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AN EXTENSIVE REVIEW OF THE ANTI-INFLAMMATORY PROPERTIES OF INDIAN SUB-CONTINENTAL WILD PLANTS

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ABSTRACT: Process by which your body's white blood cells and the things they make protect you from injury or infection from outside invaders, is known as inflammation. These days, inflammation is treated mostly with NSAIDs. Medications, raise the risk of blood clots, leading serious cardiovascular problems like heart attacks and strokes. Therefore, the research is currently being done to develop powerful anti-inflammatory medications using natural ingredients. The chemical diversity of natural products makes them an excellent source for creation of new drugs. An essential component for treatment of many inflammatory illnesses is a natural substance derived from medicinal plants. There are many drawbacks to the conventional medicine used to treat inflammation. These consequences necessitate the search for innovative drugs with minimal or nonexistent adverse effects. As per the reported studies numerous phytoconstituents have demonstrated a wide range of pharmacological effects, but these studies are of only scholarly interest. In current review, anti-inflammatory qualities of a few Indian wild herbs are reviewed.

INTRODUCTION: Living tissue will always react severely to damage of any form with inflammation. The warmth, pain, swelling and redness are the four primary signs of inflammation [1]. Any injury to the body causes the arterioles in the surrounding tissue to enlarge. This causes the region to have increased blood circulation (redness). Acute or chronic inflammations are both its types. Body suffers damage when there is ongoing inflammation because response is out of control.

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Primary enzyme responsible for production of prostaglandins, prostacyclins, and thromboxanes all are linked to inflammation, pain, and platelet aggregation is cyclooxygenase (COX) [2]. Despite their detrimental effects on the kidneys and stomach, (NASIDs & SAIDs) are currently most prescribed medications for the treatment of acute inflammatory illnesses [3]. The COX-1 and COX-2 enzymes are inhibited by these drugs. Prostaglandin production is aided by COX enzymes.

Since, NSAIDs, or SAIDs medications, have been around for a while, prolonged use of them may have negative side effects and harm the liver, gastrointestinal system, and other organs of the human body. Because of the unfavourable adverse effects, such as gastrointestinal damage, cardiovascular disease, renal failure, and stomach

lesions [4, 5]. A new anti-inflammatory medication that is effective, safe, nontoxic, or less toxic is now required. In many poor nations, the use of plant medicines in basic healthcare is rather significant. As per World Health Organization (WHO) 80% worldwide population is still primarily use medications made from plants. Many medicinal plants were used in Ayurveda, Siddha, and Unani medicine to heal human ailments [6].

Plants may create wide variety of phytochemical compounds called secondary metabolites. Phytochemicals have been effectively treats a variety of human illness. Over 20,000 species have been catalogued by the WHO in attempt to identify medicinal plant used globally. Most components of medicinal plants are used as basic medicines and have a range of therapeutic applications [7]. In conventional medicine, plants are used to treat infectious and chronic illnesses, and they also hold enormous promise for the development of novel pharmaceuticals [8]. In the current review, we investigate the anti-inflammatory qualities of some Indian medicinal plants.

Mechanism of the Inflammation: The inflammatory process starts when allergens, chemical irritants, infections, or injuries affect the body, prompting the production of chemical mediators from mast cells, platelets, neutrophils, macrophages, and lymphocytes. The production of these mediators, sometimes referred to as pro-inflammatory substances, occurs when phospholipase A aids in the transformation of membrane phospholipids into arachidonic acid. Prostaglandins (PGs), leukotrienes, and cytokines are produced from arachidonic acid in the presence of lipoxygenase and cyclooxygenase. Prostaglandins increase blood flow and dilate capillaries. Leukotrienes produce superoxide, cause degranulation, and aid neutrophil adhesion to vascular endothelial cells. TNF and other cytokines (IL-1 to IL8, IL-10 and IL-12) increase tissue damage, inhibit the spread of viruses, inhibit cell division, and increase the natural killer cells lytic activity.

The Mechanism by which Wild Plants Reduce Inflammation: The antiinflammation properties of medicinal plants include many pathways and constituents that help control and modify the inflammatory response. Below are main mechanisms anti inflammation.

Inhibition of Lipoxygenase: Leukotrienes are pro-inflammatory mediators that are produced from arachidonic acid by lipoxygenase. Inflammation is controlled by the inhibition of lipoxygenase in many plant sections [9].

Inhibition of Nitric Oxides: Many flavonoids found in plants prevent nitric oxide production from occurring. Free radicals called nitric oxides have been linked to the inflammatory process by cytokine-activated macrophages. We call them pro inflammatory mediators [10].

Inhibition of Cyclooxygenase: A multitude of compounds derived from wild plants suppress PGS synthesis by inhibiting COX-1 and COX-2. Inflammation is mediated by prostaglandins. PGS consist of four types: PGE2, PGI2, PGD2, and PGF2 [11].

PGS contribute to inflammation by inducing the characteristic signs of inflammation, namely pain, erythema, and edema. Increased permeability, vasodilation, and blood flow are causes of redness, edema. Pain arises from the influence of PGS on sensory neurons and central sites.

Inhibition of Phospholipase: Arachidonic acid is released from membrane lipid phospholipase. PGS are generated from eicosanoids, which are in turn formed from arachidonic acid. In order to alleviate inflammation, phospholipase inhibition is essential [12].

Inhibition of Pro-inflammatory Cytokines: Plant components that inhibit pro inflammatory cytokines may reduce inflammation. Signalling molecules known as pro-inflammatory cytokines are mostly produced by immune cells, namely T-cells and macrophages. Cytokines, such IL-1beta and IL-6, govern apoptosis in cells and T lymphocytes and cause inflammation. NF-alpha regulates the process of apoptosis by influencing many signalling pathways [13, 14].

Alterations in the Expression of Pro-Inflammatory Genes: The production of PGS, leukotrienes, and mediators including cytokines and chemokines depends on isomers of nitric

oxides, cyclooxygenase, and lipoxygenase, all of which have their gene expression altered by a variety of plant flavonoids [15]. **Table 1** listed the different mechanism of anti-inflammatory action observed in various wild plants discussed in this review article.

TABLE 1: MECHANISMS OF SEVERAL WILD PLANTS' ANTI-INFLAMMATORY EFFECTS

Wild Plant	Mechanism of Anti-inflammatory action by inhibition							
	TNF-α	COX-2	iNOS	NF-kB	PGE_2	NO	LOX	IL-1β
Aconitum heterophyllum					√			
Adhatoda vasica		√	√				√	
Bryophyllum pinnatum	√							√
Bacopa monnieri Linn.		√					√	
Achillea millefolium Linn.		√			√		√	
Lantana camara Linn.	√	√			√			
Cassia fistula L.		√		√				
Lycopodium clavatum Linn.			√	√		√		√
Garcinia mangostana Linn.		√	√		√	√		
Borago officinalis	√				√			
Ricinus communis Linn.	√			√				
Elaeagnus angustifolia	√							
Sesbania sesban Linn.	√							√
Sida cordifolia Linn.	√							√
Eupatorium adenophorum Spreng.	√	√						√

Anti-inflammatory activity of Wild plants: Traditionally, a number of traditional medical systems have used wild plants for their anti inflammatory property. These plants contain bioactive substances that reduce inflammation and its related effects. **Table 2** presents a compilation of prevalent medicinal wild plants characterized by anti-inflammatory qualities, specifying the used portions and their mechanisms of action.

TABLE 2: ANTI-INFLAMMATORY ACTIVITY OF SOME WILD PLANTS IN INDIA

S. no.	Plant Name	Family	Plant part	Extract to be used
1.	*Aconitum heterophyllum*	Valeraneaceae	Roots	Ethanol
2.	*Bryophyllumpinnatum*	Crassulaceae	leaves	Methanol
3.	*Adhatodavasica*	Acanthaceae	leaves	Methanol
4.	*Bacopa monnieri Linn.*	Scrophulariaceae	Whole plant	Ethanol
5.	*Achillea millefolium Linn.*	Asteraceae	Whole plant	Alcohol, Aqueous
6.	*Lantana camara Linn.*	Verbenaceae	Leaves, bark, stem, roots	Aqueous, Methanol, ethanol
7.	*Cassia fistula L.*	Caesalpiniaceae	leaves	Methanol
8.	*Lycopodium clavatum Linn.*	Lycopodiaceae	stems, leaves, petioles, flowers, fruits, and seeds	Alkaloid fraction by chloroform
9.	*Garcinia mangostana Linn.*	Guttiferae	Fruits	Methanol
10.	*Borago officinalis*	Boraginaceae	leaves, flowers, seeds, and roots	Borago oil (by Hydro-distillation), methanol extract and alkaloids
11.	*Ricinus communis Linn.*	Euphorbiaceae	Roots, leaves	Methanol,
12.	*Elaeagnus angustifolia*	Elaeagnaceae	Fruits, leaves	Methanol, Aqueous
13.	*Sesbania sesban Linn.*	Leguminosae	Leaves	Methanol, chloroform and Hexane extract
14.	*Sida cordifolia Linn.*	Malvaceae	Whole plant	Methanol, Ethyl acetate extract
15.	*Eupatorium adenophorum Spreng.*	Asteraceae	Whole plant	Essential oil (by Hydro-distillation), ethanol, Aqueous

***Aconitum heterophyllum* (Valeraneaceae):** *Aconitum heterophyllum* (Valeraneaceae) frequently referred to as "Ativisha" or “Patis" in Ayurveda. Used to treat rheumatism, fever, and problems of the digestive and neurological systems. The root of *A. heterophyllum* contains sterols, alkaloids, flavonoids, and glycosides in its ethanolic extract. Plants containing these chemical classes have significant anti-inflammatory properties *via* inhibiting prostaglandin pathways.

Cotton pellet granulomas are frequently used to evaluate the transudative and proliferative aspects of 1chronic inflammation. There is a correlation between the amount of saturated cotton pellets and quantity of granulomatous tissue. It has been shown that *A. heterophyllum* extract causes a dose-dependent decrease in mass of wet cotton pellets. Extract also exhibits an anti-inflammatory activity comparable to diclofenac sodium at higher doses. According to published research, *A. heterophyllum's* ethanolic root extract may reduce sub-acute inflammation by interfering with the metabolism of arachidonic acid [16].

FIG. 1: *ACONITUM HETEROPHYLLUM* (VALERANEACEAE)

***Adhatoda vasica* (Acanthaceae):** The natural plant family Acanthaceae includes *Adhatoda vasica* L. For thousands of years, the plant used as herbal medicine for rheumatism, whooping cough, colds, asthma, chronic bronchitis, sedative expectorant, antispasmodic, and anthelmintic. It has also been used to treat painful inflammatory swellings linked to rheumatism. The medication is used in powder, decoction, infusion, and fresh juice forms. Additionally, it is offered as a liquid extract or syrup and as an alcoholic extract [17]. This plant contains terpenes, sugars, glycosides, alkaloids, tannins, and flavonoids. In albino rats, the 4anti-inflammatory efficacy of ethanolic extract has been assessed using the carrageenan induced paw edema test and the formalin-induced paw edema assay. Ethanolic extract of *Adhatoda vasica* decreased paw edema brought on by formalin and carrageenan in a dose dependent manner [18].

FIG. 2: *ADHATODA VASICA* (ACANTHACEAE)

***Bryophyllum pinnatum* (Crassulaceae):** Ojewole *et al.* investigated the anti-inflammatory qualities of *Bryophyllum pinnatum.* In experimental animal models, study looked at plant leaf aqueous extract's anti-inflammatory qualities. Diclofenac 100 mg/kg was administered to the patients in this investigation, which used a fresh egg albumin-induced pedal oedema paradigm. *Bryophyllum pinnatum* leaf aqueous extract appears to have anti-inflammatory properties, according to findings of this study conducted on experimental animals. The plant's well-known anti-inflammatory qualities are thought to be attributed in part to its different flavonoids and polyphenols, which are chemical components [19].

FIG. 3: *BRYOPHYLLUM PINNATUM* (CRASSULACEAE)

***Bacopa monnieri Linn*. (Scrophulariaceae):** Once used as a brain tonic, *Bacopa monnieri* L. is a creeping, glabrous, succulent plant that roots at nodes and grows well in marshes and muddy beaches [20]. The plant is utilized in Pakistan and India as a digestive aid, cardiotonic, and to improve respiratory function when bronchoconstriction occurs [21]. When carrageenan is used to generate rat paw edema, the plant exhibits anti-inflammatory qualities that reduce edema by 82% when compared to indomethacin. *Bacopa monnieri* also markedly decreased the activities of 5-lipoxygenase (5-LOX), 15-lipoxygenase (15-LOX), and COX-2 [22]. *Bacopa monnieri* has considerable anti-inflammatory properties that may contribute to its efficacy in treating numerous inflammatory disorders in traditional medicine [23]. Triterpenoid and bacoside chemicals present in *Bacopa monnieri* are thought to be responsible for the plant's anti-inflammatory qualities. Tumor necrosis factor-alpha and interleukin-6 production of pro inflammatory cytokines was inhibited by the

fractions containing tri-terpenoids and bacosides. Peritoneal exudate cells and peripheral blood mononuclear cells stimulated by lipopolysaccharide were used in the *in-vitro* experiment. *Bacopa monnieri* controls the release of proinflammatory mediators, which has the ability to reduce inflammation [24].

FIG. 4: *BACOPA MONNIERI LINN.*

***Achillea millefolium Linn.* (Asteraceae):** Native to Europe, *Achillea millefolium* L. is a perennial plant that is prized in traditional medicine for its anti-inflammatory qualities. The herb has long been applied topically to burns, wounds, and skin that is irritated or swollen. Research indicates that the anti-inflammatory qualities are mostly attributed to two groups of secondary metabolites, namely phenolics and isoprenoids [25]. Traditional medicine uses *A. millefolium* aqueous and alcoholic extracts for its anti-inflammatory and internal therapy of gastrointestinal and hepatobiliary disorders. Because sesquiterpenes prevent arachidonic acid from being metabolized, they are believed to have anti-inflammatory properties. The flavonoid component of the crude extract contains three flavonoids: rutin, apigenin-7-O-glucoside, and luteolin-7-O-glucoside. The crude plant extract and two fractions containing greater concentrations of flavonoids and dicaffeoylquinic acids inhibit human neutrophil elastase and matrix metalloproteinases, which have been linked to anti-inflammatory properties in *in-vitro* research [26].

FIG. 5: *ACHILLEA MILLEFOLIUM LINN*. (ASTERACEAE)

***Lantana camara Linn*. (Verbenaceae):** Many lantana species' aerial parts are widely employed in conventional cancer and tumor therapies. Leaves and flowers was used to alleviate fever, influenza, and stomach pain. Additional applications of the plant demonstrate anti-malarial, anti-bacterial, and anti-diarrheal properties.

Research has shown that the aqueous extract of *Lantana camara* leaves is a very safe and efficient way to treat hemorrhoids. The aqueous extract of *Lantana camara* leaves has demonstrated notable analgesic, anti-inflammatory, and anti-hemorrhoidal properties [27].

FIG. 6: *LANTANA CAMARA* LINN. (VERBENACEAE)

According to Suthar *et al.*, the lead compound 14 (3b, 22b-Di (2-(2-(2,6-dichlorophenyl amino)

phenyl) acetoyloxy)-olean12-en-28-oic acid) obtained from the leaves of *Lantana camara* L. may prevent TNF-a-induced activation of NF-kB by blocking IKK activation and IkBa degradation. Additionally, compound 14 inhibited the NF-kB-regulated synthesis of the proteins cyclin D1, which controls proliferation, and COX-2, which regulates inflammation. Compound 14 demonstrated a dose-dependent decrease in A549 lung cancer cell growth [28]. Early phytochemical screening revealed the presence of flavonoids and triterpenoids in the methanolic extract of *Lantana camara* Linn. Flavonoids are recognized for their ability to target prostaglandins implicated in acute inflammation [29].

A significant correlation exists between inflammation and cancer, indicating that inflammation may contribute to the development of cancer [30]. A nuclear component the major target NF-kB, which regulates inflammation and prevents apoptosis, is primarily overexpressed in cancer cells [31]. Similarly, COX-2, an inducible form of cyclooxygenase, serves as a mediator between cancer and inflammation. The anomalous activation of COX-2 has been linked with the development of several cancers. COX-2 facilitates the catabolism of arachidonic acid, yielding a variety of prostaglandins that serve as essential mediators of inflammatory reactions [32].

Wu *et al.* evaluated the anti-inflammatory qualities of 10 *Lantana camara* L. isolates in a different in vitro study by calculating the suppression of nitric oxide release in a BV-2 cellular model produced by lipopolysaccharide. In this model, all isolates showed anti-inflammatory properties, however IC_{50} values below 40 μM indicated increased activity for Lantrieuphpene B, Lantrieuphpene C, and 19α-hydroxyoleanonic acid [33]. At doses of 100, 200, and 400 mg/kg body weight, the ethanol extract of *Lantana camara* L. leaves demonstrated significant anti-inflammatory and COX-2 inhibitory activities ($p<0.05$). The presence of active phytoconstituents, such as flavonoids, in *Lantana camara* L. leaves may be responsible for their anti-inflammatory qualities. Previous research suggests that different flavonoid subclasses may affect different stages of inflammation [34]. In rat paw pouch exudate cells, quercetin, a flavanol, was demonstrated to inhibit the synthesis of COX-2 mRNA, indicating that its anti-inflammatory properties could be partly explained by inhibiting COX-2 up-regulation [35]. The mice treated with bark and leaves extract exhibited a substantial decrease in paw volume produced by Carrageenan at doses of 100 and 200 mg/kg ($P<0.01$ and $P<0.05$) compared to the standard group, starting from 2 hours post-treatment. Both extracts demonstrated anti-inflammatory effects for up to 5 hours at both dosages. In comparison to the control group, the indomethacin, leaves, and bark extract at both doses showed a significant ($P<0.01$ and $P<0.05$) reduction in histamine-induced paw edema from 2 hours forward. The extract treatment decreased inflammation in a dose-dependent way [36]. At both doses, both extracts showed anti-inflammatory effects for up to five hours. The extract showed anti-inflammatory properties that were dose-dependent.

Millycent *et al.* administered 25, 50, and 100 mg of aqueous plant extracts to Swiss Albino mice and observed that all dosages demonstrated a significantly significant reduction in edema. White blood cell infiltration in the pleural fluid was significantly reduced by the herb's 25 mg and 100 mg doses. The dose of 50 mg had no effect [37]. According to this study, carrageenan, like diclofenac, decreased the development of pleurisy and edema by the fourth hour [37]. Thus, it may be concluded that the decrease in COX activity may have inhibited both processes. However, it is also possible that it worked by preventing the movement of white blood cells. The roots methanolic extract at 200 and 400 mg/kg body weight effectively and dose-dependently reduced the mean paw volume increased by carrageenan. At four hours, the greatest percentage inhibition of the methanol extract at 200 and 400 mg/kg bodyweight, respectively, was 35.92 and 46.80%. On the other hand, standard (Diclofenac, 50 mg/kg body weight) concurrently shown very strong inhibition [38]. Paw edema was reduced in another trial using a methanolic extract of *Lantana camara L.* leaves at all doses. Nevertheless, *Lantana camara L.* extract shows superior anti-inflammatory action and an effective dosage of 1500 mg/kg BW.

***Cassia fistula L.* (Caesalpiniaceae):** The *Cassia fistula* is one of the most prevalent trees in Indian woods. Rheumatism, anorexia, jaundice,

inflammatory diseases, and skin disorders can all be treated using the plant's full medicinal properties. *Cassia fistula* bark extracts show potent anti-inflammatory effects in both the acute and chronic anti-inflammatory models of rat inflammation. Pathophysiology of several diseases, including diabetes, cancer, atherosclerosis, arthritis, and aging, is associated to endogenous and external reactive oxygen species (ROS). The genesis of inflammatory diseases depends heavily on ROS. The main anti-inflammatory substances found in *Cassia fistula* are flavonoids and bio-flavonoids [39].

FIG. 7*: CASSIA FISTULA L.* (CAESALPINIACEAE)

***Lycopodium clavatum Linn.* (Lycopodiaceae):** It has been shown that club moss, or *Lycopodium clavatum*, is effective in healing wounds. Only the alkaloid fraction and the chloroform extract, which were extracted from the aerial portions of *Lycopodium clavatum*, had substantial anti-inflammatory benefits when compared to Indomethacin, according to the study conducted by Orhan *et al.* This was assessed by measuring the capillary permeability caused by acetic acid in mice. Petroleum ether, chloroform, ethyl acetate, and methanol were the other four extracts [40].

FIG. 8: *LYCOPODIUM CLAVATUM* LINN. (LYCOPODIACEAE)

***Garcinia mangostana* Linn. (Guttiferae):** In traditional medicine, traumas and dermatological conditions have been treated using *Garcinia mangostana* rinds. The main bioactive ingredients found in mangosteen fruit hulls are xanthones called α- and γ-mangostins. The xanthones demonstrate their biological effects by inhibiting cyclooxygenase-2 (COX-2) and inducible nitric oxide synthase (iNOS). It has been demonstrated, two mangostins lower prostaglandin (PGE2) levels by preventing production of nitric oxide and COX-2. α-Mangostin suppresses PGE2 release more strongly than either serotonin or histamine [41].

FIG. 9: *GARCINIA MANGOSTANA* LINN. (GUTTIFERAE)

***Borago officinalis*:** *Borago officinalis* is often referred to as starflower. It is a perennial herbaceous blooming plant. It is a member of the Boraginaceae family. Its anti-inflammatory qualities make it very effective in treating dermatitis, bronchitis, and arthritis. Principal ingredients demonstrating strong amoebicidal and anti-inflammatory effects include alkaloids, methanol extract, and borage oil. This plant's seeds provide the oil, which has strong anti-inflammatory qualities. Oil contains the omega-6 fatty acid gamma-linolenic acid, or GLA [42].

Gamma linoleic acid inhibits production of PGS and leukotrienes, a family of pro-inflammatory mediators derived from arachidonic acid. Moreover, it suppresses cyclooxygenase-2, an enzyme that contributes to inflammation. Tumor necrosis factor alpha is reduced by gamma linoleic acid, which inhibits the inflammatory process. Tumor necrosis factor alpha is one of the proteins implicated in inflammation. Because it may result in miscarriage, it should not be taken when pregnant [43].

FIG. 10: *BORAGO OFFICINALIS*

***Ricinus communis Linn.* (Euphorbiaceae):** *Ricinus communis Linn.* is found in tropical and subtropical areas all over the world. Ilavarasan *et al.* investigated the anti-inflammatory and free radical scavenging capabilities of a methanolic extract of *Ricinus communis* root in Wistar albino rats. The methanolic extract showed notable anti-inflammatory efficacy in the carrageenan-induced hind paw edema model. The methanolic extract demonstrated strong free radical scavenging action by lowering lipid peroxidation. Phytochemicals including flavonoids, alkaloids, and tannins found in plant extracts may be the source of the pharmacological action that has been seen [44].

FIG. 11: *RICINUS COMMUNIS LINN.* (EUPHORBIACEAE)

***Elaeagnus angustifolia*:** A member of the Elaeagnaceae family, *Elaeagnus angustifolia* is found throughout the world, from the Himalayas to northern Asia and Europe. Because of its potent anti-inflammatory properties, fruit and extract of *Elaeagnus angustifolia*, includes glycosides, terpenoids, flavonoids, used to treat inflammation in both its forms [45]. It is the most effective treatment for asthma, rheumatoid arthritis, and dermatitis. It has an anti-inflammatory effect by reducing pro-inflammatory cytokines. It has antinociceptive and anti-ulcerogenic properties [46].

FIG. 12: *ELAEAGNUS ANGUSTIFOLIA*

***Sesbania sesban Linn.* (Leguminosae):** The genus *Sesbania sesban* has around 50 species, mostly annuals. Africa has the highest species diversity, including 33 species. While annual species have garnered attention, subsequent studies have concentrated on perennial species. Among all perennial plants, *Sesbania sesban* has shown promise [47]. This little perennial tree has elongated pods, yellow blooms, and woody stems [48]. According to published research, terpenoidal and steroidal saponins, tannins, and flavonoids, all have been demonstrated anti-inflammatory qualities were among the many components found in the phytochemical study of crude saponin extract [49]. Prevention of carrageenan-induced edema by crude saponin extract was shown. The crude saponin extract has effectively regulated the escalation of paw edema in both the initial phase and later hours by inhibiting the production of prostaglandins. Therefore, it can be said that current anti-inflammatory action of crude saponin extract may result from its effects on both the early and late phases of inflammation [50].

FIG. 13: *SESBANIA SESBAN* LINN. (LEGUMINOSAE)

***Sida cordifolia Linn*. (Malvaceae):** A perennial subshrub, *Sida cordifolia* belongs to the Malvaceae family. It is currently regarded as an invasive weed in French Polynesia, Australia, New Guinea, Hawaii, and Africa. It has spread around the world. In conventional medicine, *Sida cordifolia* is used to treat nasal congestion, blennorrhagia, asthmatic bronchitis, and oral mucosal irritation [51]. It has been examined for its anti-inflammatory properties, its role in inhibiting cell proliferation, and its capacity to promote liver expansion [52-54].

FIG. 14: *SIDA CORDIFOLIA LINN.* (MALVACEAE)

***Eupatorium adenophorum Spreng*. [*Ageratina adenophora* (Spreng.)]:** *Eupatorium adenophorum* Spreng (EAS) is a member of the Asteraceae family and is semi-shrub. Originating in Mexico and Central America, EAS is well known for its invasive traits, spreading rapidly and causing significant ecological damage worldwide [55]. There are various recognized applications of EAS in traditional medicine, including the treatment of wounds, diabetes, inflammation, fever, jaundice, and dysentery [56-58]. In recent years, a large number of studies have been carried out to outline the pharmacological and chemical characteristics of EAS. Numerous phytochemicals have been found and isolated, such as phenolics, triterpenes, sesquiterpenoids, flavonoids, coumarins, steroids, and phenylpropanols. The many biological activities of EAS extracts, including as their anti-inflammatory, anti-bacterial, anti-cancer, wound-healing, analgesic, and antipyretic qualities, have been highlighted by recent pharmacological study [59-61].

FIG. 15: *EUPATORIUM ADENOPHORUM SPRENG*

Chakravarty *et al.* discovered that ethanolic leaf extract of EAS has anti-inflammatory effect by inhibiting IL-1β and COX2 genes, as well as neutralizing reactive oxygen species such as hydroxyl radicals. A pro-inflammatory cytokine called TNF-α is also produced in tandem with EAS. Only the role of TNF-α in tissue repair following inflammation may explain this paradox. In addition, EAS induces the production of the TGF-β gene, which codes for the cytokine involved in growth and repair pathways. The efficacy of EAS as a source of anti-inflammatory agents merits reporting. The active ingredient in the extract has not yet been identified. The isolation of that chemical will facilitate the comprehension of the molecular mechanism behind the substance's function [62]. Zhang *et al.* have revealed the existence of many flavonones and sesquiterpene lactones in *E. adenophorum* [63].

Zheng Qiang *et al.* made a significant finding in their work by LC–MS/MS analysis, identifying 222 chemical compounds in the EAS-Aqueous extract (EAS–AE). Among the ten most prevalent chemical molecules identified in (EAS–AE), several compounds have antioxidant properties, including gentianic acid, procaine, and L-tyrosine. Moreover, some compounds in (EAS–AE) have anti-inflammatory characteristics, such as gentianic acid, loratadine, and 4-hydroxycoumarin. Additionally, a number of compounds in (EAS–AE), such as 4-hydroxycurcumin, hydroquinone, and gentianic acid, have antibacterial qualities. According to these findings, (EAS–AE) demonstrates a wide range of biological roles and has promise for further development [64].

CONCLUSIONS: Plants have been integral to human healthcare since antiquity. Conventional

plants play an important part in the creation of new medications. The vast majority of people on the planet suffer from diseases linked to inflammation. Because of its side effects, which include hepatic impairment and gastrointestinal discomfort, among others, current analgesic medications such as opiates and NSAIDs are deemed useless in some situations. This review examines the capacity of wild plants to elicit anti-inflammatory effects by addressing stages of inflammatory process. Research on plants with anti-inflammatory properties is a relatively recent area in contemporary biomedicine. It is still necessary to do further study on plants that have anti-inflammatory properties. Their valuable findings may elucidate the medicinal potential of plants that have not been adequately explored in this context.Research in this field is currently under progress and might advance our knowledge of natural anti-inflammatory medications and their medical applications.

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