water bath. Reducing sugars were present when an orange-red precipitate formed.

FEHLINGS TEST

Fehling's A and B solutions were used to heat the filtrates after they had been hydrolyzed with diluted hydrochloric acid and neutralized with alkali. The presence of carbohydrates was shown by the formation of a crimson precipitate.

BARFORDS TEST

After using Barfoed's reagent, the filtrates were heated in a water bath. Reducing sugars were present when an orange-red precipitate formed.

DETECTION OF GUMS AND MUCILAGE

ALCOHOL PRECIPITATE TEST

With continuous stirring, 25 milliliters of 100% alcohol were gradually mixed with 10 milliliters of aqueous extract. The precipitate underwent filtering.

RUTHENIUM RED TEST

With continuous stirring, 25 milliliters of 100% alcohol were gradually mixed with 10 milliliters of aqueous extract. After filtering, the precipitate was allowed to dry in the open. The swelling characteristics of the precipitate were investigated.

MATERIALS AND METHODS

COLLECTION AND IDENTIFICATION OF DRYNARIA QUERCIFOLIA

Yercaud Hills, Salem District, Tamil Nadu, India is where the rhizome of Drynaria quercifolia was gathered. The Botanical Survey of Medicinal Plants Unit Siddha, Government of India, Palayamkottai, provided the taxonomic identification.

EXTRACTION AND ISOLATION OF DRYNARIA QUERCIFOLIA

Drynaria quercifolia rhizomes were separated, dried in the shade, ground into a powder using a mechanical grinder, and then sieved through a 40 mesh screen. An airtight container was used to store the powdered plant ingredients. The aforementioned powdered materials were extracted one after the other using ethanol using the heated continuous percolation process in a Soxhlet apparatus for a full day. After concentrating the extract using a rotary evaporator [31], it was freeze-dried in a lyophilizer [32] until a dry powder was produced.

PHYTOCHEMICAL SCREENING

The phytoconstituents, including carbohydrates, gum and mucilage, amino acids, polyphenols, fixed oil and lipids, alkaloids [33], tannins [34], saponins [35], and flavonoids [36], were quantitatively analyzed in the plant's ethanol extract.

GAS CHROMATOGRAPHY-MASS SPECTROSCOPY ANALYSIS

The Clarus 680 GC was used in the study to engage a fused silica column filled with Elite-5MS (30 m × 0.25 mm ID × 250 µm df, 5% biphenyl 95% dimethylpolysiloxane). Helium was used as a carrier gas at a constant flow rate of one milliliter per minute to separate the components. Throughout the chromatographic run, the injector temperature was maintained at 260°C. The oven temperature was as follows when 1µL of the extract sample was infused into the device: 60°C for two minutes; 300°C at a pace of 10°C min−1; and 300°C, where it was maintained for six minutes. The conditions for the mass detector were as follows: transfer line temperature of 240°C, ion source temperature of 240°C, ionization mode Electron impact (EI) at 70 eV, scan time of 0.2 seconds, and scan interval of 0.1 seconds. The components' spectrum [37] and fragments between 40 and 600 Da were compared to the database of known component spectra kept in the GC-MS NIST (2008) library.

INDENTIFICATION OF PHYTOCOMPONENTS

The National Institute of Standards and Technology (NIST) database, which contains over 62,000 patterns, was used to analyze mass-spectrum GC-MS [38, 39]. The spectra of the known components kept in the NIST library was correlated with the spectrum of the unknown components. The test materials' component names, molecular weights, and structures were verified.

REPORT

Glycosides, tannins, saponins, flavonoids, steroids, gum and mucilage polysaccharides, amino acids, polyphenols, fixed oil, and lipids were found in the ethanolic extract of Drynaria quercifolia, according to phytochemical study (Table 10).

Using the NIST library, GC-MS analysis of an ethanolic extract of Drynaria quercifolia rhizome identified several chemicals [41]. Table 2 revealed the 11 most prevalent compounds along with their retention time, chemical formula, molecular weight, and peak area. The GC-MS chromatogram of the eleven peaks of the compounds found. Eleven bioactive chemicals were identified in the ethanolic extract of Drynaria quercifolia rhizome, including 2,4,6-cycloheptatrien-1-one, 3,5-bis-trimethylsilyl, 1,2-bis(trimethyl silyl) benzene, 2-propanol, 1-chloro-3-(1-methylethoxy)-, Silane, 1,4-phenylene bis[trimethy-, 2,6-lutidine] 3,5-dicholoro-4-dodecylthio-, 1-heptyn-4-ol, 2-propanol, 1-chloro-3-propoxy-, and 6-amino- 5-cyano-4-(3-iodophenyl) 2-myristynol-glycinamide, -2-methyl-4H-pyron-3-carboxylic acid ethyl ester, 1,2,4-benzene tri carboxylic acid, 1,2-dimethyl ester, and 2-(tert-butyldimethyl silyl)-1-isopropyl)-4-methy. There are more active components in the ethanolic extract of Drynaria quercifolia, according to phytochemical analysis and GC-MS. These active principles serve as motivation for additional research aimed at finding new herbal medications.

TABLE 10 [PHYTOCHEMICAL SCREENING RESULT OF ETHANLOIC ETRACT OF RHIZOME OF DRYNARIA QUERCIFOLIA]

S.NO	QUALITATIVE TEST	ETHANOLIC EXTRACT OF DRYNARIA QUERCIFOLIA
1.	Akaliods	+
2.	Carbohydrates	+
3.	Glycosides	+
4.	Phytosterols	+
5.	Fixed oil and fats	+
6.	Saponins	+
7.	Phenolic compounds and tannin	+
8.	Proteins and aminoacids	+
9.	Gum and mucilage	+
10.	Flavaniods	+
11.	Lignin	-
12.	Triterpeniods	-

TABLE 10 [Phytochemical Screening Result Of Ethanolic Extract Of Rhizome Of Drynaria Quercifolia]

S. no	RT	COMPOUND NAME	MOL. FORMULA	MOL. WT	%PEAK AREA	COMPOUND NATURE
1.	27.693	2,4,6-Cycloheptatrien – one,3,5- bis-trimethlsilyl	C12H22OSI2	250	10.092	Aliphatic
2.	28.024	1,2-bis(trimethylsilyl)benzene	C12H22SI2	222	7.444	Aromatic
3.	28.159	2-propanol,1-chloro-3-(1- methylethoxy)-	C6H12O2Cl	152	10.492	Alcohol and ether
4.	28.289	Silane,1,4-phenylene bis[trimethyl-	C12H22SI2	222	12.077	Aromatic
5.	28.434	2,6-lutidine 3,5-dichloro-4- dodecylthio-	C16H31NCl2S	37	10.038	Not identified
6.	28.584	1-heptyn-4-ol	C7H14O	114	4.949	Alcohol
7.	28.694	2-propanol,1-chloro-3-propoxy-	C6H13O2Cl	152	7.370	Ether and alcohol
8.	28.869	6-amno-5-cyano-4-(3-iodophenyl-2-methyl -4H-pyron-3-carboxylic acid ethyl ester	C16H15O3N2I	410	4.505	Not identified
9.	29.014	2-myristynol-glycinamide	C16H28O2N2	280	22.502	Not identified
10.	29.354	Benzene-2-(tert-butyldimethyl silyl)-1-isopropyl-4-methy	C16H28OSI	264	4.730	Aromatic
11.	30.214	1,2,4-benzene tri carboxylic acid,1,2-dimetyl ester	C11H10O6	238	5.801	Aromatic

TABLE 11 [PHYTOCOMPONENTS IDENTIFIED IN ETHANOLIS EXTRACT OF RHIZOME OF DRYNARIA QUERCIFOLIA]

S.no	R. Time	Name of the compound	Mol.fh17ormula	Mol.wt	Peak area%
1.	4,354	Pentanoic acid , Methyl ether	C6H12O2	116	0.29
2.	9.780	Undecane(cas)N-undecane	C12H24	156	0.46
3.	13.255	Cyclohexasiloxane,dodecamethyl-	C12H36O6	444	0.32
4.	21.633	1,2-benzenedicarboxylic acid, diethyl ester	C12H14O4	222	13.94
5.	21.731	1,2-benzenedicarboxylic acid, diethyl ester	C12H14O4	222	36.05
6.	23.209	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8	592	1.87
7.	25.700	1,3-diphenyl-1,3,5,5-tetremethyl-yclotrisiloxane	C16H22O3Si3	346	6.08
8.	26.13	Benzenesulfonamide,3-amino-4- hydroxy-	C6H8N203S	188	0.82
9.	26.274	Octadecamethylclononasiloxane	C18H54O9Si9	666	0.78
10.	27.108	Benzene propanoic acid, alpha,4- bis(acetyloxy)- ,methyl ester	C14H16O6	280	1.54
11.	27.221	1,2-benzenedicarboxylix acid,bis- (2-methylpropyl)ester	C16H22O4	278	3.74
12.	27.285	2-pyridinepropanamide,N-phenyl-	C14H14N2O	226	1.95
13.	27.419	Silane, [1,3,5-benzenetriyltris(oxy)]tris[trimetyl-	C15H30O3Si3	342	3.66
14.	27.975	Hexadecanoic acid, methyl ester(cas)methyl palmitate	C17H34	270	3.33
15.	28.495	Palmitic acid	C16H22O2	256	2.18
16.	28.673	1,2-benzenedicaboxylic acid, dibutyl ester	C16H22O4	278	3.08
17.	29.396	Nonametyl, phenyl- ,cyclopentasiloxane	C15H22O5Si5	432	0.89
18.	30.283	1-Octadecanol	C18H38O	270	0.36
19.	30.386	9,12-Octadecadienioc acid(z,z)- ,Methyl ester	C19H34O2	294	3.26
20.	30.40	9-Octadecanolioc acid(z)- ,methyl ester	C19H36O2	296	0.93
21.	30.63	tetracosamethylcyclododecasiloxane	C24H72O12Si12	888	0.23
22.	30.747	Octadecanioc acid, methyl ester	C19H3O2	298	0.24
23.	30.925	Octadec-9-Enioc acid $$ 9-Octadecaenioc acid	C18H34O2	282	0.57
24.	31.497	Pentamethyl phenyl-disilane	C11H20Si2	208	1.20
25.	32.608	4-p-chlorophenyl-2-dimethylamino- 5-nitrosothiazole	C12H13N3OS	247	6.57
26.	33.962	1,2,6-pentamethyl phenyl-disilane	C11H20Si2	208	1.26
27.	34.93	(4-chlorophenyl)Methanesulfonamide	C7H8ClNO2S	205	1.10
28.	37.299	Cyclooctasiloxane,hexadecamethyl	C16H48O8Si8	592	0.48
29.	38.298	1,2,-benzenedicarboxylic acid, Diisooctyl ester	C24H38O4	390	1.70
30.	38.553	Phosphine oxide,triphenyl-	C24H38O4	390	1.11

TABLE 12 [Phytochemical Identified In The Methanolic Extract Of Drynaria Quercifolia Rhizome By Using GC-MS]

THIN LAYER CHROMATOGRAPHY (TLC)

TLC analyses were performed for several extracts. To choose the solvent system that might demonstrate superior resolution, several solvent systems with varying polarity were produced and TLC analyses were conducted.

TLC plate, development chamber, capillary tube, micropipette, and spraying apparatus are examples of equipment.

Silica gel 60F (0.25 pre-made aluminum sheets) is the adsorbent (Merck).

Sample preparation: Samples were taken in small amounts and dissolved in the appropriate solvents.

Visualization: Iodine chamber, spraying reagent, and UV at 254 and 366 nm.

METHOD

Using capillary tubes, the previously prepared sample solutions were applied to pre-coated TLC plates and developed in a TLC chamber with an appropriate mobile phase. After being air dried, the produced TLC plates were examined under a UV lamp at 254 and 366 nm. After that, they were sprayed with various spraying agents, and some of them were put in a hot air oven for one minute to allow the color to develop in distinct bands. The Rf values were computed for several samples.

RESULT AND DISCUSSION

PROXIMATE ANALYSIS

The total ash value, acid insoluble ash, water-soluble ash, water-soluble extractive value, alcohol-soluble extractive value, and moisture content of Drynaria quercifolia Linn. rhizome were assessed.

PRELIMINARY PHYTOCHEMUCAL SCREENING

A total of 100 grams of Drynaria quercifolia rhizome extracts were prepared using the successive solvent extraction method. Solvents were used to remove the materials one after the other. In ascending order of polarity, petroleum ether, chloroform, ethanol, and water are the solvents utilized. In this procedure, the material that is soluble in a solvent with a specific range of polarity was extracted in the solvent, and the residual marc was then extracted using the subsequent solvent.

QUALITATIVE ANALYSIS OF EXTRACTS

To identify the chemical components contained in each of the five extracts derived from serial solvent extraction, qualitative chemical analysis was performed. Fats, fixed oils, and phytosterols were found in petroleum ether extract. Sterols are visible in the chloroform extract. Alkaloids, carbohydrates, glycosides, tannins, proteins, and amino acids are present in the methanolic extract, while saponins, tannins, carbohydrates, proteins, and amino acids are present in the water extract (table 6).

Name of the extract	Mobile phase	Detection agents	Number of spots	
Petroleum ether	Hexane: ethyl acetate[7:3]	Iodine chamber and anisaldehyde sulphuric acid spray	02	
Chloroform	Hexane: ethyl acetate[7:3]	Iodine chamber and anisaldehyde sulphuric acid spray	03	
Methanol	Hexane: ethyl acetate[7:3]	Iodine chamber and anisaldehyde sulphuric acid spray	05	0.08 0.115 0.17 0.27 0.31

Water	Hexane: ethyl acetate[7:3]	Iodine chamber and anisaldehyde sulphuric acid spray	03	0.18 0.22 0.27
Methanol	Chloroform: methanol [7:3]	Dragondorffs reagent	03	

TABLE 13 [TLC Analysis Of Different Solvent Extracts Of Drynaria Quercifolia Rhizome]

MEDICINAL USES

- Broken bones can be strengthened and healed by consuming Drynaria quercifolia. Additionally, it can help treat weak loins, stress fractures, and sprains,knees.
- It aids in the healing of damaged ligaments, prevents osteoporosis, and increases bone density. It is excellent for bones on the hole.
- Drynaria tonic is good for the kidneys and liver.Frequent ingestion will strengthen teeth and assist heal bleeding gums or toothaches. Additionally, it can be used to treat tinnitus, an ear ailment.
- Drynaria plants can be applied topically as a hair tonic to promote hair growth and enhance the condition of hair.
- Combined with the Asparagus racemosus plant, applied to the head to lessen hair loss and have a relaxing effect.
- According to reports, the entire Drynaria plant was used to treat tuberculosis, frenetic fever, dyspepsia, and cough[42]
- The pounded fronds, or leaves, were applied as a poultice over inflammatory areas[43]
- The macerated rhizome paste was applied to the forehead to relieve headaches[44].
- The entire Drynaria plant was used to treat skin and chest conditions as a pectoral, expectorant, and anthelmintic[45].
- According to Ayurvedic theory, the plant's tonic acts as an astringent to the bowels during typhoid fever; other medical folklore stories emphasize its effectiveness against phthisis and with hay fever [46]
- Urinary tract infections are among the many health issues that distinct groups of people address with it in the traditional medical system.
- It is referred to as "Ashwakatri" in the Ayurvedic medical system and is used as an anthelmintic, pectoral, and expectorant. Additionally, it is used to treat cutaneous ailments, dyspepsia, loss of appetite, chronic jaundice, cough, and hectic fever[48].
- Used to treat arthritis in Tamil Nadu
- Rhizomes are utilized to treat excited mental problems in Bangladesh.
-
- Drynaria rhizome decoction is used as an antipyretic in South East Asia [49].
- The leaves and rhizome are used to treat intestinal worms and stomach pain in Tripura[51], while fronds are applied as a poultice to swelling in Malasia[50]. The rhizome is used in Vietnam to treat osteodynia, dentagia [52], rheumatism, and TB [50].
- For swellings, pounded fronds are applied as a poultice. Spermatorrhoea and urinary problems are treated with peeled rhizome and sugar [53].
- The rhizome of this fern was utilized by tribal people in India's Kalakad Mundanthurai Tiger Reserve to treat rheumatism.
- One of the twelve components of a medication used to treat cancer is the rhizome of this fern[54].

RESULT AND DISSCUSSION

The phytochemical screening of the plant extracts revealed the presence of several bioactive compounds. Tests confirmed carbohydrates, proteins, alkaloids, flavonoids, steroids, and fixed oils in varying concentrations across different solvent extracts. The methanol extract showed a higher number of positive reactions, indicating better extraction efficiency for polar compounds. These phytoconstituents are known for their antioxidant, anti-inflammatory, and therapeutic properties. The results support the traditional medicinal use of the plant and suggest its potential as a natural source of pharmacologically active compounds. Further quantitative and biological studies are required to validate these findings.

CONCULSION

The article's thorough examination solidifies Drynaria quercifolia, the oak leaf fern, as an essential medicinal plant in Asian traditional systems. Its rhizome has long been used in India to treat a variety of illnesses, such as fever, typhoid, diarrhea, headaches, and skin conditions.

These traditional uses are supported by scientific research, which demonstrates the plant's strong anti-inflammatory, analgesic, antipyretic, antibacterial, antidiabetic, hypo-lipidemic, and wound-healing qualities. Its complex phytochemical profile, which is rich in important secondary metabolites such flavonoids, alkaloids, tannins, saponins, and glycosides, is responsible for its medicinal efficacy.

The presence of these chemicals in the rhizome was confirmed by successive solvent extraction and thorough phytochemical screening. Additionally, eleven more bioactive compounds were found in the ethanolic extract by GC-MS analysis. In the end, the study effectively combines botanical traits, ethnomedical evaluation, and thorough chemical analysis, confirming the traditional use of D. quercifolia and highlighting its significant potential for modern and preventative medicine.

REFERENCES

1. Prasanna G, Anuradha R. A comprehensive review on phytochemical constituents and pharmacological activities of *Drynaria quercifolia* L. Int J Pharm Sci Rev Res. 2017;42(1):168-177.
2. Khan MA, Rahman AA, Islam S, Khandokhar P, Rashid MMU. A comprehensive review on phytochemical and pharmacological aspects of *Drynaria quercifolia*. J Ethnopharmacol. 2016;181:129-140.
3. Wang J, Liu H, Li N, Zhang M, Chen D. The protective effect of *Drynaria fortunei* extract on osteoporosis in ovariectomized rats. J Ethnopharmacol. 2014;151(1):629-637.
4. Tan RX, Chen JH. The cerebrosides from *Drynaria fortunei*. Phytochemistry. 2003;63(7):835-838.
5. Namsa ND, Tag H, Mandal M, Kalita P, Das AK. An ethnobotanical study of traditional anti-inflammatory plants used by the Lohit community of Arunachal Pradesh, India. J Ethnopharmacol. 2009;125(2):234-245.
6. Radhika LG, Meena CV, Peter S, Rajesh KS, Rosamma MP. Phytochemical and antimicrobial study of *Drynaria quercifolia*. Int J Pharm Sci Res. 2012;3(4):1081-1088.
7. Srivastava HN. Fundamentals of Pteridophytes. 13th ed. Pradeep Publications; 2002:1-16.
8. Kirtikar KR, Basu BD. Indian Medicinal Plants. 2nd ed. Delhi: Periodical Experts Book Agency; 1993;5:2554.
9. Khare CP. Indian Medicinal Plants: An Illustrated Dictionary. 1st ed. Springer; 2007:226.
10. Karthik V, Raju K, Ayyanar M, Gowrishankar K, Sekar T. Ethnomedicinal uses of pteridophytes in Kolli Hills, Eastern Ghats of Tamil Nadu, India. J Nat Prod Plant Resour. 2011;2:50-55.
11. Rajendran A, Rajan S. *Drynaria quercifolia*: An antifertility agent. Ancient Sci Life. 1996;15:286-287.
12. Anuja GI, Latha PG, Shine VJ, Suja SR, Shika P. Anti-oedimatous and analgesic properties of fertile fronds of *Drynaria quercifolia*. ISRN Inflamm. 2014:1-8.
13. Khan A, Haque E, Rahman MM, Mosaddik A, Al-Bari MAA, Rahman M. Antipyretic activity of rhizome of *Drynaria quercifolia* in rabbits. Pharm Biol. 2007;45(4):312-315.
14. Kandhasamy M, Arunachalam KD, Thatheyus AJ. *Drynaria quercifolia*: A potential resource for antibacterial activity. Afr J Microbiol Res. 2008;2:202-205.
15. Soni D, Jagan Mohan K, Sai Goud A, Krishna Raju VR. Antiulcer activity of ethanolic extract of *Drynaria quercifolia* Linn. leaves. J Pharm Res. 2012;5(Suppl 1):117-119.
16. Hooker WJ. Garden Ferns. L. Reeve; 1862.
17. Negi S, Tewari LM, Pangtey YPS, Kumar S, Martolia A, Jalal J, Upreti K. Taxonomic studies on the family Polypodiaceae (Pteridophyta) of Nainital Uttarakhand. New York Sci J. 2009;2(5):47-83.
18. Riffle RL. The Tropical Look: An Encyclopedia of Dramatic Landscape Plants. Timber Press; 1998:152.
19. Lin TH, Yang RS, Wang KC, et al. Ethanol extracts of fresh *Davallia formosana* and osteoblastic proliferation. J Ethnopharmacol. 2013;147(1):164-170.
20. Ramesh N, Viswanathan MB, Saraswathy A, et al. Phytochemical and antimicrobial studies of *Drynaria quercifolia*. Fitoterapia. 2001;72(8):934-936.
21. Sasidharan S, Chen Y, Saravanan D, Sundram KM, Yoga Latha L. Extraction, isolation and characterization of bioactive compounds. Afr J Tradit Complement Altern Med. 2011;8(1):1-10.

22. Negi S, Tewari LM, Pangtey YPS, et al. Taxonomic studies on Polypodiaceae. New York Sci J. 2009;2(5):47-83.
23. Padhy R, Dash SK. Medico-folklore study on some pteridophytes from South Odisha. Res J Pharm Biol Chem Sci. 2015;6(4):2029-2035.
24. Kumar S, Pandey AK. Chemistry and biological activities of flavonoids. ScientificWorldJournal. 2013;2013:162750.
25. Benjamin A, Manickam VS. Medicinal pteridophytes from the Western Ghats. Indian J Tradit Knowl. 2007;6(4):611-618.
26. Wang XL, Wang NL, Zhang Y, et al. Effects of eleven flavonoids from *Drynaria fortunei* on osteoblastic proliferation. Chem Pharm Bull. 2008;56(1):46-51.
27. Lee HS, Park JB, Lee MS, et al. Anticancer activity of *Drynaria fortunei*. J Ethnopharmacol. 2019;235:257-263.
28. Xu T, Yang Q, Fan W, Li S, Yang L. Identification of microRNAs in *Drynaria fortunei*. PLoS One. 2017;12(8):e0182521.
29. Muthukumar T, Udaiyan K. Arbuscular mycorrhizas of plants in Western Ghats. Mycorrhiza. 2000;9(6):297-313.
30. Azmir J, Zaidul ISM, et al. Techniques for extraction of bioactive compounds: A review. J Food Eng. 2013;117:426-436.
31. Sivakrishnan S, Kottaimuthu A, Kavitha J. GC-MS analysis of ethanolic extract of *Albizia procera*. Int J Pharm Pharm Sci. 2014;5(Suppl 3):702-704.
32. Harborne JB. Phytochemical Methods. Chapman & Hall; 1973:49-188.
33. Van Buren JP, Robinson WB. Formation of complexes between protein and tannic acid. J Agric Food Chem. 1981;17:772-777.
34. Obadomi B, Ochuko P. Phytochemical studies of crude extracts of some plants. Glob J Pure Appl Sci. 2001;8:203-208.
35. Boham BA, Kocipai-Abyazan R. Flavonoids and condensed tannins. Pac Sci. 1973;48:458-463.
36. Hites RA. Gas Chromatography Mass Spectroscopy. 1997:609-611.
37. Jayapriya G, Gricilda Shoba F. GC-MS analysis of *Justicia adhatoda*. J Pharmacogn Phytochem. 2015;4(Suppl 1):113-117.
38. Kanthal LK, Dey A, Satyavathi K, Bhojaraju. GC-MS analysis of *Lactuca runcinata*. Pharmacogn Res. 2015;6(1):58-61.
39. Ezhilan BP, Neelamegam R. GC-MS analysis of *Polygonum chinense*. Phcog Res. 2012;4(Suppl 1):4-11.
40. Mass Spectrometry Data Centre. Eight Peak Index of Mass Spectra. 2nd ed. 1974.
41. Nayar BK. Medicinal Ferns of India. Natl Botanic Gardens; 1959:1-29.
42. May LW. Economic uses and folklore of ferns. Bot Rev. 1978;44(4):491-528.
43. Jain SK. Glossary of Indian Medicinal Plants. 2nd supplement. 1992.
44. Kaushik P, Dhiman AK. Common Medicinal Pteridophytes. Indian Fern J. 1995;12:139-145.
45. Brahmam OM, Dutta PK. Glimpses of Indian Ethnobotany. Phytotherapy. 2002;16:29.
46. Sen A, Ghosh PD. Ethnobotanical studies of pteridophytes in Assam. Indian J Tradit Knowl. 2011;10(2):292-295.
47. Khare DP. Indian Medicinal Plants: An Illustrated Dictionary. Springer; 2007.
48. Ramesh N, Viswanathan MB, Saraswathy A, et al. Phytochemical and antimicrobial studies on *Drynaria quercifolia*. Fitoterapia. 2001;72:934-936.
49. Dixit RD, Vohra JN. Dictionary of Pteridophytes of India. Botanical Survey of India; 1984.
50. Das HB, Majumdar K, Datta BK, Ray D. Ethnobotanical uses of plants by Tripuri tribes. Nat Prod Radiance. 2009;8:172-180.
51. Ueda J, Tezuka Y, Banskota AH, et al. Anti-proliferative activity of Vietnamese medicinal plants. Biol Pharm Bull. 2002;25:753-760.
52. Tran TVA, Malainer C, Schwaiger S, et al. Screening of Vietnamese medicinal plants for NF-κB inhibitors. J Ethnopharmacol. 2015;159:36-42.
53. Alam MK. Medical ethnobotany of the Marma tribe of Bangladesh. Econ Bot. 1992;46(3):330-335.
54. Sutha S, Mohan VR, Kumaresan S, Murugan C, Athiperumalsamy T. Ethnomedicinal plants used by tribals of KMTR. Indian J Tradit Knowl. 2010;9(3):502-509.