



‘Ethno-medicinal properties of *Drynaria quercifolia* (L.) J. Smith’

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ABSTRACT

Drynaria quercifolia (L.) J. Smith is an important medicinal plant used in traditional medicinal system by different group of people to treat various kinds of health problems. It is commonly known as oak leaf fern of the family Polypodiaceae of Pteridophyta. It is distributed widely in the evergreen forests of India and is native to tropical areas of Africa, Asia, and Australia and cultivated mostly as a medicinal plant. It plays an important medical role in many countries, especially in Asia. Various phytochemicals like 3,4-dihydroxybenzoic acid, friedelin, epifriedelinol, β -amyrin, β -sitosterol and β -sitosterol 3- β -D-glucopyranoside has been isolated from the plant. The rhizome is reported to have anti-fertility, anti-inflammatory and antipyretic, antimicrobial, antioxidant, wound healing, bone regenerative activity and various other activities of traditional and medicinal uses. This review has been aim to provide scientific information and folklore uses of *Drynaria quercifolia* as an ethno-medicinal plants.

Keywords: *Drynaria quercifolia*, rhizome, ethno-medicinal, phytochemical, antioxidant.

I. Introduction

Ethno-medicinal plants have a long history of make use of for the beneficial of mankind. According to the report of the World Health Organization (W.H.O.) about 80% of the world's populations rely mainly on traditional therapies which involve the use of plant extracts or their active substances [1]. Medicinal plants play significant role in traditional health care systems for remedial many diseases. The medicinal properties of these plants lie in some chemical substances that produce a definite useful action on human body. The use of medicinal plants as a source for relief from illness had been recognized by early civilization in China, India and the other country, but it is thoughtless as art as old as mankind. Ferns are called vascular cryptogams or free - living spring tracheophytes, occupy strategic position between seed- bearing spermatophytes and the non – seed bearing cryptogams [2] dispersed throughout the world. Ferns are also used in different traditional medicinal systems of India. Although in India, total ferns' species were about 1022, they have been recorded with respect to vast angiospermic diversity (more than 15000 species), in that ferns' plants played a significant role on ethno-medicine. In ancient Indian medicine, several ferns were

used, and in particular by Unani physicians in India and Western Asia [3]. Ferns play an important role in folklore medicine.

Drynaria quercifolia is an important ethno medicinal plant used in traditional medicinal system by different group of people to cure various kinds of health problems. *Drynaria quercifolia* along with other combination of herbs is used in pain from traumatic injury and also effective for lower back and ligament injuries [4]. In India variety of medicinal plants are used to control a number of diseases in folk medicine [5]. The antifungal activity of the ethanolic extract of rhizome of *D. quercifolia* on dermatophytic species was first reported [6]. The methanol extracts of rhizome of *Drynaria quercifolia* have effective against gram positive bacteria (*Bacillus subtilis*) and some gram negative bacteria [7]. The several report showed the antimicrobial activity of different rhizome fractions of *Drynaria quercifolia* showed mild antimicrobial activity in ethyl acetate and carbon tetra chloride fractions.

II. Geographical distribution of *Drynaria quercifolia*

Drynaria quercifolia can be either epiphytic as they grow on trees trunks in open forests and rainforests or epipetric as some are grow on rocks. They are known to have nectar-secreting structures, found at the base or the underside of the frond lobes. They produce nectar which is rich in amino acids and sugars. It is because of this, it plays an important economical role in many countries. It is native to tropical areas of Asia, Australia, Oceania, Western Australia Southeast Asia, Malaysia, Indonesia, Philippines, New Guinea, Africa, and as well as in India. It is cultivated and used as medicine in many Asian countries, such as China, Thailand, Taiwan and Vietnam.

III. Systematic position and morphology

Drynaria quercifolia (L.) J. Smith is commonly known as oak leaf fern of the family Polypodiaceae of Pteridophyta is distributed widely in the evergreen forests of India. It is native to tropical areas of Africa, Asia, and Australia and cultivated mostly as a medicinal plant. It plays a key ethno-medical role in many countries, especially in Asia.

Table: 1 Systematic position

Kingdom	Plantae
Subkingdom	Tracheobionta
Division	pteridophyta
Class	filicopsida
Order	polypodiales
Family	polypodiaceae
genus	<i>Drynaria</i> (L.) J. Sm
species	<i>quercifolia</i> .

Table: 2 Vernacular names

Common name	Oak(basket fern)
Sanskrit	Aswakarti
Hindi	Asvakatri, Katikapan, Basingh
Bangla	Pankhiraj, Pankha, Garur
Malayam	Matilpanna, Pannakizhangu,
Tamil	Attukkal kizhangu
Philippines	Pakpak lawin
Chinese	Li ye hu jue

The plant is short height ranges from 60-100 cm long having long-creeping, a thick, densely scaly brown rhizome. Fronds are dimorphic, sterile fronds and fertile fronds. Sterile fronds usually brown in colour and much shorter than the fertile ones. Fertile fronds are green in colour .Sporangia are observed on fertile leaves only, in punctiform sori, over the vein plexuses forming two irregular rows between adjacent main

lateral veins of the lobes and non-indusiate. Spores are bilateral with very minute sparse echinations on the exine. Gametophytes are cordate with marginal club-shaped unicellular hairs [8].



a) Natural habitat

b) rhizome

c) fertile frond

figure 1. Photography of *Drynaria quercifolia* (L.) J. Smith

III- Importance of *Drynaria quercifolia* in ethno-medicinal system

Drynaria quercifolia is used in medicinal system by different groups of people to treat various kinds of health problems. It plays an important role in traditional Indian Ayurvedic medicine. In Ayurvedic system of medicine, it is called 'Ashwakatri' use by different tribal people for the treatment of chest disease, cough, hectic fever, dyspepsia, loss of appetite and chronic jaundice [9]. The roots are being used in Ayurveda, the ancient Indian system, to stimulate appetite, relieve flatulence and as a general tonic. Tribals in kalakad, Mundanthurai Tiger Reserve India, utilizes its rhizome to cure rheumatism [10]. [11] reported that the epiphytic fern gives the helping hand to people who suffer from relapsed, drug-resistant tuberculosis. This study is done to analyse the efficiency of the rhizome of *Drynaria quercifolia* as a case study of a 29 year old male who visited a tribal healer from Malasar community in the study area Velliangiri hills which is located in the eastern part of Western Ghats, India. generally the soup prepared from the rhizome of *D. quercifolia* is very popular among tribes of Tamil Nadu, Eastern Ghats, and the soup drink to get relief from rheumatic complaints [12].

Table 3: Medico folklore data on *Drynaria quercifolia* (L.) J. Smith

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	10-15gm macerated with cow milk = 1dose.	Internal use	Abdominal – renal colic pain relief
Rhizome	Aqueous extract prepared from grounded rhizome (50 gms), made to volume 250 ml/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

Rhizome along with <i>Atropa belladonna</i> .	Macerated paste	Externally applied as poultice (bandaged)	Anti-inflammatory setting of fractured bones
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Source : (Padhy and Dash, 2015)..... [13].

In Chinese system of medicine, it is called 'Li ye hu jue', is extensively used in various traditional systems to cure lower back, ligament injuries, chronic jaundice etc. In Chinese herbal medicine, it was said that the increasing the dosage of *Drynaria quercifolia* to 120 grams in decoction per day yield good result in as Alzheimer's disease. *Drynaria* plants can be used typically as a hair tonic which stimulate hair growth and to improve hair condition. The mixer of the rhizome of *Drynaria quercifolia* with the plant *Asparagus racemosus*, found to reduce hair loss. They can help to treat bleeding gums or toothaches, and regular consumption makes teeth strong. *Drynaria quercifolia* used for tinnitus, a situation of the ears. Tonic prepared from *Drynaria* is beneficial to liver and kidney. The macerated paste of rhizome when applied on fore head to relives headache [14]. In Tripura, the leaves and rhizome of *Drynaria quercifolia* are used for the treatment of intestinal worms and abdominal pain related diseases. The rhizome of this fern is one of the twelve ingredients of a drug to treat cancer [15].

IV- Phytochemical analysis of *Drynaria quercifolia*

Phytochemicals are chemicals derived from plants are often used to describe the large number of secondary metabolic compounds found in plants. Phytochemical screening assay is a simple, speedy procedure that gives the researcher a quick answer to the various types of phytochemicals in a mixture and key tool in bioactive compound analyses. After the preparation of the crude extract or active fraction from plant material, phytochemical screening can be performed with the proper tests to get an idea regarding the type of phytochemicals existing in the crude extract or fraction. Usually the identified components from plants extract active against microorganisms are saturated or aromatic organic compounds, they are frequently obtained through initial ethanol or methanol extraction [16]. The curative value of these plants lies in some chemical substances that produce a specific physiological action on the human body. The majority of these bioactive constituents of plants are tannins, alkaloids, flavonoids, and phenolic compounds. The plant part used in folk medicine of *Drynaria quercifolia* are rhizomes. [17] reported that the Preliminary phytochemical screening of appropriate solvent extracts of rhizome of *Drynaria quercifolia* showed the presence of sterols, tannins, proteins and amino acids, flavonoids, terpenoids, saponin, carbohydrates and absence of alkaloids, glycosides and volatile and fixed oil. Extraction is the crucial first step in the analysis of medicinal plants, because it is essential to extract the desired chemical components from the plant materials for further analysis and characterization. The necessary operation included steps, such as pre-washing, drying of plant materials or freeze drying, grinding to acquire a homogenous sample and often improving the kinetics of analytic extraction. Proper precautions must be taken to assure that potential active constituents are not lost or destroyed during the preparation of the extract from plant samples.

Table 4: Phytochemicals identified in the methanolic extracts of *Drynaria quercifolia* rhizome by using GC-MS.

S. No	R. time	Name of the compound	M. formula	MW	Peak area%
1.	4.354	Pentanoic Acid, Methyl Ester	C ₆ H ₁₂ O ₂	116	0.29
2.	9.780	Undecane (Cas) N-Undecane	C ₁₁ H ₂₄	156	0.46
3.	13.255	Cyclohexasiloxane, Dodecamethyl-	C ₁₂ H ₃₆ O ₆	444	0.32
4.	21.633	1, 2-Benzenedicarboxylic Acid, Diethyl Ester	C ₁₂ H ₁₄ O ₄	222	13.94
5.	21.731	1, 2-Benzenedicarboxylic Acid, Diethyl Ester	C ₁₂ H ₁₄ O ₄	222	36.05
6.	23.209	Cyclooctasiloxane, Hexadecamethyl-	C ₁₆ H ₄₈ O ₈ Si ₈	592	1.87
7.	25.700	1, 3-Diphenyl-1, 3, 5, 5-Tetramethyl-yclotrisiloxane	C ₁₆ H ₂₂ O ₃ Si ₃	346	6.08
8.	26.163	Benzenesulfonamide, 3-Amino-4-Hydroxy-	C ₆ H ₈ N ₂ O ₃ S	188	0.82
9.	26.274	Octadecamethylcyclononasiloxane	C ₁₈ H ₅₄ O ₉ Si ₉	666	0.78
10.	27.108	Benzenepropanoic Acid, . Alpha., 4-Bis(Acetyloxy)-, Methyl Ester	C ₁₄ H ₁₆ O ₆	280	1.54
11.	27.221	1, 2-Benzenedicarboxylic Acid, Bis (2-Methylpropyl) Ester	C ₁₆ H ₂₂ O ₄	278	3.74
12.	27.285	2-Pyridinepropanamide, N-Phenyl-	C ₁₄ H ₁₄ N ₂ O	226	1.95
13.	27.419	Silane, [1, 3, 5-Benzenetriyltris (Oxy)] Tris [Trimethyl-	C ₁₅ H ₃₀ O ₃ Si ₃	342	3.66
14.	27.975	Hexadecanoic Acid, Methyl Ester (Cas) Methyl Palmitate	C ₁₇ H ₃₄	270	3.33
15.	28.495	Palmitic Acid	C ₁₆ H ₃₂ O ₂	256	2.18
16.	28.673	1, 2-Benzenedicarboxylic Acid, Dibutyl Ester	C ₁₆ H ₂₂ O ₄	278	3.08
17.	29.396	Nonamethyl, Phenyl-, Cyclopentasiloxane	C ₁₅ H ₃₂ O ₅ Si ₅	432	0.89
18.	30.283	1-Octadecanol	C ₁₈ H ₃₈ O	270	0.36
19.	30.386	9, 12-Octadecadienoic Acid (Z, Z)-, Methyl Ester	C ₁₉ H ₃₄ O ₂	294	3.26
20.	30.450	9-Octadecenoic Acid (Z)-, Methyl Ester	C ₁₉ H ₃₆ O ₂	296	0.93
21.	30.653	Tetracosamethylcyclododecasiloxane	C ₂₄ H ₇₂ O ₁₂ Si ₁₂	888	0.23
22.	30.747	Octadecanoic Acid, Methyl Ester	C ₁₉ H ₃₈ O ₂	298	0.24
23.	30.925	Octadec-9-Enoic Acid §§ 9-Octadecenoic Acid	C ₁₈ H ₃₄ O ₂	282	0.57
24.	31.497	Pentamethyl Phenyl-Disilane	C ₁₁ H ₂₀ Si ₂	208	1.20
25.	32.608	4-P-Chorophenyl-2-Dimethylamino-5-Nitrosothiazole	C ₁₂ H ₁₃ N ₃ O S	247	6.57
26.	33.962	1.26 Pentamethyl Phenyl-Disilane	C ₁₁ H ₂₀ Si ₂	208	1.26
27.	34.593	(4-Chlorophenyl)Methanesulfonamide	C ₇ H ₈ ClNO ₂ S	205	1.10
28.	37.299	Cyclooctasiloxane, Hexadecamethyl	C ₁₆ H ₄₈ O ₈ Si ₈	592	0.48
29.	38.298	1, 2-Benzenedicarboxylic Acid, Diisooctyl Ester	C ₂₄ H ₃₈ O ₄	390	1.70
30.	38.553	Phosphine Oxide, Triphenyl-	C ₂₄ H ₃₈ O ₄	390	1.11

Source : (Prasanna and Chitra, 2015)..... [18]

[19] reported the physicochemical, fluorescence, histochemical and phytochemical analysis of methanol extract of *Drynaria quercifolia* rhizome. In physicochemical analysis, parameters such as moisture content (3%), water soluble ash (6%), sulphated ash (5%), alcohol soluble extractive value (7%) and water soluble extractive value (9%) of plant were determined. In fluorescence study, different colors of fluorescent were observed under UV and visible light. The histochemical analysis indicates the presence of lignin, flavonoids, alkaloids and polyphenol generally based on colours. Quantitative phytochemical analysis of their report revealed the chief amount of flavonoids (32.84 mg/g), saponin (32.74 mg/g), phenols (84.56 mg/g), tannins (45.23 mg/g) and alkaloids (6.38 mg/g). [20] reported that the dried rhizomes of *Drynaria quercifolia* contained following phytoconstituents; friedelin, epifriedelinol, β-amyrin, β-sitosterol 3-beta-D-glucopyranoside and naringin. [21] also reported that the GC-MS analysis of ethanolic extract of rhizome of *Drynaria quercifolia* showed 11 bioactive compounds, the highest compound was found as 2-myristinol-glycinamide (22.502%) and lowest compound was named as 6-amino-5-cyano-4-(3-iodophenyl)-2-methyl-4H-pyron-3-carboxylic acid ethyl ester (4.505%). [22] used TLC method to identify the constituents, present in different extracts of rhizome of *Drynaria quercifolia*.

Table 5: Phytochemicals identified in 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-1-one,3,5-bis-trimethylsilyl	C ₁₃ H ₂₂ OSi ₂	250	10.092	Aliphatic
2.	28.024	1,2-bis(trimethylsilyl) benzene	C ₁₂ H ₂₂ Si ₂	222	7.444	Aromatic
3.	28.159	2-propanol, 1-chloro-3-(1-methylethoxy)-	C ₆ H ₁₃ O ₂ CL	152	10.492	Alcohol and Ether
4.	28.289	Silane,1,4-phenylene bis(trimethyl-	C ₁₂ H ₂₂ Si ₂	222	12.077	Aromatic
5.	28.434	2,6-lutidine 3,5-dichloro-4-dodecylthio-	C ₁₉ H ₃₁ NCL ₂ S	375	10.038	Not identified
6.	28.584	1-heptyn-4-ol	C ₇ H ₁₄ O	114	4.949	Alcohol
7.	28.694	2-propanol,1-chloro-3-propoxy-	C ₆ H ₁₃ O ₂ CL	152	7.370	Ether and Alcohol
8.	28.869	6-amino-5-cyano-4-(3-iodophenyl)-2-methyl-4H-pyron-3-carboxylic acid ethyl ester	C ₁₆ H ₁₅ O ₃ N ₂ I	410	4.505	Not identified
9.	29.014	2-myristinol-glycinamide	C ₁₆ H ₂₈ O ₂ N ₂	280	22.502	Not identified
10.	29.354	Benzene,2-(tert-butyl dimethyl silyl)-1-isopropyl)-4-methyl	C ₁₆ H ₂₈ OSi	264	4.730	Aromatic
11.	30.214	1,2,4-benzene tri carboxylic acid, 1,2-dimethyl ester	C ₁₁ H ₁₀ O ₆	238	5.801	Aromatic

Source : (Nitin *et al.*, 2020)..... [23]

V- Antimicrobial activity

Synthetic drug resistant bacterial strains were developed due to the increased use of a number of antibacterial drugs. It also created the problem in controlling the growth of infectious disease causing pathogenic bacteria. Moreover synthetic drugs may produce side effect to the users [24]. Regular uses of antibiotics make the organisms to become resistant to such antibiotics [25]. Because of this reason new antibiotics are discovered to control the infectious disease causing pathogens. As a result, anti-microbial substances derived from plants have received considerable attention to controls the diseases [26]. Higher plants are basically rich in active principles, which are generally used as therapeutic drugs [27]. The antimicrobial potential of some ferns has also been studied by various authors [28],[29]. *Drynaria quercifolia* shows one of the potential sources of antimicrobial proerties. [30]. reported that organic solvents such as ethanol, methanol, petroleum ether, hexane, benzene and chloroform were used to extract the bioactive compounds from the rhizome of *Drynaria quercifolia*. These bioactive compounds they screened for the antibacterial activity against infectious disease causing bacterial pathogens such as *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Salmonella marscence*, *Salmonella paratyphi A*, *Salmonella paratyphi B*, , *Staphylococcus aureus* and *Bacillus subtilis* by agar diffusion method. The ethanolic extract of *D. quercifolia* was found more active against 80% of the organisms tested. They also found that the methanolic extract (70%), benzene (50%) and chloroform extract (40%) in inhibiting the growth of the organisms tested. Petroleum ether and hexane extract of rhizome of *D. quercifolia* did not show any antibacterial activity against the pathogenic bacteria tested in the experiment.

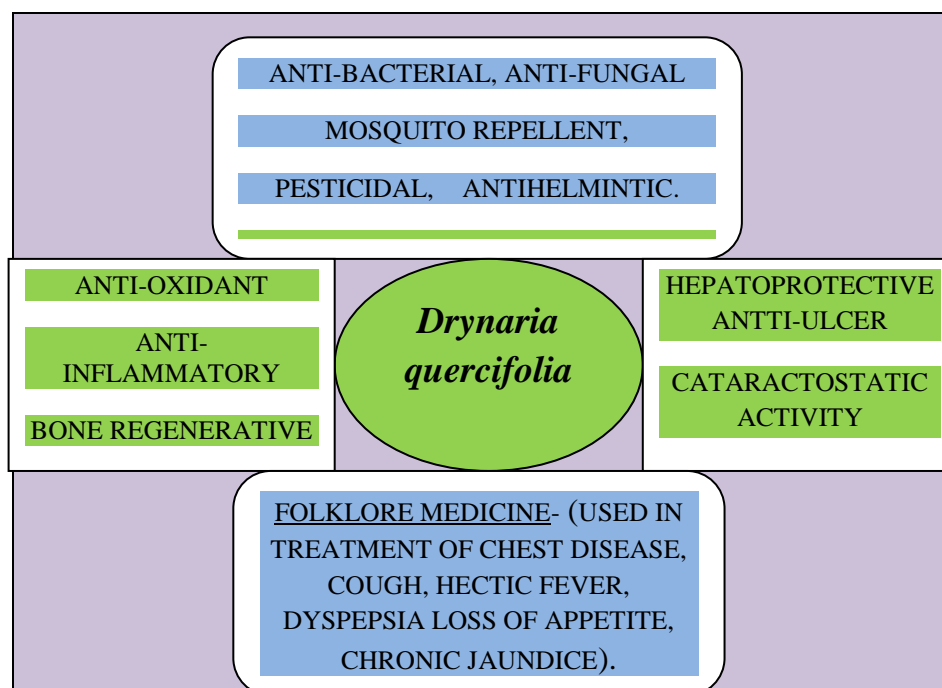


Figure 2: Ethno-medicinal activity exhibited by *Drynaria quercifolia*

VI- Antioxidant activity

Drynaria quercifolia can be the potent source of natural antioxidants. Oxidation and reduction reactions are important to many living organisms for the production of energy to metabolic processes. Oxygen free radicals and other reactive oxygen species (ROS) which are continuously produced in living organism, result in cell death and tissue damage. These species can react with biological substrates such as DNA and proteins, leading to several diseases including cancer, diabetes, cardiovascular diseases, aging, and arthritis. [31] measured the antioxidant activity of different rhizome fractions of *Drynaria quercifolia* on the basis of its DPPH scavenging activity which showed strong antioxidant activity. [32] reported that the polyphenolic composition and antioxidant properties of methanol extract of rhizome of *Drynaria quercifolia* by DPPH assay, hydroxyl ion radicals ($\cdot\text{OH}$), nitric oxide (NO), hydrogen peroxide (H_2O_2) and 2, 2'-Azinobis (3-ethylbenzothiazoline sulphonic acid) ABTS scavenging assays. The antioxidant capacities of the extract were stronger than that of the antioxidant standard, butyl hydroxy toluene (BHT) when compared with other medicinal ferns. There is an increasing concern in antioxidants, particularly in those anticipated to prevent the presumed deleterious effects of free radicals in the human body, and to prevent the worsening of fats and other constituents of foodstuffs. In both cases, there is a preference for antioxidants from natural sources rather than from synthetic sources [33].

VII-Pesticidal and Pest repellent activities

[34] have studied the pesticidal and pest repellency activities of rhizome of *Drynaria quercifolia* against *Tribolium castaneum* (Herbst) which is a harmful pest of stored grain and flour-based products. They used surface film method and filter paper disc method respectively. They also reported the activity of the isolated compound 3, 4-dihydroxybenzoic acid was evaluated against the pest. Chloroform soluble fraction of

ethanol extract of rhizome of *Drynaria quercifolia* showed significant pesticidal activity at doses 0.88 to 1.77 mg/cm and significant pest repellency activity at doses 0.94 to 0.23 mg/cm.

VIII –Anti-helmintic activity

[35] evaluated the anti-helmintic potential of *Drynaria quercifolia* against adult earthworms and piperazine citrate as standard. Results showed that the anti-helmintic potency of the extract, inversely proportional to the time taken for paralysis and death of the worms.

IX- Bone regenerative activity

[35] have evaluated the effect of *Drynaria quercifolia* rhizome extract as bone forming substitute in periodontal intraosseous defects. Their study involved twenty patients with chronic periodontitis with intraosseous defects. They set the experiment consist of Control group which was treated with open flap debridement (OFD) while the treatment group had OFD and placement of *Drynaria* plant extract. Probing pocket depth reduction (PPD) and relative attachment level gain after 6 months were more for the treatment group and this difference statistically significant. Their Results suggested the rhizome extract has potential regenerative effect on bone cells.

X-Cataractostatic activity

[36]reported the cataractostatic activity of methanolic and ethyl acetate extracts of *Drynaria quercifolia* tuber as a potential treatment for lens cataracts using a glucose-induced cataract in isolated goat lenses in an in-vitro model. Their results showed the ethyl acetate extract of rhizome was able to inhibit cataractogenesis. Study results suggest a potential cataractostatic agent to prevent diabetic cataract.

Discussion

Drynaria quercifolia uses in Ayurveda, Unani system of medicine along with other varied importance in folklore medicine throughout the world. The presence of variety of phytochemicals such like 3,4-dihydroxybenzoic acid, friedelin, epifriedelinol, β -amyrin, β -sitosterol and β -sitosterol 3- β -D-glucopyranosid etc reported from this group of plants justify their use as a potential source for preparation of medicaments against different ailments. In folklore medicinal plant *Drynaria* mostly using for treatment of stomach ache, peptic ulcers, dysentery, gastro-intestinal disorders; wound, abscess, eczema and scabies like skin problems, cold, , cough, jaundice, fever, urinary complaints, fracture of bones, hypertension, glandular swellings, snake bite and also used as a tonic for vigor etc. *Drynaria quercifolia* has a wide range of phytochemicals which could be useful for treatment of various diseases. Many reports were done on screening of rhizome of *Drynaria quercifolia* both *in-vivo* and *in-vitro* exhibited its potency to cure diseases. In coming year we could see more research and standardization of phytoconstituents of the ethnomedicinal wonder fern *Drynaria quercifolia* for the benefit of mankind.

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