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Research Article

Antiinflammatory activity of rhizome of *Drynaria quercifolia* (L.) J.Sm (Polypodiaceae)

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Abstract

Plant-derived phytochemicals are recognized for their potential as sources of antimicrobial and anti-inflammatory compounds. The natural compounds derived from these plants exhibited encouraging anti-inflammatory properties for the treatment of various inflammatory conditions affecting the skin, liver, cardiovascular system, joints, gastrointestinal tract, nervous system, and lungs. Pteridophytes, commonly referred to as ferns and their relatives, possess antimicrobial characteristics that can be utilized in the treatment of bacterial and fungal infections. Aim of the present study was investigation of anti-inflammatory properties of rhizome of *Drynaria quercifolia* (L.) J.Sm.

Methods: Powdered materials of *D.quercifolia* rhizome were extracted with ethanol for 3h and collected the extract and their extract studied for carrageenan-induced paw edema model in Wistar rats. Ethanolic extract of *D. quercifolia* rhizome and standard drug of Diclofenac sodium (10 mg/kg) compared to carrageenan control at different hours in carrageenan-induced paw edema model in Wistar rats.

Results: Ethanolic extract of *D.quercifolia* rhizome was administered at a dose of 500 mg/kg p.o prevented carrageenan-induced paw edema with a percentage inhibition at 66.91% in 3h. Ethanolic extracts of *D. quercifolia* tested doses of 100, 200 and 500 mg/kg had been a significant reduction in carrageenan-induced paw edema in rats, with inhibition rates of 30.01%, 54.21%, and 65.66 % respectively. The findings of the current study indicate that the rhizome of *D. quercifolia* exhibits significant anti-inflammatory properties. Active compounds were identified in the extracts derived from the rhizome of *D.quercifolia* , which demonstrated anti-inflammatory effects that were dependent on concentration. Consequently, it is recommended that further purification and assessment of these extracts, along with a more detailed investigation into the anti-inflammatory potential of the plant, be conducted.

Keywords: Antiinflammatory activity; rhizome; Drynaria quercifolia;Polypodiaceae

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1. Introduction

Inflammation is a biological defense mechanism that protects living cells against diseases such as bacteria, fungi, viruses, physical agents, and defective immune (Dharmadeva *et al*., 2018; Otunola and Afolayan, 2018). Inflammation may be caused by acute (initial inflammation) or chronic (out of proportion of protection damage) types (Sumathi and Anuradha, 2016). Inflammation is mainly the result of cytokines involved in enzyme activation, mediators release, fluid extravasation and vasodilation, cell migration, and tissue damage (Devi *et al*., 2015). At potential injuries, histamine is generated from granules called basophils and eosinophils in white blood cells. Histamine results in the opening of blood capillaries and the release of blood cytokines, which allow more white blood cells to kill pathogens and are responsible for inflammation (Benly,2015). There are many side effects associated with the administration of non-steroidal anti-inflammatory drugs, such as headache, gastric ulcer, damage of liver function (Oguntibeju *et al*.,2018). The anti-inflammatory effects of various phytoconstituents are demonstrated by their ability to inhibit inflammation mediators such as iNOS, NO, and cytokines including TNF-α, IL-1β, IL-6, and IL-12.

Medicinal plants are the primary source of medicines. They have no side effects, and they have become a popular form of health care. Even though several differences exist between herbal and conventional pharmacological treatments, herbal medicine needs to be tested for efficacy using conventional trial methodology and several specific herbal extracts have been demonstrated to be efficacious for specific conditions (Firenzuoli and Gori, 2007). Pteridophytes are non-flowering plants that possess horticultural and medicinal value. Humans have known about the medicinal properties of pteridophytes for over 2,000 years. Vegetative parts or even entire plants, fiddleheads, and rhizomes of pteridophytes are edible and rich in nutritional composition. They are also possessing plentiful phytochemicals including flavonoids, phenolic acids, lignans, coumarins, chromones, phenylpropanoids, quinones, xanthones, terpenoids, alkaloids, and glycosides (Murthy *et al*.,2023). However, there are very few applications of pteridophytes in modern chemotherapy compared to angiosperms. Pteridophytes are increasingly recognized for their potential as therapeutic agents, attributed to the variety of phytochemicals they contain and their notable bioactivities such as antioxidant, anti-inflammatory, anti-cancer, Anti-diabetic, anti-viral, anti-microbial, neuroprotective, anti-tumor, and anti-HIV. Aim of the present study was investigation of anti-inflammatory activity of rhizome of *Drynaria quercifolia* (L.) J.Sm.

2. Materials and Methods

2.1 Collection and Preparation of ethanolic Extract

The fresh rhizomes of *Drynaria quercifolia* (L.) J. Sm were collected from Southern Western Ghats, Thenmalai, Kerala in May 2023. Fresh rhizomes of *D. quercifolia* (L.) J. Sm., weighing approximately 1kg, were thoroughly cleaned and rinsed with tap water to eliminate any dust particles. Subsequently, the woolly brown scales were removed, and the cleaned rhizomes were shade-dried at room temperature for a duration of two weeks, yielding around 200g of dry materials. The dried rhizomes were then ground into a powder using an electric grinder. A total of 30 g of the coarsely powdered rhizomes was extracted with 100 ml of ethanol utilizing a Soxhlet apparatus for a 2h. The resulting extract was concentrated using a Buchi-type rotary evaporator under reduced pressure and at a temperature of 45 °C, achieving a percentage yield of 7% (w/w). The ethanolic extract of *D. quercifolia* rhizome was subsequently stored in an airtight container at 4°C for future applications. The crude ethanolic extract of *D. quercifolia* was subsequently suspended in a 10% Tween-80 solution to achieve the desired concentrations for experimental use.

2.1.2 Phytochemical analysis

The initial phytochemical analysis of the rhizome was conducted to identify various phytoconstituents in accordance with established protocols (Wallis,2005).

2.2 Anti-inflammatory activity

2.2.1 Experimental Animals

The selected experimental animals of Wistar rats weighing between 150 and 250grams were kept in polyacrylic cages, with two animals per cage. They were maintained under standard laboratory conditions, which included a temperature range of 24 to 28°C, relative humidity of 60 to 70 %, and a 12hr light/dark cycle. The animals were provided with commercial rat feed from Lipton India Ltd, Mumbai, and had access to boiled water at all times. All animal experiments were conducted in accordance with NIH guidelines.

2.2.2 Carrageenan-induced paw edema model

Experimental work studied by according to Winter et al., (1964) method followed by the paw edema was induced by injecting 0.1 ml of 1% w/v carrageenan suspended in 1% CMC into subplantar tissues of the left hind paw of each rat. Experimental rats were divided into four groups; each group consisting of six animals.

Group – I: Carrageenan control

Group- II: Ethanolic extract (100 mg/kg)

Group -III: Ethanolic extract (200 mg/kg)

Group -IV: Ethanolic extract (500 mg/kg)

Group- V: Diclofenac sodium (10 mg/kg) as standard reference

The paw thickness was measured before injecting the carrageenan and after 60, 120, 180, and 240 minutes, the thickness was measured using a vernier caliper. The anti-inflammatory activity was calculated as percentage inhibition of oedema in the animals treated with extract under test in comparison to the carrageenan control group.

The percentage (%) inhibition of edema is calculated using the formula

$$\textbf{\% inhibition} = \frac{T_o - T_t}{T_t} \times 100$$

3. Results and Discussion

3.1 Phytochemical analysis

In the present study, identification of secondary metabolites of *D.quercifolia* rhizome and leaves were represented in the table-1.). Kalpana Devi *et al*., (2014) evaluated qualitative and quantitative phytochemical analysis of some important pteridophytes of western ghat with the solvent aqueous, ethanolic and petroleum ether extracts of *Actinopteris rediata, Drynaria quercifolia, Dryopteris cochleata*, and *Pityrogramma calomelanos*. According to Jadhav *et al* ., (2019) reported that phytochemical analysis of methanolic extracts of *Asplenium indicum, Lepisorous nudus*, and *Microsorum membranecium*. Our results suggest that phytochemical screening of several fern species like *Cheilanthes farinosa, C.anceps, C.tenuifolia*, and *C. Albomarginata, Azolla filiculoides* and *Salvinia molesta*, *Helminthostachys zeylanica, Bolbitis appendiculata, Blechnum orientale, Dicranopteris linearis, Marattia fraxineaand Microlepia speluncae,Pityrogramma calomelanos, Christella parasitica Adiantum capillus veneris* and *Pteris quadriureta* L. (Pradnya and Ghorpade *et al*.,2015; Naveen Kumar and Vinoth Kumar,2023; Dahmani *et al*., 2019; Benhamou *et al*.,2013; Nustup Bandyopadhyay and Abhijit Dey, 2022; Manivannan *et al.,* 2020; Rakkimuthu and Naveenraj *et al*.,2018; Kalpana Devi and Rajesh *et al*.,2020; Subramani and Vasantha *et al*., 2014; Vijaya kumari *et al*.,2023; Satabdi Rautray *et al*., 2018).

Table-1: Phytochemical screening of *D.quercifolia* rhizome

Sl No.	Active compounds	*D.quercifolia*	
		Leaves	*Rhizome*
1	Alkaloids	+	+
2	Terpenoid	+	+
3	flavonoids	++	+++
4	Steroid	+	+
5	Coumarin	+	+
6	Cardiac Glycoside	++	+++
7	Saponin	+	+
8	Tannin	+	+

"+" Low quantity; "++" medium;;"+++" High

Table -2: Anti inflammatory activity of ethanolic extract of *Drynaria quercifolia* rhizome

Groups	Dose of extract (mg/kg) p.o.				
	Dose	1st h	2nd h	3rd h	4th h
I	Control	0.46 ± 0.02	0.65 ± 0.02	0.82 ± 0.02	0.91 ± 0.02
II	Carrageenan control (0.1 ml of 1% w/v)	0.68 ± 0.02	1.24 ±0.11	2.78 ±0.02	2.97± 0.02
III	Carrageenan (0.1 ml of 1% w/v) + 100mg of extract	0.49 ± 0.013 (27.94 %)	1.08 ± 0.012 (12.90%)	1.78 ± 0.02 (35.97%)	1.96 ± 0.02 (30.01%)
IV	Carrageenan (0.1 ml of 1% w/v) + 200 mg extract	0.48 ± 0.02 (29.41%)	0.96 ± 0.02 (22.58%)	1.12 ± 0.02 (59.71%)	1.36 ± 0.02 (54.21%)
V	Carrageenan (0.1 ml of 1% w/v) + 500mg extract	0.46 ± 0.02 (32.35%)	0.74 ± 0.02 (37.09%)	0.92 ± 0.02 (66.91%)	1.02 ± 0.02 (65.66%)
VI	Carrageenan (0.1 ml of 1% w/v) + diclofenac sodium	0.42 ± 0.011 (38.23%)	0.71 ± 0.02 (42.74%)	1.08 ± 0.02 (61.15%)	0.96 ± 0.02 (67.68%)

"All values are triplicates" : % of the edema inhibition

3.1. Anti-inflammatory Activity

The results of the present study were observed that *Drynaria quercifolia* rhizome extract was significant reduction in carrageenan-induced paw edema in Wistar rats represented in the table-2. All the tested doses of 100, 200 and 500 mg/kg^{-1}, of *D. quercifolia* rhizome extract were observed that edema inhibition rates of 30.01%, 54.21%, and 65.66 % 4h respectively. 10mg/kg^{-1} dose of Diclofenac sodium was exhibited the highest level of edema inhibition, achieving a good rate of 67.68% in 4h.

Previous studies, Dion *et al*., (2015) who reported that good anti-inflammatory activity of extracts of *Matteuccia struthiopteris, Osmundajaponica, Matteuccia orientalis* and *Pteridium aquilinum*. According to Nesrine ouda *et al*., (2021) reported that similar results of an anti- inflammatory activity were observed by aqueous extract of *Carthamus caeruleus* L. Phytochemicals from medicinal plants play a significant role in managing several inflammatory disorders (Ayertey *et al*., 2020).

For examples, hyoscine and berberine which obtained from *Datura stramonium* and Berberis vulgaris, respectively were reported as a licensed alkaloid compounds on the market as a potential anti-inflammatory agent (Heinrich *et al*., 2021). Secondary metabolites isolated from various parts of medicinal plants were reported to treat a wide spectrum of inflammation diseases (Gonfa *et al*., 2021). Earlier studies, preliminary phytochemical investigations of *Cyathea nilgirensis* had identified the presence of carbohydrates, alkaloids, and flavonoids and its extract is active against the anti-inflammatory effects observed in *Cyathea nilgirensis* (Sahaya Mary *et al*., 2015). This anti-inflammatory activity could be due to the phytochemical compounds. The findings of the current study indicated that the phytochemical analysis of the rhizome extract of *D. quercifolia* identified various secondary metabolites, including alkaloids, flavonoids, terpenoids, phenolic compounds, tannins, saponins, steroids, glycosides, and quinones. These compounds may contribute to the anti-inflammatory properties observed in this study.

4. Conflicts of Interest

The author declare that they have no conflicts of interest.

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