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Original Research Article

Pharmacognostical Studies and Validation of Polyphenol Rich Extract of *Alectra parasitica* subsp. *chitrakutensis* in Traditional Claim for Edema

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Abstract

Background: *Alectra parasitica* subsp. *chitrakutensis*, a holoparasitic plant endemic to India, is traditionally used for rheumatism, edema, and leukoderma. However, scientific validation of its medicinal claims remains limited.
Objectives: This study aimed to quantify key phenolic compounds using reverse-phase high-performance liquid chromatography (RP-HPLC) and evaluate the anti-edematous potential of the plant through *in vitro* antioxidant and anti-inflammatory assays.
Materials and Methods: The rhizomes were collected and subjected to physicochemical and phytochemical analyses. RP-HPLC was employed to quantify key phenolic compounds. Additionally, *in vitro* assays including 2,2-diphenyl-1-picrylhydrazyl (DPPH), oxygen radical absorbance capacity (ORAC), ferric reducing power assay (FRAP), lipid peroxidation, and 2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), anti-protease, and protein denaturation were performed to assess biological activities relevant to edema.
Results: RP-HPLC analysis revealed the presence of four phenolic compounds; gallic acid (1.40 ± 0.08 µg mg^{-1}) was in abundance. The extract demonstrated strong antioxidant activity (DPPH IC_{50}: 32.29 µg mL^{-1}; ABTS IC_{50}: 41.05 µg mL^{-1}; ORAC: 210,404.3 µmol g^{-1} ASE equivalents; lipid peroxidation IC_{50}: 31.46 µg mL^{-1}) and a dose-dependent increase in ferric reducing capacity. Anti-inflammatory potential was confirmed through anti-protease (IC_{50}: 89.92 µg mL^{-1}) and protein denaturation (IC_{50}: 53.86 µg mL^{-1}) assays.
Conclusion: This study scientifically validates the traditional use of *A. parasitica* in managing edema by demonstrating its ability to mitigate oxidative stress and inflammation, two key factors contributing to edema. Its rich polyphenolic content, along with significant antioxidant and anti-inflammatory activities, positions it as a promising candidate for further development as a plant-based therapeutic agent.

Keywords

Alectra parasitica, phenolic compounds, anti-edema, antioxidant, anti-inflammatory

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Introduction

Alectra parasitica subsp. *chitrakutensis* (M.A. Rau) K.K. Khanna & An. Kumar (Orobanchaceae) is a holoparasitic plant native to India and grows predominantly in seasonally dry tropical biomes (POWO, 2024). *A. parasitica* is endemic to the Chitrakoot region of Madhya Pradesh (India) and Boondi (Rajasthan) (Prasad & Dixit, 1993) and is locally known as *Nirgundi*. This root-parasitic plant features rhizomatous, perennating stems; rhizomes are orange-yellow, and upon drying, they turn black. The inflorescences are terminal on the rhizome, purple, and hispid, bearing very small, scale-like leaves. This plant is typically found in association with *Vitex negundo* L., apparently parasitizing its roots (Rau, 1961).

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The species is traditionally valued by local communities for its wide range of medicinal uses, particularly in the management of edema. It is commonly administered in the form of powder mixed with honey, which has shown noticeable benefits in reducing edematous swellings (Bedi, 1967). In addition to its anti-edematous effects, the plant is also used to support digestion, relieve gas, promote bile flow, and treat conditions such as blood disorders, fever, constipation, intestinal worms, leprosy, rheumatism, leukoderma, paralysis, and as a general tonic (Bedi, 1967).

Literature suggests the presence of steroids, triterpenes, alkaloids, saponins, glycosides, phenolics, flavonoids, and so on (Sharma et al., 2016). Metabolites such as naringenin, ouabagenin, convallatoxin, genipin, bartsioside, deoxypodophyllotoxin, and strigolactones have also been documented (Patil, 2020), along with the carotenoid azafrin, which remains the only compound isolated and structurally characterized so far (Agrawal et al., 2014). The whole extract of *A. parasitica* had anti-cancerous (Patil, 2020), anti-bacterial (Saxena & Vyas, 1993), anti-microbial (Kakpure & Rothe, 2016), and anti-diabetic (Ranjana et al., 2023).

Edema is a pathological increase in interstitial fluid volume resulting from dysregulation of homeostatic mechanisms controlling transcapillary fluid exchange, systemic water balance, and electrolyte distribution across physiological compartments. It primarily arises due to an imbalance between capillary filtration and lymphatic drainage, mediated by inflammatory responses, oxidative stress, and alterations in vascular permeability (Levenbrown & Costarino, 2019). Polyphenols are well known for their antioxidant and anti-inflammatory effects, making them valuable as adjuvant therapeutic agents. They scavenge reactive oxygen species (ROS), inhibit proinflammatory enzymes such as cyclooxygenase (COX) and lipoxygenase (LOX), and modulate key signaling pathways like nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB) and mitogen-activated protein kinase (MAPK), thereby reducing oxidative stress and the production of inflammatory mediators at the molecular level (Hussain et al., 2016).

Despite its traditional use in managing edema, scientific validation of anti-edematous activity remains limited. Therefore, the present study aims to: (a) quantify the phenolic compounds, namely, gallic acid, ascorbic acid, protocatechuic acid, and caffeic acid, in the methanolic extract of *A. parasitica* through reverse-phase high-performance liquid chromatography (RP-HPLC)-PDA, and (b) validate its anti-edematous activity through *in vitro* assays.

Materials and Methods

Reagents

Marker compounds ascorbic acid (≥97%), protocatechuic acid (≥97%), caffeic acid (≥97%), and gallic acid (≥95%) were procured from Sigma–Aldrich (USA). The reagents, 2,2-diphenyl-1-picrylhydrazyl (DPPH), 2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS), bovine serum albumin (BSA), casein, and buffers were procured from MP Biomedicals (India). The solvents, methanol, water, acetonitrile, glacial acetic acid, and sodium acetate, were HPLC grade (SRL Laboratories Ltd., India).

Plant Material and Extraction

The sample (rhizome) was collected from the Kamtanath hill area, Chitrakoot (Latitude: 25°09′09″N; Longitude: 80°51′17″E). The plant was identified, authenticated, and a herbarium specimen was prepared and deposited in the CSIR-NBRI, Lucknow herbarium (LWG 110866). The methanol extract was prepared for further analysis (Chaudhary et al., 2024).

Pharmacognosy of *A. parasitica*

The physicochemical parameters, including moisture content, ash values (total ash, water-soluble ash, acid-insoluble ash), and extractive values (water-soluble extractive, ethanol-soluble extractive, and hexane-soluble extractive), were assessed according to the *Ayurvedic Pharmacopeia of India* (Anonymous, 2009). The quantitative estimation of different phytochemicals, namely, total tannin content (Horwitz & Latimer, 1975), total phenolic content (Bray & Thorpe, 1954), and total flavonoid content (Ordonez et al., 2006), was analyzed as per standard protocols using a UV-spectrophotometer (Shimadzu, UV-1800, Japan).

Quantification of Phenolic Compounds through RP-HPLC-PDA

Preparation of Standard and Sample Solutions

The stock concentration of reference markers (Figure S1), namely, ascorbic acid, gallic acid, protocatechuic acid, and caffeic acid, was freshly prepared at a concentration of 1 mg mL^{-1} in HPLC-grade methanol. On the day of analysis, stock solutions were diluted further, and a working solution of 0.1 mg mL^{-1} was prepared. A working solution of plant extract was prepared at a concentration of 10 mg mL^{-1}, and before analysis, working solutions were filtered through a 0.22 μm Millipore membrane filter (USA).

Instrumentation and Chromatographic Condition

The separation and quantification of phenolic compounds were done on an RP-HPLC system of Waters (USA). The separation of metabolites was achieved on a C_{18} RP-HPLC column (4.6 × 250 mm internal diameter, 5 μm particle size), supplied by SunFire (USA). For the separation of phenolic compounds, the mobile phase consisting of 0.01 M sodium acetate (pH 3 by adding glacial acetic acid) (A) and acetonitrile (B) was used. Elution was carried out in an isocratic

manner (65:35 v/v; A:B), with a flow rate of 0.7 mL min^{-1}, thermostated at 35°C for a total run time of 17 min. The injection volume was 10 µL for all analytes. Identification of peaks was done by comparing the retention time (R_t) of standard peaks and the R_t of sample peaks, along with the spectral information provided by the photodiode array (PDA) detector operated over the range of 190–400 nm.

Validation of Anti-edematous Activity

The anti-radical activity of plant extract was assayed by DPPH radical scavenging assay (Duh & Yen, 1997), oxygen radical absorbance capacity (ORAC) (Prior et al., 2003), ferric reducing power assay (FRAP) (Oyaizu, 1986), lipid peroxidation assay (Ohkawa et al., 1979), and ABTS radical scavenging assay (Re et al., 1999). Different concentrations of methanolic extract were used and compared with ascorbic acid, which is the positive control in the above assays. Further, *in vitro* protease inhibition and protein denaturation assay of the methanolic extract of the sample were performed according to the standard protocols (Kakade, 1969; Sakat et al., 2010). Aspirin is used as a positive control, and IC_{50} values were calculated.

Statistical Analysis

The experiments were performed in triplicate and the results were expressed as mean value ± standard deviation (SD) using XLSTAT (2010).

Results and Discussion

Quality Control of A. parasitica

The rhizome of *A. parasitica* contains a moisture content of 0.66% ± 0.01. Total ash was highest, that is, 7.74% ± 0.15, followed by water-soluble and acid-insoluble ash. Extractive values were assessed by the cold maceration method in three solvents, namely, water, ethanol, and hexane, and phytoconstituents present within the crude drug were estimated qualitatively based on their polarity. The data suggest that extractive value in water was higher than that of ethanol (1.81% ± 0.08) and hexane (0.15% ± 0.01). The total flavonoid, phenolics, and tannin content in the extract was 0.02% ± 0.001, 0.03% ± 0.002, and 0.1% ± 0.03, respectively. These physicochemical and phytochemical parameters are graphically represented in Figure S2. These parameters provide crucial information for evaluating the quality of the crude drug; however, the results were different than previous literature (Sharma et al., 2016; Soni & Sikarwar, 2011) and possibly due to variation in sampling, that is, collection site, time of collection, and so on.

RP-HPLC Quantification of Phenolic Compounds

The developedtxt chromatogram (Figure 1) suggests the presence of ascorbic acid, gallic acid, protocatechuic acid, and caffeic acid, which were eluted at retention times (R_t) of 4.09 ± 0.05, 5.84 ± 0.06, 9.12 ± 0.03, and 12.77 ± 0.06 min, respectively (Figure 1A). The presence of standards in the sample was confirmed by matching the absorption spectra (190–400 nm) of standards with samples at their respective R_t, and quantification was done at absorption maxima of 254 nm (Figure 1) for targeted metabolites. In the test extract, gallic acid (1.40 ± 0.08 µg mg^{-1}) was found to be the highest, followed by ascorbic acid, caffeic acid, and protocatechuic acid, 0.49 ± 0.04 µg mg^{-1}, 0.39 ± 0.04 µg mg^{-1}, and 0.15 ± 0.02 µg mg^{-1}, respectively. The value indicates that the plant is a rich source of polyphenolics, inheriting various pharmacological properties such as antioxidant, anti-inflammatory, hypoglycemic, anti-tumor, anti-microbial, and neuroprotective activities (Chaudhary et al., 2024), and so on. The method for the quantification of phenolic compounds was validated (Misra et al., 2023) as per ICH guidelines.

Validation of Anti-edematous Property

Edema in the central nervous system (CNS) is often driven by oxidative stress and inflammation, leading to disrupted cellular processes and tissue damage. Free radicals and hypoxia can impair sodium–potassium adenosine triphosphatase (Na^+–K^+-ATPase), a key enzyme for cellular transport, making it highly susceptible to damage from oxidative stress and lipid peroxidation. This impairment can result in brain edema by weakening tight junctions and compromising the blood–brain barrier (BBB) (Toklu & Tümer, 2015). Additionally, oxidative stress can activate nuclear factor (NF-κB), which upregulates proinflammatory cytokines and adhesion molecules, contributing to pulmonary edema and cerebral edema (Himadri et al., 2010; Sarada et al., 2008). Phenolic compounds have demonstrated significant antioxidant, anti-inflammatory, and anti-edematous properties. They reduce the expression of proinflammatory cytokines (e.g., interleukin-1 [IL-1], interleukin-6 [IL-6], and tumor necrosis factor-alpha [TNF-α]), enzymes like cyclooxygenase-2 (COX-2), and cell adhesion molecules (e.g., intercellular adhesion molecule-1 [ICAM-1] and vascular cell adhesion molecule-1 [VCAM-1]), which are involved in vascular permeability and fluid accumulation, thus alleviating inflammation-induced edema. In addition, these compounds also reduced edema and decreased IL-1β levels and myeloperoxidase (MPO) activity, indicating potent anti-inflammatory and anti-edematous potential in ear edema models (Dos Santos et al., 2019). Therefore, the validation of anti-edematous activity of the plant extract is strongly supported by the results of *in vitro* antioxidant and anti-inflammatory assays.

In the DPPH radical scavenging assay, plant extract showed 5.33%–77.33% inhibition at concentrations ranging from 10 to 50 µg mL^{-1}, and the IC_{50} value was 32.29 µg mL^{-1}. The yielded regression equation was found to be linear ($y = 1.6867x - 4.4667$) with a statistically significant regression coefficient (R^2) of 0.95. The IC_{50} value of ascorbic acid

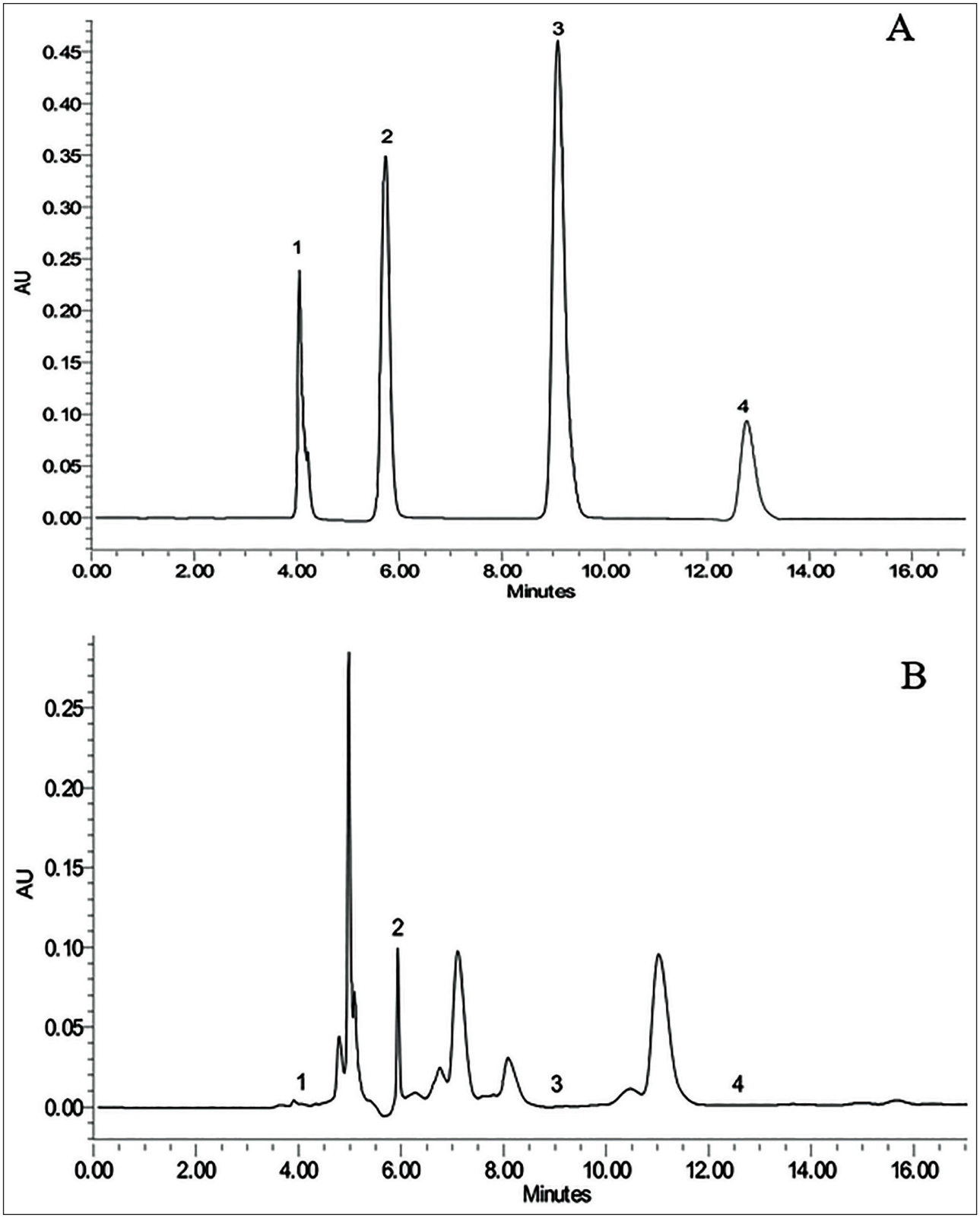


Figure 1. RP-HPLC Chromatogram of Mixture of Marker Compounds (Ascorbic Acid (1), Gallic Acid (2), Protocatechuic Acid (3) and Caffeic Acid (4)) (A) and Sample (B).

Note: RP-HPLC: Reverse-phase high-performance liquid chromatography.

is 2.72 µg mL^{-1} and was significantly different from the test extract. The ABTS radical scavenging activity of the plant extract was estimated at five different concentrations, ranging from 10 to 50 µg mL^{-1}, and the effect was concentration dependent, that is, inhibition increases with an increase in concentration. The IC_{50} of the plant extract was 41.05 µg mL^{-1}, with a regression equation, $y = 1.3867x - 6.9333$, and a regression coefficient (R^2) of 0.97. In comparison, the IC_{50} of the positive control (ascorbic acid) was 0.82 µg mL^{-1} and was statistically insignificant compared to the sample. In the FRAP assay, data indicate that with an increase in concentration (100–500 µg mL^{-1}), absorbance of the sample also increases, with a regression coefficient (R^2) of 0.96 and the regression equation, $y = 934.58x - 33.382$. In comparison, an increase in concentration (100–500 µg mL^{-1}), the absorbance of the control also increases, with a regression coefficient (R^2) of 0.9987 and the regression equation, $y = 64.056x - 2.7196$, and was statistically insignificant to the sample. The ORAC value of the extract was 210,404.3 µmol g^{-1} ascorbic acid equivalent (ASE), indicating a promising antioxidant potential of the plant extract. In lipid peroxidation assay, IC_{50} was recorded at 31.46 µg mL^{-1}, with a regression coefficient (R^2) of 0.96 and a regression equation, $y = 1.7676x - 5.6154$. Whereas, the IC_{50} of the positive control was 27.02 µg mL^{-1} and was insignificantly different from the plant extract. These results are comprehensively illustrated in Figure S3.

Inflammation is a primary driver of edema, particularly in conditions involving tissue damage and increased vascular permeability. Inflammation is characterized by edema and accumulation of leukocytes, accompanied by necrosis. The ability of electrolytes to produce necrosis was found to increase with the valence of their basic ion, and in this respect was in accord with their ability to denature proteins (Opie, 1962). The anti-protease activity of the plant extract increases with increasing concentration, with an IC_{50} of 89.92 µg mL^{-1} and a regression coefficient (R^2) of 0.98, indicating its ability to inhibit proteolytic enzymes like neutrophil elastase. These enzymes are known to degrade extracellular matrix components, leading to tissue inflammation and edema (Fujie et al., 1999). The plant extract's anti-protease activity is comparable to aspirin, which had an IC_{50} value of 49.99 µg mL^{-1}. This suggests that the mechanism of action of the plant extract may be similar to those drugs, exerting potent anti-edematous effects. Moreover, in protein denaturation assay, the IC_{50} value was 53.86 µg mL^{-1} with a regression coefficient (R^2) of 0.96, further corroborating the extract's anti-inflammatory potential. These findings are comprehensively illustrated in Figure S4. Denatured proteins can act as antigens, triggering inflammatory responses that exacerbate edema. By inhibiting this process, the plant extract may reduce inflammation and the associated fluid accumulation in tissues. In this study, *in vitro* anti-radical and anti-inflammatory assays were selected because free radicals and inflammatory mediators are the two primary factors responsible for edema, and curbing these kinds of intermediates will cumulatively address the issue. A previous study on anti-edematous activity of *Andrographis paniculata* justifies the present study (Lin et al., 2009). *In vivo* studies have demonstrated that brain edema can be prevented by the administration of protease inhibitors such as ulinastatin or aprotinin. These inhibitors not only reduce the activity of proteases but also decrease brain edema and the breakdown of the BBB. The observed anti-protease activity of the plant extract in the present study suggests that it could exert similar protective effects against edema. Additionally, the increase in brain glutathione levels (BGL) activity in edematous brains is reduced by protease inhibitors, further supporting the role of anti-protease activity in preventing edema (Yamaguchi, 1989).

Conclusion

This study provides comprehensive *in vitro* validation of *A. parasitica* subsp. *chitrakutensis* for its traditional use in edema. The extract was found rich in polyphenolic compounds with proven antioxidant and anti-inflammatory properties. It demonstrated significant free radical scavenging, lipid peroxidation inhibition, and anti-protease activities, mechanisms closely associated with edema reduction. The rationale for conducting antioxidant and anti-inflammatory assays to validate anti-edematous property lies in the fact that oxidative stress and inflammation are key contributors to the development of edema. Future studies should focus on *in vivo* validation, identification of bioactive constituents, and elucidation of molecular pathways involved.

Abbreviations

ABTS: 2,2′-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid); ASE: Ascorbic acid equivalent; BBB: Blood–brain barrier; BGL: Brain glutathione levels; BSA: Bovine serum albumin; CNS: Central nervous system; DPPH: 2,2-Diphenyl-1-picrylhydrazyl; FRAP: Ferric reducing power assay; ICAM: Intercellular adhesion molecule; IL: Interleukin; MPO: Myeloperoxidase; Na^+–K^+-ATPase: Sodium–potassium adenosine triphosphatase; NF: Necrosis factor; PDA: Photodiode array; RP-HPLC: Reverse-phase high-performance liquid chromatography; VCAM: Vascular cell adhesion molecule.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical Approval and Informed Consent

Not applicable.

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Supplementary Material

Supplementary material for this article is available online.

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References

Agrawal, P., Laddha, K., & Tiwari, A. (2014). Isolation and HPLC method development of azafrin from *Alectra parasitica* var. *chitrakutensis*. *Natural Product Research*, *28*(13), 940–944. https://doi.org/10.1080/14786419.2014.896009

Anonymous. (2009). *Ayurvedic pharmacopoeia of India, part 2* (1st ed.). Department of Health, Ministry of Health and Family Welfare, Government of India.

Bedi, R. (1967). *Alectra parasitica* var. *chitrakutensis*. *Economic Botany*, *21*(3), 277–283. https://doi.org/10.1007/BF02860377

Bray, H. G., & Thorpe, W. V. (1954). Analysis of phenolic compounds of interest in metabolism. *Methods of Biochemical Analysis*, *1*, 27–52. https://doi.org/10.1002/9780470110171.ch2

Chaudhary, M. K., Tripathi, D., Misra, A., Singh, S. P., Srivastava, P. K., Gupta, V., Acharya, R., & Srivastava, S. (2024). Nutritional characteristics of *Stereospermum chelonoides* (Lf) DC. *Heliyon*, *10*(2), Article e24193. https://doi.org/10.1016/j.heliyon.2024.e24193

Dos Santos, Z. M.Q., Dos Santos, M. Q., Zancanaro, V., Bellaver, E. H., Nardi, G. M., Gelinski, J. M. L., & Locatelli, C. (2019). Topical application of phenolic compounds suppresses *Propionibacterium acnes*-induced inflammatory responses in mice with ear edema. *Naunyn-Schmiedeberg's Archives of Pharmacology*, *392*(5), 529–540. https://doi.org/10.1007/s00210-018-01604-z

Duh, P.-D., & Yen, G.-C. (1997). Antioxidative activity of three herbal water extracts. *Food Chemistry*, *60*(4), 639–645. https://doi.org/10.1016/S0308-8146(97)00049-6

Fujie, K., Shinguh, Y., Inamura, N., Yasumitsu, R., Okamoto, M., & Okuhara, M. (1999). Release of neutrophil elastase and its role in tissue injury in acute inflammation: Effect of the elastase inhibitor, FR134043. *European Journal of Pharmacology*, *374*(1), 117–125. https://doi.org/10.1016/s0014-2999(99)00268-x

Himadri, P., Kumari, S. S., Chitharanjan, M., & Dhananjay, S. (2010). Role of oxidative stress and inflammation in hypoxia-induced cerebral edema: A molecular approach. *High Altitude Medicine and Biology*, *11*(3), 231–244. https://doi.org/10.1089/ham.2009.1057

Horwitz, W., & Latimer, G. (1975). *Official methods of analysis*, *222*. Association of Official Analytical Chemists.

Hussain, T., Tan, B., Yin, Y., Blachier, F., Tossou, M. C. B., & Rahu, N. (2016). Oxidative stress and inflammation: What polyphenols can do for us? *Oxidative Medicine and Cellular Longevity*, *2016*(1), Article 7432797. https://doi.org/10.1155/2016/7432797

Kakade, M. (1969). An evaluation of natural vs. synthetic substrates for measuring the antitryptic activity of soybean samples. *Cereal Chemistry*, *46*, 518–526.

Kakpure, M., & Rothe, S. (2016). *Alectra parasitica* A. Rich. An unexplored parasitic plant with potential as antimicrobial agent. *Bioscience Discovery*, *7*, 25–29.

Levenbrown, Y., & Costarino, A. T. (2019). Edema. *In Nephrology and fluid/electrolyte physiology* (pp. 271–290). Elsevier. https://doi.org/10.1016/B978-0-323-53367-6.00017-0

Lin, F. L., Wu, S. J., Lee, S. C., & Ng, L. T. (2009). Antioxidant, antioedema and analgesic activities of *Andrographis paniculata* extracts and their active constituent andrographolide. *Phytotherapy Research*, *23*(7), 958–964. https://doi.org/10.1002/ptr.2701

Misra, A., Chaudhary, M. K., Tripathi, D., Srivastava, P. K., Gupta, V., Acharya, R., & Srivastava, S. (2023). Nutritional potential of an edible terrestrial orchid *Eulophia nuda* LINDL and validation of its traditional claim in arthritis. *Journal of Ethnopharmacology*, *306*, Article 116123. https://doi.org/10.1016/j.jep.2022.116123

Ohkawa, H., Ohishi, N., & Yagi, K. (1979). Assay for lipid peroxides in animal tissues by thiobarbituric acid reaction. *Analytical Biochemistry*, *95*(2), 351–358. https://doi.org/10.1016/0003-2697(79)90738-3

Opie, E. L. (1962). On the relation of necrosis and inflammation to denaturation of proteins. *The Journal of Experimental Medicine*, *115*(3), 597–608. https://doi.org/10.1084/jem.115.3.597

Ordonez, A., Gomez, J., Vattuone, M., & Lsla, M. (2006). Antioxidant activities of *Sechium edule* (Jacq.) Swartz extracts. *Food Chemistry*, *97*(3), 452–458. https://doi.org/10.1016/j.foodchem.2005.05.024

Oyaizu, M. (1986). Studies on products of browning reaction antioxidative activities of products of browning reaction prepared from glucosamine. *The Japanese Journal of Nutrition and Dietetics*, *44*(6), 307–315. https://doi.org/10.5264/eiyogakuzashi.44.307

Patil, S. P. (2020). Proton NMR and HR-LC/MS based phytochemical analysis of methanolic fraction of *Alectra parasitica* A. Rich. rhizomes. *Heliyon*, *6*(1), Article e03171. https://doi.org/10.1016/j.heliyon.2020.e03171

POWO. (2024). *Plants of the world online*. Facilitated by the Royal Botanic Gardens. https://powo.science.kew.org/

Prasad, R., & Dixit, R. (1993). An endemic medicinal parasite from Madhya Pradesh under threat of extinction. *Rural reconstruction, ecosystem and forestry* (pp. 185–187). MD Publishing Private Limited.

Prior, R. L., Hoang, H., Gu, L., Wu, X., Bacchiocca, M., Howard, L., Hampsch-Woodill, M., Huang, D., Ou, B., & Jacob, R. (2003). Assays for hydrophilic and lipophilic antioxidant capacity (oxygen radical absorbance capacity (ORACFL)) of plasma and other biological and food samples. *Journal of Agricultural and Food Chemistry*, *51*(11), 3273–3279. https://doi.org/10.1021/jf0262256

Ranjana, M., Binwal, M., Verma, A. K., Bawankule, D. U., Tiwari, N., & Shanker, K. (2023). Stimulation of glucose uptake by

glycosides from *Alectra parasitica* subsp. *chitrakutensis* (M. A. Rau) K. K. Khanna & An. Kumar: An in-vitro study of TNF-α induced insulin resistance in L6 myoblasts. *Natural Product Research*, *37*(12), 2024–2030. https://doi.org/10.1080/14786419.2022.2112957

Rau, M. (1961). Occurrence of *Alectra parasitica* A. Rich. *In India a new variety from Banda distria* (pp. 25–27). Nelumbo.

Re, R., Pellegrini, N., Proteggente, A., Pannala, A., Yang, M., & Rice-Evans, C. (1999). Antioxidant activity applying an improved ABTS radical cation decolorization assay. *Free Radical Biology and Medicine*, *26*(9–10), 1231–1237. https://doi.org/10.1016/s0891-5849(98)00315-3

Sakat, S., Juvekar, A. R., & Gambhire, M. N. (2010). *In vitro* antioxidant and anti-inflammatory activity of methanol extract of *Oxalis corniculata* Linn. *International Journal of Pharmacy and Pharmaceutical Sciences*, *2*(1), 146–155.

Sarada, S., Himadri, P., Mishra, C., Geetali, P., Ram, M. S., & Ilavazhagan, G. (2008). Role of oxidative stress and NF-kB in hypoxia-induced pulmonary edema. *Experimental Biology and Medicine*, *233*(9), 1088–1098. https://doi.org/10.3181/0712-RM-337

Saxena, A., & Vyas, K. (1993). Antimicrobial activity of *Alectra parasitica* var. *chitrakutensis* Rau. *Journal of Economic and Taxonomic Botany*, *17*, 55–59.

Sharma, S. K., Patil, A. S., & Sikarwar, R. (2016). Comparative phytochemical evaluation of ethnobotanically important medicinal parasitic herb: *Alectra chitrakutensis*. *International Journal of Pharmacy and Pharmaceutical Sciences*, *8*, 351–355.

Soni, P., & Sikarwar, R. (2011). Pharmacopoeial standardization of *Alectra chitrakutensis* (MA Rau.) R. Prasad & RD Dixit found in Chitrakoot Region. *Journal of Natural Remedies*, *11*(2), 124–131.

Toklu, H. Z., & Tümer, N. (2015). *Oxidative stress, brain edema, blood–brain barrier permeability, and autonomic dysfunction from traumatic brain injury*. CRC Press/Taylor & Francis.

Yamaguchi, M. (1989). Anti-edema effect of protease inhibitors. In J. T. Hoff & A. L. Betz (Eds.), *Intracranial pressure VII* (pp. 1004–1007). Springer. https://doi.org/10.1007/978-3-642-73987-3_262