Development of Instant Soup Mix using Oak Fern

E Ramanji Reddy[1*], Aruna Sree T N A[2], Poojitha P[3], Sanchita Mukherjee[4], Nandhakumar Srinivasan[5], Prathiksha S[6], Athithi J[7], Dhanuprakash S T[8], Graceline Remi W[9]

[1] *Assistant Professor, Bannari Amman institute of technology, Sathyamangalam, Tamilnadu, India. ramanji.edamakanti20@gmail.com*
[2] *Assistant Professor, Bannari Amman institute of technology, Sathyamangalam, Tamilnadu, India.*
[3] *Assistant Professor, Department of food Technology, Saintgits College of Engineering (Autonomous), Kottayam, Kerala, India*
[4] *Assistant Professor, Department of food Technology, Parul University, Vadodara, Gujarat, India*
[5] *Research Scholar, Department of Chemical Engineering, Anna University, Chennai, Tamilnadu, India*
[6] *Department of food technology, Bannari Amman institute of technology, Sathyamangalam, Tamilnadu, India*
[7] *Department of food technology, Bannari Amman institute of technology, Sathyamangalam, Tamilnadu, India*
[8] *Department of food technology, Bannari Amman institute of technology, Sathyamangalam, Tamilnadu, India*
[9] *Department of food technology, Bannari Amman institute of technology, Sathyamangalam, Tamilnadu, India*

KEYWORDS
Oak fern, Veldt Grape, Soup Mix, Arthritis, Shelf Life

ABSTRACT
In order to create an instant soup mix, this project will research and formulate two main components that are well-known for their nutritional and therapeutic properties: Cissus quadrangularis and oak fern (Drynaria quercifolia). Traditional Asian medicine frequently employs Drynaria quercifolia because of its anti-inflammatory, antioxidant, and bone-regenerating qualities. The ability of Cissus quadrangularis to support bone health and repair is well known. The goal of the research is to utilize the medicinal properties of these plants, especially for those with weaker bone joints and arthritis. Different ratios of oak fern, Cissus quadrangularis, and various spice powders were used to create the soup mix. The shelf life and sensory assessment of the produced product samples S1, S2, S3 and S4 were assessed. Upon evaluating the sensory attributes of various formulations, sample S3 exhibited considerably higher ratings for appearance, color, flavor, and taste. This soup mix is so simple to prepare that it may be referred to as a handy, healthful soup mix. According to the study, there may be room for research and goods made from oak fern, which has an excellent nutritional profile and is readily accessible.

1. Introduction:

U. M Dhanalekshmi et al (2021) has studies that traditional usage of drynaria quercifolia rhizome for treatment of joint pain, diarrhea, typhoid, cholera and skin diseases. In many parts of Tamil Nadu and Kerala, the rhizome has been consumed as fresh juice which is considered to be energy drink. There is no in vitro study yet on anti-arthritis effect of rhizome. So, in vitro studies on rhizome and its anti-arthritic activities were evaluated by using elastase, PLA2, hyaluronidase, and proteinase and assays like protein denaturation inhibition, membrane lysis, and NO scavenging activity. Kamaldeep Kour et al. (2023) study was carried out to construct an instant vegetable soup mix using tomatoes and broccoli and to assess its quality during a 90-day storage period in terms of water activity, moisture, crude fat, crude protein, ash, crude fiber, carbohydrate, and energy. As per the traditional formula, corn flour, onion powder, garlic powder, salt, and black pepper powder were combined with tomato and broccoli powder in different ratios (100:00, 95:05, 90:10, 85:15, 80:20, 75:25, and 70:30) to create the quick vegetable soup mix. Kamalakkannan Mani et al. (2023) An overview of Drynaria quercifolia's pharmacological, phytochemical, and traditional uses is given in the paper. In addition to its many traditional use, Drynaria quercifolia is used in several folk remedies. A thorough assessment is therefore required in order to match the traditional of this plant with the available scientific literature. Numerous possible studies and long-term examinations on this plant's pharmacological effects, the identification of possible lead compounds, and the standardization of various plant sections to avoid adulteration are all possible. It has long been used as an adjuvant treatment for diabetes and to treat pain, worm infections, skin conditions, fever, diarrhea, and infertility. Breanna N. Lindler et al. (2020) this study provides overview of that 25% of Americans suffer from arthritis, a chronic illness. Two common types of arthritis that are linked to excruciating joint pain and a lower quality of life are osteoarthritis usage (OA) and rheumatoid arthritis (RA). When non-pharmacological therapy is not enough to manage. arthritis, a variety of pharmacological therapies may be used. We try to provide an

overview of the workings, safety, and effectiveness of herbal remedies for OA and RA in this article. Nine herbs were found among 23 clinical studies used to treat OA or RA patients after examining electronic databases. Improvement of OA and RA symptoms, pain, and inflammation was demonstrated. Ameen Jubber & Arumugam Moorthy (2021) this study provides information on arthritis and mainly on reactive arthritis. It is a form of inflammatory arthritis triggered by a remote antecedent infection, usually in the genitourinary or gastrointestinal tract. It is part of the spondyloarthropathy (spa) spectrum, an umbrella term for a group of distinct conditions with shared clinical features. The appropriate clinical setting, HLA-B27 can assist the diagnosis and act as a prognostic signal. While most individuals experience a self-limiting course, some require immunomodulatory medication in order to develop chronic spa. Kumudhini Akasapu & Ramagopal V. S. Uppaluri (2023), this paper is an overview of Nutritional Efficacy Based Vegetables Selection for the Development of Ready to Cook Soup Mix Formulations. As the vegetables are good source of nutrient, they read to cook food product from soup which contains various benefits like ease to prepare, accepted by wide range of people, effective utilization of vegetables, rich in nutrition. Analysis of soup mix and formulation soup mix method is studied, analysis like moisture content, yield and important nutritional characteristics such as antioxidant activity, total phenolic content, vitamin C, soluble protein and crude fiber in due course of heat treatments namely hot water blanching and tray drying was investigated in this paper. Rex M et al. (2020) is a review on Cissus quadrangularis L. as herbal medicine. The plant cissus is found in major parts of world. Carotenoids, flavonoids, ascorbic acid, and triterpenoids are all abundant in C. quadrangularis. Additionally, it is the most effective approach to treat a variety of illnesses, including diarrhea, intestinal problems, burns, hemorrhoids, leprosy, epilepsy, dyspepsia, and dysentery. The antibacterial, analgesic, antiulcer, antihelmintic, antifungal, antihemorrhoidal, and fracture-healing properties of C. quadrangularis are also present. Nidhi Joshi et al. (2020) this paper has done evaluation of Antioxidant Activity of Developed Instant Soup Mixes using Vegetable Leaf Powders from Unconventional Greens. This is carried out to formulate soup mixes using vegetable leaf. Two trial formulation of instant soup mix which has turnip, radish or carrot leaf powders as major components has carried out and its antioxidant activity using DPPH assay. carrot leaf powders did not reduce significantly after storage of two months. The antioxidant activity of ten commercially available soup mixes varied between 18.64 to 34.45% with the mean value of 25.21%. The three optimized soup mix formulations with or without the vegetable leaf powders showed a significantly ($p \leq 0.05$) higher antioxidant activity in comparison to the commercially available soup mixes.

Ilhami Gulcin et al. (2023) reviewed the use of natural antioxidants to combat oxidative damage in human metabolism and preserve fatty foods, highlighting the popularity of the DPPH assay for measuring antioxidant activity. The review discusses adaptations of the DPPH method, optimizations for higher activity, and the need for standardization in assay conditions. Despite technological advances, the basic DPPH method—mixing compounds with a DPPH solution and measuring absorbance—remains unchanged. Haripriya A & Aparna N V (2023) conducted a study on the effect of roasting on nutrient profile and functional properties of chia seeds (Salvia hispanica) and the optimization of a chia seed-based instant soup mix. Chia seeds are known for their anti-inflammatory, antioxidant, cancer-preventive, and anti-aging properties, and can enhance omega-3 fatty acid content in foods. This study investigated how roasting impacts the nutrient composition and functional properties of chia seeds. Additionally, a convenient instant soup mix was developed with chia seed powder incorporated at levels of 5%, 10%, and 15%. The sensory quality of the soup mix was evaluated by a semi-trained panel using a 9-point hedonic scale, showing that all samples scored similarly across sensory attributes. The study concluded that roasting affects the proximate composition of chia seed flour and demonstrates potential for creating nutritious instant soup mixes with chia seed incorporation. Rajesshwari Priya S & Haripriya A (2021) conducted a study to formulate and evaluate an instant soup mix enriched with microgreens. Microgreens, known for their vibrant color, taste, and high nutrient content, face the challenge of a limited shelf life, for which dehydration serves as a

preservation method. Through a consumer preference survey, mung bean and pea microgreens emerged as the most preferred, with high demand in snacks, chutney powders, and soups. The study used peas, mung beans, and mustard microgreens in a ready-to-cook soup mix at 10%, 20%, and 30% incorporation levels. Sensory evaluation by semi-trained panelists on a 9-point hedonic scale revealed that the mustard microgreen soup mix (10%) scored the highest in taste, appearance, and flavor. Mung bean microgreens at 30% incorporation also received favorable responses. The study concludes that microgreens can be a beneficial addition to instant soup mixes due to their nutritional value and consumer acceptability. G.K. Gomathi & S. Parameshwari (2022) developed and evaluated an instant soup mix using buckwheat, an underutilized pseudo-cereal with functional food potential. The study incorporated varying levels of gelatinized buckwheat flour (0-50%) into soup mixes, identifying 30% as optimal based on proximate, functional, and sensory analyses.

2. Methodology

Collection of raw materials that is drynaria rhizome and veld grape. Raw material should be clean from impurities and dirt. Washing and cleaning should be done in clean water and pat drying should be done. Peeling and cutting the rhizome should be done in uniform size and shape. Drying of rhizome is done in different temperatures until the sample achieves constant weight. Rhizome has been dried in 40, 50, 60 and 70 degrees Celsius. And estimating the suitable drying temperature that is 60 degrees. Drying of veld grape is carried out in 60 degrees. After drying our main components grinding into fine powder is carried out. After obtaining the powder in desired texture then soup mix formulation trials are done.

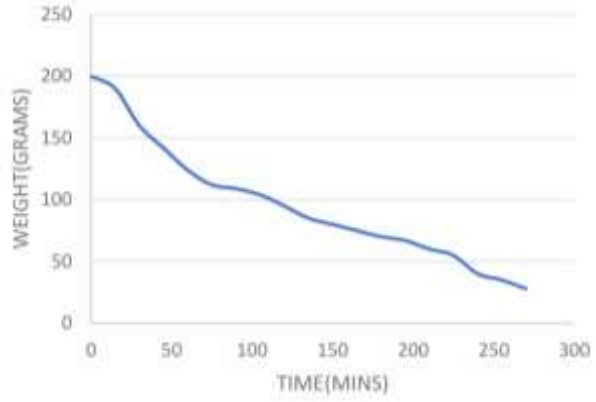
Figure 1. drynaria rhizome and veld grape

Figure 2. Raw materials after drying process.

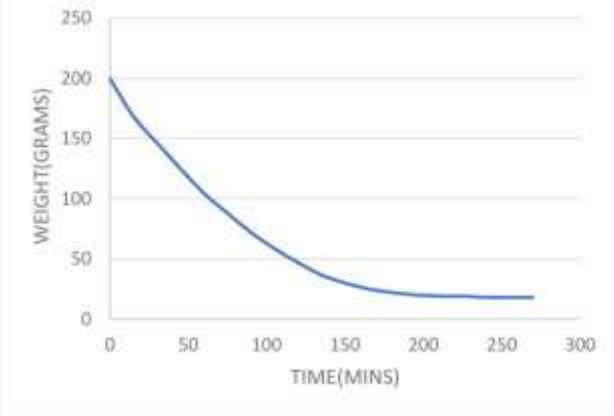
Figure 3. Powder obtained from the dried sample.

3. Drying of Oak Fern Rhizome:

Drying at 50ºC of drynaria rhizome found that the rhizome becomes darker in colour but not darker as 40ºc, which is caused due to long time exposure approximately 10 hrs. Initial weight taken for drying is 200g, the weight after drying final weight is 17g. Moisture content of rhizome dried at 50 degree is 9.07% and Water activity is 0.543aw. Drying at 60ºC of drynaria rhizome found that the rhizome powder becomes brown in color, which is acceptable colour and also with optimum smell. Initial weight taken for drying is 200g, the weight after drying final weight is 18g. Moisture content of rhizome dried at 60 degrees is 8.17% and Water activity is 0.425aw.

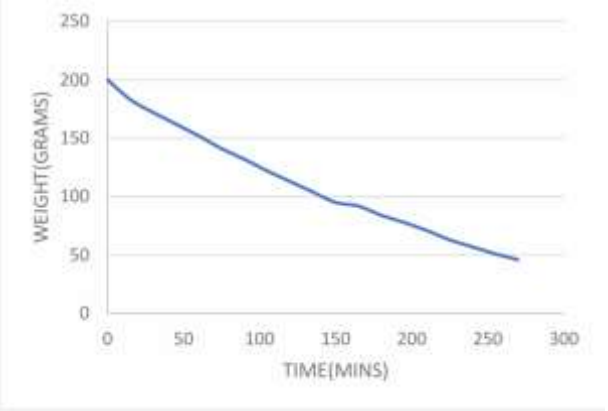


Graph 1. Drying of Oak Fern Rhizome at 50 ºC



Graph 2. Drying of Oak Fern Rhizome at 60 ºC

Drying at 70ºC of drynaria rhizome found that the rhizome powder becomes burnt color and unacceptable smell due to burnt condition of rhizome. Burnt smell color is due to high heat exposure. Initial weight taken for drying is 200g, the weight after drying final weight is 17g. Moisture content of rhizome dried at 70 degree is 8.04% and Water activity is 0.442aw.



Graph 3. Drying of Oak Fern Rhizome at 70 ºC

By Comparing different (40,50,60,70) drying temperature of drynaria rhizome it is found that 60 degree is suitable for optimum drying.

4. Formulation of Soup Mix

In developing an instant soup mix, four formulations were created to assess the impact of varying levels of these therapeutic ingredients on the soup's sensory and functional qualities. The control sample included the primary flavoring ingredients: tomato powder, onion powder, garlic powder, ginger powder, cumin powder, pepper powder, salt, and corn flour. As oak fern and veldt grape were gradually incorporated at 10%, 20%, 30%, and 40% levels, corresponding adjustments were made to other ingredients to balance the flavor, texture, and nutritional profile of each sample.

In the 10% oak fern formulation, slight reductions in tomato and corn flour allowed for the initial integration of therapeutic compounds, aiming to preserve the soup's original flavor while subtly enhancing its medicinal profile. With increased oak fern levels (20%, 30%, and 40%), further reductions in ingredients like tomato powder, onion powder, and corn flour balanced the flavor as the concentration of medicinal components increased, intensifying the functional benefits, especially for anti-inflammatory and bone-supportive properties. The S3 formulation, which contained the 30% oak fern concentration, prioritized medicinal efficacy and presented a more pronounced herbal flavor profile.

Table 1. Different Formulations

Ingredients	Control sample	S1	S2	S3	S4
Tomato Powder	30	25	24	21	18
Onion Powder	15	17	16	12	10
Garlic Powder	10	5	5	5	5
Ginger Powder	10	5	5	5	5
Cumin Powder	5	8	8	9	5
Pepper Powder	5	2	2	2	2

Pepper Powder	5	2	2	2	2
Veldt Grape	0	5	5	5	5
Oak Fern	0	10	20	30	40
Salt	5	5	5	2	2
Corn Flour	20	18	10	9	8
Total	100	100	100	100	100

5. Results and Discussion

Moisture Content of Soup Mix Samples

Among the samples, S3 formulation (9.22%) show optimal moisture content closest to the FSSAI standard, balancing both therapeutic benefits and moisture stability. The 10% sample's higher moisture may pose a slight risk for microbial activity and may require additional drying or packaging adjustments. Overall, the S3 sample stands out as it maintains a beneficial moisture level under 10%, aligning with FSSAI guidelines while maximizing the health benefits of oak fern and veldt grape.

Table 2. Moisture content

Sample	Moisture content (%)
Control sample	8.88
S1	10.73
S2	9.55
S3	9.22
S4	9.20

Water Activity of Soup Mix Samples

In the control sample, the water activity was measured at 0.519, indicating good stability. The S1 sample showed a slightly higher water activity of 0.572, nearing the upper limit of stability and suggesting a slightly increased potential for microbial activity. FSSAI generally recommends a water activity level below 0.60 for dried foods to minimize microbial risks. Among all samples, the S3 and S4 formulations exhibit the lowest water activity levels (0.515 and 0.509), making them the most favourable for long-term storage with minimal risk of microbial growth.

Table 3. Water Activity

SAMPLE	WATER ACTIVITY (a_w)
Control sample	0.519
S1	0.572
S2	0.524
S3	0.515
S4	0.509

Colour Analysis of Soup Mix Samples

The S3 sample achieved the highest lightness and yellowness values, potentially offering the most visually appealing balance for a consumer product. However, the color differences observed in S1, S2, and S4 indicate that increased oak fern concentrations may lead to darker, less vibrant colors, which could affect consumer perception based on visual appeal.

Table 4. Calorimeter Value

Column1	Control sample	S1	S2	S3	S4
L*	50.22	45.16	52	59.99	51.19
a*	17.83	11.2	10.88	12.71	11.35
b*	19.88	14.93	17.34	23.75	21.94

Proximate Analysis of Soup Mix Samples

The S3 and S4 formulations offer a far better nutritional profile, with higher levels of protein, fat, fiber, and minerals. These enhanced values make S3 and S4 ideal choices for consumers looking for a more nutrient dense, health-focused soup mix.

Table 5. Proximate Analysis Value

Samples	Protein(%)	Fat(%)	Fiber(%)	Ash(%)
Control sample	5.91	1.002	2.00	3.012
S1	6.543	2.705	4.887	4.99
S2	6.855	2.991	5.52	5.12
S3	7.891	3.571	5.621	5.89
S4	8.501	4.616	5.991	6.05

Comparison of S3 and Commercial Soup Mix Samples

The comparison between the S3 soup mix and the commercial sample highlights sample S3 superior nutritional and functional qualities. While the commercial soup has a lighter color, S3 stands out with a deeper red and yellow hue, suggesting a richer presence of beneficial compounds, likely due to the inclusion of veldt grape.

Table 6. Comparison of commercial Sample VS Sample 3

Samples	Protein (%)	Fat (%)	Fiber (%)	Ash (%)	Colour			Moisture Content (%)
					L*	a*	b*	
S3	7.891	3.57	5.62	5.892	59.99	12.71	23.75	9.22
Commercial	8.21	3.55	3.48	4.887	64.38	3.45	9.52	13.98

ANTI-OXIDANT ANALYSIS (DPPH ASSAY)

The antioxidant analysis (DPPH assay) of the S3 sample, which combines oak fern and veldt grape, demonstrated significantly higher free radical inhibition compared to the commercial sample

containing only oak fern. At a concentration of 12 ppm, the S3 formulation showed an inhibition rate of 59.8%, compared to 39.2% in the commercial sample. This marked increase in antioxidant activity is attributed to the addition of veldt grape, known for its potent bioactive compounds that enhance radical scavenging. These compounds contribute not only to antioxidant protection but also to anti-inflammatory and bone-healing properties, accelerating the recovery process for joint and bone-related health issues. This comparison highlights the S3 formulation's enhanced therapeutic potential, providing greater efficacy for individuals seeking natural healing support compared to standard commercial alternatives.

Table 7. Absorbance Value of S3 Sample

Obtained solution	Concentration	Absorbance	Inhibition
Control	0	0	-
1	4	0.112	48.8%
2	8	0.099	54.7%
3	12	0.088	59.8%

Table 8. Absorbance Value of Commercial Sample

Obtained solution	Concentration	Absorbance	Inhibition
Control	0	0	-
1	4	0.215	1.8%
2	8	0.167	23.7%
3	12	0.133	39.2%

6. Conclusion

In preparing a high-quality soup mix, careful attention was given to the drying process of the rhizome to retain its color, aroma, and nutrient profile. Drying was conducted at various temperatures—40°C, 50°C, 60°C, and 70°C—to determine the optimal conditions. Through this study, 60°C emerged as the ideal temperature for drying. At this temperature, the rhizome not only preserved its natural color and aroma but also maintained its essential nutrients better than at the other tested temperatures. Lower temperatures like 40°C and 50°C did not achieve adequate drying, which could affect shelf life, while higher temperatures, such as 70°C, resulted in nutrient degradation and loss of sensory qualities. Therefore, the rhizome dried at 60°C was selected for the formulation of the soup mix, ensuring that the final product is flavorful, visually appealing, and nutritionally beneficial. This choice of drying conditions enhances the overall quality and market value of the soup mix by providing an optimal balance of sensory and nutritional properties.

After analyzing the various formulations, Sample S3 emerges as the optimal formulation for the soup mix. With a balanced profile of high protein (7.891%), fat (3.571%), fiber (5.621%), and ash (5.892%) content, S3 stands out nutritionally. Additionally, its moisture content (9.22%) and water activity (0.515) are within desirable ranges for product stability, giving it better shelf life potential compared to the other formulations. The enhanced protein, fiber, and mineral (ash) content makes S3 particularly suitable for individuals seeking a nutrient-dense soup mix that also promotes bone health and anti-

inflammatory benefits. When compared to a commercially available soup mix, Sample S3 demonstrates several advantages. Although the commercial product has a slightly higher protein content, S3 contains more fiber and ash, providing a richer source of essential minerals and dietary fiber. The sample S3 has lower moisture and water activity values contribute to its enhanced shelf stability.

Reference

[1] Akasapu, K., & Uppaluri, R. V. S. (2023). Nutritional efficacy-based vegetables selection for the development of ready-to-cook soup mix formulations. Food Technology Journal, vol. 10, no. 4, pp. 56–64.
[2] Attawish, A. (2022). Subchronic toxicity of Cissus quadrangularis Linn. Songklanakarin Journal of Science and Technology, vol. 24, no. 1, pp. 39–51.
[3] Dhanalekshmi, U. M. (2021). Anti-arthritis activities of Drynaria quercifolia rhizome. International Journal of Phytomedicine, vol. 5, no. 1, pp. 23–31.
[4] Joshi, N. (2020). Evaluation of antioxidant activity of developed instant soup mixes using vegetable leaf powders. Journal of Food Processing and Preservation, vol. 44, no. 5, pp. 18–25.
[5] Jubber, A., & Moorthy, A. (2021). Clinical insights into arthritis with Drynaria quercifolia applications. Journal of Medicinal Plants Research, vol. 14, no. 2, pp. 112 119.
[6] Kamalakkannan, M. (2023). Overview of pharmacological uses of Drynaria quercifolia. Ethnobotany Research Journal, vol. 12, no. 1, pp. 20–29.
[7] Kour, K. (2023). Instant vegetable soup mix development with quality assessments. Food Science Research Journal, vol. 15, no. 3, pp. 115–122.
[8] Mani, K., (2020). Formulation and optimization of oak fern and veldt grape soup mix. International Journal of Food Sciences and Nutrition, vol. 8, no. 2, pp. 90–97.
[9] Rex, M. (2020). Cissus quadrangularis as herbal medicine: A review. Journal of Herbal Pharmacology, vol. 22, no. 4, pp. 56–67.
[10] Selvi, B. P. (2021). Phytochemical analysis of Drynaria quercifolia rhizome. Journal of Plant Sciences, vol. 5, no. 1, pp. 35–42.
[11] Singh, Y., & Prasad, K. (2021). Sorption isotherms of instant soup mixes under controlled environments. Cogent Food & Agriculture, vol. 6, no. 2, pp. 43–55.
[12] Sugumar, J. K. (2021). Development of a functional soup mix of Solanum nigrum. International Journal of Gastronomy and Food Science, vol. 9, no. 1, pp. 128 137.
[13] Surendar, J. (2020). Storage stability of Cissus quadrangularis for soup mixes. Journal of Agricultural Engineering and Food Technology, vol. 10, no. 4, pp. 141–149.
[14] Xun et al., (2020), Analysis of flavor-related compounds in four edible wild mushroom soups, Microchem. J., 159 (September), Article 105548.
[15] Modak, D. (2021). Validating potent anti-inflammatory and anti-rheumatoid properties of Drynaria quercifolia rhizome methanolic extract through in vitro, in vivo, in silico, and GC-MS-based profiling. BMC Complementary Medicine and Therapies, 21(1), 89. https://pubmed.ncbi.nlm.nih.gov/33711984/
[16] Jainu, M. (2020). Protective effect of Cissus quadrangularis on neutrophil mediated tissue injury induced by aspirin in rats. Journal of Ethnopharmacology, 104(3), 302 305. https://www.sciencedirect.com/science/article/abs/pii/S0378874105004220.
[17] Choudhary, N. (2021). Medicinal plants with potential anti-arthritic activity: A review. Journal of Intercultural Ethnopharmacology, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4488002/. 4(2), 147–179.
[18] Prasanna, G., & Chitra, M. (2021). In vitro antioxidant activity of Drynaria quercifolia L. rhizome. International Journal of Pharmaceutical Sciences and Research, 6(7), 3061–3066. https://ijpsr.com/bft-article/in-vitro-antioxidant-activity-of-drynaria quercifolia-l-rhizome/.
[19] Ramesh, N. (2020). Phytochemical and antimicrobial studies on Drynaria quercifolia. Fitoterapia, 72(8), 934–936. https://pubmed.ncbi.nlm.nih.gov/11731117/.
[20] Saravanan, S. (2020). Ameliorative effect of Drynaria quercifolia (L.) J. Sm., an ethnomedicinal plant, in arthritic animals. Food and Chemical Toxicology, 51, 356–363. https://pubmed.ncbi.nlm.nih.gov/23174524/