Anti Inflammatory Activity of Herbal Plants –A Review

K.Sathiya seelan[1], Dr. S. Swarnalattha[2], Ms. M.Suganya M.Pharm[3]
[1, 2, 3] Dept of Pharmacology
[1, 2, 3] Pallavan Pharmacy College,Kolivakkam,
Iyyengarkkulam, Kanchipuram-631502

Abstract- *Inflammation is a component of vascular tissues' complicated biological reaction to adverse stimuli such as infections, damaged cells, or irritants. It is distinguished by the presence of redness, swollen joints, joint discomfort, stiffness, and loss of joint function. NSAIDs are now used to treat inflammation. Unfortunately, these medications induce an increase inBlood clots pose a danger of causing heart attacks and strokes. As a result, the creation of strong antiinflammatory medicines derived from natural ingredients is now being considered. Because of their chemical variety, natural products are a great source for the discovery of novel medications. A natural substance derived from medicinal plants plays an important role in the treatment of various disorders connected with inflammation. The traditional medicine on the market for treating inflammation has a number of negative effects. Because of these adverse effects, there is a need for the development of novel medications with fewer or no negative effects. Hundreds of phytoconstituents have been claimed to exhibit several pharmacological actions, while the majority of these findings are of academic interest and just a handful make it into clinical trials. The purpose of this study is to compile data on potential phytochemicals from herbal plants that have been studied in inflammatory models using contemporary scientific methods.*

Keywords- Herbal medicine, NO, NSAIDs, Inflammation, Phytoconstituents.

I. INTRODUCTION

Inflammation is a natural, defensive reaction to tissue damage caused by physical trauma, toxic chemicals, or microbiological organisms. Inflammation is classified into two categories, which are as follows:

- **Acute inflammatory response :**

It is linked to increased vascular permeability, capillary infiltration, and leukocyte emigration.

- **Chronic inflammatory response** :

It is related with mononuclear immune cell infiltration, macrophages, monocytes, neutrophils, fibroblast activation, proliferation (angiogenesis), and fibrosis. Rheumatoid arthritis (RA) is a chronic debilitating autoimmune ailment (1) that affects roughly 1% of the population in developed countries(2). Local redness, swelling, discomfort, heat, and loss of function (3)are all classic indicators of inflammation. Nitric oxide (NO), a gaseous short-lived free radical, has been identified as a mediator of inflammation, and manipulation of NO production or activity leads in relief of acute inflammation and experimental arthritis(4,5). The enzyme Nitric Oxide Synthase produces NO by oxidising the terminal guanidine nitrogen atom of L-arginine (NOS). There are three primary isoforms of Nitric Oxide Synthase (NOS). Two constitutively produced NOS isoforms are calcium/calmodulin independent and are classed as constitutive NOS isoforms (cNOS). The third is cytokine-inducible, calcium/calmodulin-independent NOS (iNOS), which is controlled by a number of inflammatory mediators (6).

Increased NOS activity or NO release has been shown in both acute and chronic inflammatory model. Furthermore, Larginine, a precursor for NO production, enhanced paw edoema in adjuvant arthiritis(7). NSAIDS are among the most widely used medications in the world.

They are used to treat orthopaedic diseases such as osteoarthritis, soft-tissue injuries, and fractures, among others(8).

In the aforementioned circumstances, nonsteroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen and naproxen are employed. Glucocorticoids, such as cortisone and prednisone, are another family of medications.

However, in addition to their high prices, they are associated with significant adverse effects and toxicity, including an increased risk of infection in subgroups of patients receiving biological response modifiers such as tumour necrosis factor and alpha blocking medicines(9).

Current medications cause G.I ulceration and bleeding, renal damage, hypertension, and hyperglycemia. Aside from the aforementioned adverse effects, the major disadvantage of currently available powerful aynthetic medications is their toxicity and recurrence of symptoms after withdrawal.

As a result, screening and development of medications for anti-inflammatory action is critical, and numerous attempts are being made to identify anti-inflammatory pharmaceuticals from indigenous medicinal plants(10).

II. PLANT AS ANTI INFLAMMATORY AGENTS

Unlike current allopathic pharmaceuticals, which have singular active components that target a particular route, herbal remedies function through a symphonic approach.

A plant includes a plethora of distinct chemicals that work together to target certain aspects of the intricate biological system(11) .

For many years, medicinal plants have been a source of a wide range of biologically active substances, which have been widely employed as raw material or as pure compounds to treat a variety of illness conditions(12).

Because of the toxicity and side effects of allopathic treatments, the usage of herbal remedies is becoming more widespread.

Medicinal plants are crucial in the production of powerful medicinal medicines. Over 1.5 million traditional medicine practitioners use medicinal plants in preventative, promotional, and curative applications(13).

India, having the world's largest collection of medicinal plants, may continue to play a significant role in the manufacture of raw materials, either directly for crude medications or as bioactive chemicals in pharmaceutical and cosmetic formulations, etc(14).

Table: 1- Plants having anti-inflammatory potential

S.No	**Plant Name**	**Family**	**Plant Part**	**Type of Extract**
1	*Achillea millefolium*	Asteraceae	Whole Plant	Aqueous, alcohol
2	*Aconitum heterophyllum*	Valeraneaceae	Root	Ethanol
3	*Adhatoda vasica Nees*	Acanthaceae	Leaves	Methanol
4	*Adansonia digitata*	Malvaceae	Fruit	Aqueous
5	*Aegle marmelos*	Rutacae	Leaves	Ethylacetate and methanol
6	*Aloe vera*	Asphodelaceae	Leaves	Pet.ether, Ethanol
7	*Azardirachta indica*	Meliaceae	Leaves	Hydro-alchol
8	*Annona squamosa*	Annonaceae	Seeds	Ethanol
9	*Baccharis incarum*	Astereae	Whole plant	Ethanol
10	*Bacopa Monnieri*	Scrophulariaceae	Whole Plant	Ethanol
11	*Barleria prionitis*	Acanthaceae	Whole plant	Methanol
12	*Bonafousia sananho*	Apocyanaceae	Whole plant	Ethanol

13	*Boussingaultia gracilis*	Bassellaceae	Leaves, Stem and Bark	Aqueous
14	*Boswellia serrata*	Burseraceae	Resin	Methanol
15	*Bryophyluum pinnatum*	Crassulaceae	Leaves	Methanol
16	*Bursera simaruba*	Burseraceae	Leaves, Bark	Hexane, Ethanol
17	*Caralluma Thberculata*	Asclepiadaceae	Whole plant	Ethanol
18	*Cassia fistula*	Caesalpiniaceae	Leaves	Methanol
19	*Cassia obtusifolia*	Leguminosae	Leaves	Methanol
20	*Citrus auranticum*	Rutaceae	Fruit	Not indicated
21	*Commiphora mukul*	Burseraceae	Resin	Methanol
22	*Cordia ulmifolia*	Boraginaceae	Leaves	Pet.ether
23	*Curcuma longa*	Zingiberaceae	Rhizomes	Ethanol
24	*Daphne pontica*	Thymelaeaceae	Aerial Parts, Roots	Methanol
25	*Elephantophs scaber*	Compositae	Leaves	Pet.ether
26	*Emblica officinalis*	Euphorbiacea	Fruit	Ethanol and Aqueous
27	*Erythrospermum monticoloum*	Flacourtiaceae	Leaves	Methanol
28	*Garcinia mangostana*	Guttiferae	Fruit	Methanol
29	*Hammada elegans*	Chenopodiaceae	Aerial part	Ethanol
30	*Hedera rhombea*	Araliaceae	Leaves	Methanol
31	*Iberis amara*	Brassicaceae	Whole plant	Ethanol
32	*Kirkia acuminate*	Simaroubaceae	Leaves	Methanol
33	*Lantana camera*	Verbenaceae	Leaves	Pet.ether
34	*Lippia geminate*	Verbenaceae	Leaves	Pet.ether, Ethanol
35	*Lippia nodiflora*	Verbenaceae	Leaves	Pet.ether, Ethanol
36	*Lycopodium clavatum*	Lycopodiaceae	Aerial Parts	Chloroform extract, the alkaloid fraction
37	*Mangifera indica*	Anacardiaceae	Bark	Aqueous
38	*Marsdenia condurango*	Asclepiadaceae	Whole plant	Ethanol

39	*Mikania cordata*	Compositae	Root	Methanol
40	*Moringa olifera*	Moringaceae	Root, Flowers,	Methanol, Aqueous
41	*Paederia foetida*	Rubiaceae	Leaves	Methanol
42	*Palisota hirsute*	Commelinecea ae	Leaves	Aqueous
43	*Petiveria alliaceae*	Phytolaccacea e	Root	Ethanol
44	*Phyllanthus polyphyllus*	Euphorbiacea e	Whole plant	Ethanol
45	*Piper longum*	Piperaceae	Roots	Aqueous
46	*Piper ovatum*	Piperaceae	Leaves	Hydro alcoholic
47	*Pluchea indica*	Asteraceae	Root	Methanol
48	*Ricinus communis*	Euphorbiacea e	Roots, leaves	Methanol, pet ether
49	*Rheum australe*	Polygonaceae	Root	Pet.ether, Chloroform,
50	*Rubrus ellipticus*	Rubiaceae	Leaves	Ethanol
51	*Saussurea costus*	Asteraceae	Whole Plant	Methanol
52	*Sesbania sesban*	Leguminosae	Leaves and Bark	Methanol
53	*Sida cordifolia*	Malvaceae	Whole Plant	Water
54	*Sidium guajava*	Myrtaceae	Fruit	Methanol
55	*Swertia chirata*	Gnetaceae	Aerial part	Benzene
56	*T. buxifolium*	Rosaceae	Leaves, Stem	Methanol
57	*T. flavum*	Ranunculacea e	Leaves, Stem	Methanol
58	*T. micrantha*	Myrtaceae	Leaves	Ether, Ethanol
59	*Tinospora diversifolia*	Menispermea ceae	Aerial part	Aqueous
60	*Tuberaria lignose*	Cistaceae	Leaves	Hexane
61	*Thespesia populnea*	Malvaceae	Leaves and Barks	Oil
62	*Vinca rosea*	Apocynaceae	Leaves	Not indicated
63	*Visnea mocanera*	Theaceae	Leaves	Ethanol
64	*Vitex negundo*	Lamiaceae	Leaves	Alcohlic
65	*Xeromphis spina*	Compositae	Pulp	Ethanol
66	*Zanha Africana*	Sapindaceae	Root bark	Methanol

67	*Zingiber officinalae*	Zingiberaceae	Rhizome	Ethanol

***1.Emblica officinalis*: (Euphorbiaceae)**

Emblica officinalis is a tree that grows in the subtropical and tropical regions of China, India, Indonesia, and the Malay Peninsula. It has been utilised in these locations for anti-inflammatory and antipyretic properties. Recent research has discovered anti-inflammatory effects in the water fraction of methanol extract of plant leaves. The effects of fraction on the generation of inflammatory mediators such as leukotriene B4, platelet activating factor (PAF), and thromboxane were investigated. In low concentrations, the water portion of methanol extract hindered the migration of human PMN in relatively low concentration(15).

***2.Lycopodium clavatum* Linn : (Lycopodiaceae)**

Lycopodium clavatum, often known as club moss, has been shown to have wound healing properties. According to Orhan et al, using acetic acid-induced increase in capillary permeability assessment in mice, four extracts prepared with petroleum ether, chloroform, ethyl acetate, and methanol as well as the alkaloidal fraction from the aerial parts of Lycopodium clavatum revealed that only the chloroform extract and the alkaloid fraction displayed marked anti-inflammatory effect when compared to Indomethacin(16).

***3.Achillea millefolium* Linn: (Asteraceae)**

Achillea millefolium L. is a perennial plant native to Europe that is well-known in traditional medicine for its anti-inflammatory qualities. The herb has traditionally been used topically to heal wounds, burns, swelling, and irritated skin. According to research, two groups of secondary metabolites, isoprenoids and phenolics, contribute significantly to the anti-inflammatory characteristics(17). .Aqueous and alcoholic extracts of A. millefolium are used internally in traditional medicine to treat symptoms produced by suppression of arachidonic acid metabolism. Rutin, aspigenin-7-O-glucoside, and luteolin-7-Oglucoside are the three flavonoids found in the crude extract and concentrated in the flavonoid fraction. As an antiphlogistic medication, it is used to treat gastrointestinal and hepatobiliary problems. Sesquiterpenes have anti-inflammatory properties when used topically(18).

Fig 1:

Fig : 2

Fig : 3

***4. Ricinus communis* Linn: (Euphorbiaceae)**

Ricinus communis Linn. is found practically everywhere in the world's tropical and subtropical climates. The anti-inflammatory and free radical scavenging effects of a methanolic extract of Ricinus communis root were examined in Wistar albino rats by llavarasan et al. In a carrageenan-indexed hind paw edoema model, the methanolic extract demonstrated considerable anti-inflammatory action. By

reducing lipid peroxidation, the methanolic extract demonstrated considerable free radical scavenging activity. The presence of phytochemicals such as flavonoids, alkaloids, and tannins in the plant extract may explain the observed pharmacological action(19).

***5.Sida cordifolia* Linn: (Malvaceae)**

Sida cordifolia is a perennial subshrub in the Malvaceae family of mallows. It has spread over the world and is now classified an invasive species. Weed is found in Africa, Australia, the Hawaiian Islands, New Guinea, and French Polynesia(20). Sida cordifolia is used in traditional medicine to treat oral mucosal irritation, blenorrhea, asthmatic bronchitis, and nasal congestion(21,22). It has been studied as an anti-inflammatory, to limit cell proliferation, and to promote liver development(23,24).

6. *Thespesia:* (Malvaceae)

In southern India and Sri Lanka, the leaves and bark of Thespesia populnea are used to make oil for the treatment of fracture wounds and as an anti-inflammatory poultice used to ulcers and boils. Thespesia populnea ethanolic extract has anti-inflammatory effects in both acute and chronic settings. According to phytochemical research, the ethanolic extract of bark includes alkaloids, carbohydrates, proteins, tannins, phenols, flavonoids, gums and mucilage, saponins, and terpenes(25).

Fig : 4

Fig : 5

Fig : 6

7. *Daphne pontica* Linn. (Thymelaeaceae)

Since the second century AD, Daphne species have been thought to offer anti-cancer properties.Flavonoids components such as daphnodorins were identified from the roots of Daphne pontica, which has antitumor action. Several Daphne species have been used to treat inflammatory conditions. Daphne pontica has been used to alleviate rheumatic pain and inflammatory conditions. PGE2 and IL-1ß production is inhibited by the extracts(26).

***8.Garcinia mangostana* Linn. (Guttiferae)**

Garcinia mangostana fruit rinds have been used in traditional medicine to heal injuries and skin diseases. The xanthones, - and -mangostins are key bioactive componds discovered in mangosteen fruit hulls. The biological effects of xanthones are demonstrated by their inhibition of inducible nitric oxide synthase (iNOS) and cyclooxygenase-2 (COX-2). It has been observed that two mangostins reduce PGE2 levels by inhibiting COX-2 activity and NO generation. It has been found that -mangostin inhibits PGE2 release more effectively than histamine or serotonin(27).

***9. Adhatoda vasica*: (Acanthaceae)**

Adhatoda vasica L. is a native plant in the Acanthaceae family. The plant has been used as to treat colds, coughs, whooping cough, chronic bronchitis, asthma, sedative expectorant, antispasmodic, anthelmintic, rheumatism, and rheumatic painful inflammatory swellings. The medication is used in a variety of forms, including fresh juice, decoction, infusion, and powder. It is also available as alcoholic extract, liquid extract, and syrup(28). Alkaloids, tannins, flavonoids, terpenes, sugars, and glycosides are all found in this plant(29). The anti-inflammatory efficacy of ethanolic extract was tested in albino rats using carrageenan-induced paw edoema assay and formalin-induced paw edoema assay(30).

Fig : 7

Fig : 8

Fig : 9

10.*Corchorus aestuans* Linn: (Malvaceae)

The anti-inflammatory efficacy of a methanol extract of Corchorus aestuans aerial parts was tested using carrageenan-induced rat paw edoema. The increase in paw thickness was assessed after 1, 2, 3, and 4 hours of injection using a digital vernier calliper. A 200 mg/kg dosage of methanol fraction of plant aerial parts effectively suppressed acute phase inflammation(31).

11.*Crotalaria juncea* : (Fabaceae)

Crotalaria juncea seed oil (CJSPE) anti-inflammatory impact was evaluated by its influence on NO radical generation in isolated macrophages from rat peritoneal (in vitro technique); carrageenan-induced paw edoema rat model; and cotton pellet-induced granuloma formation in rat model (in vivo method). The CJSPE reduced carrageenan-induced rat paw edoema in a dose-dependent manner. Furthermore, CJSPE (200 mg/kg) demonstrated considerable (p0.001) anti-inflammatory action in the late phase of inflammation, with an effect equivalent to diclofenac sodium. CJSPE was also shown to be beneficial in reducing the size (48.55 0.244%) of granuloma development, with an impact that was virtually identical to that of diclofenac sodium(32).

12. *Cuminum cyminum:* (Apiaceae)

Cumin volatile oil was tested for antiinflammatory efficacy in carrageenan-induced rat paw oedema. When compared to the control group, the volatile oil reduced rat paw oedema at a dosage of 0.1ml/kg, ip. The activity was equivalent to that of diclofenac sodium, the conventional medication(33).

Fig : 10

Fig : 11

Fig : 12

III. CONCLUSION

Since ancient times, plants have played an important part in human health care. Traditional plants play an important role in the discovery of novel medications.

The majority of the world's population is impacted by inflammation-related diseases. Current analgesic medicines, such as opiates and NSAIDS, are thought to be ineffective in some circumstances because to side effects such as GIT irritation, liver failure, and other complications. A variety of immunosuppressive drugs have been developed based on their

COX-1 inhibition mechanism, however they have serious adverse effects when used long term.
To prevent the negative effects of COX-1 inhibitors, selective

COX-2 inhibitors were created. One of these inhibitors, however, has been linked to an increased risk of myocardial infraction and atherothrombotic events.

As a result, COX-2 inhibitors are unlikely to be useful in the treatment of chronic inflammatory illnesses such as rheumatoid arthritis50. Currently available medicines for rheumatoid arthritis are largely aimed at controlling pain or the inflammation associated with sinovitis.

Many botanical species have been used traditionally or as folk remedies to treat inflammatory diseases. Many of them have been scientifically examined and proven to be effective anti-inflammatory medicines.

Despite the many bioactivities of plant medicines against various illnesses, the active components of most plant extracts have not been adequately explained due to their complex combinations. However, polyphenils, flavonoids, terpenoids, alkaloids, anthraquinones, lignans, polysaccharides, saponins, and peptides have been reported to be active in the main chemical families of anti-inflammatory drugs derived from natural sources. According to the research so far, flavonoids are powerful anti-inflammatory agents.
Some of them are phospholipase inhibitors, while others have been claimed to be TNF-inhibitors in various inflammatory situations. Biochemical studies have also revealed that, depending on their chemical structures, flavonoids can block both the cyclooxygenase and lioxygenase pathways of arachidonic metabolism.

Berberine, for example, has been shown to have remarkable anti-inflammatory effect in alkaloids of the claimed skeletal type based on the pyridine ring system. Berberis is a traditional treatment for rheumatism. Terpenoids considerably slow the progression of chronic joint swelling. Terpenoids may influence many mechanisms related to inflammations caused by various etiological factors56.

However, many herbal remedies for inflammation and rheumatism have yet to be scientifically investigated. As a result, it is imperative that all such herbal medications explore determining their pharmacological activity, as well as isolating a specific item responsible for anti-inflammatory diseases.

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