

REVIEW OF ETHNOMEDICINAL PLANTS WITH ANTI-ARTHRITIC POTENTIAL FOR RHEUMATOID ARTHRITIS

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ABSTRACT

Traditional medicinal herbs are utilized globally for the treatment of many acute and chronic ailments. The formulation of herbal products offers numerous benefits, including enhanced affordability, increased acceptability, and diminished negative effects. Arthritis ranks as the second most prevalent disease globally with India accounting for 22-39 percent of the overall incidence. Rheumatoid Arthritis is a systemic autoimmune disorder marked by persistent inflammatory states. The manifestations of rheumatoid arthritis include discomfort, oedema, rigidity and degradation of cartilage and bone. The etiology of rheumatoid arthritis remains unclear however the release of metabolic intermediates such as interleukins (IL) and tumor necrosis factor-alpha (TNF α) from T-cells which produce growth factors, cytokines, and adhesive molecules on immune cells, leads to inflammation and tissue destruction. Numerous medicinal plants in tribal and rural regions have been employed for the treatment of rheumatoid arthritis and present a prospective avenue for the development of an anti-arthritis drug with minimized adverse effects. This review concentrated on ethnobotanical medicinal plants exhibiting anti-arthritis properties throughout many global locations. This review sought to examine numerous medicinal plants and their separated active compounds that exhibit anti-arthritis properties supported by scientific evidence and concluded that herbal medicine represents a promising field for the development of anti-arthritis drugs.

KEYWORDS: Rheumatoid arthritis, Anti-arthritis activity, ethnobotanical medicinal plants, inflammatory autoimmune disorder.

1. INTRODUCTION

Medicinal herbs are extensively utilized for the treatment of rheumatism and various ailments.^[1-7] Most individuals rely on these plants and trees for their existence and well-being. Forest communities are considered adherents of traditional medicine for their basic health needs.^[8-9] The treatment of numerous inflammatory illnesses is achieved by the use of

certain medicinal herbs. The World Health Organisation (WHO) states that 80% of the global population relies on traditional medicine for common ailments. The reliance of individuals on traditional medicines is rising daily and it also mitigates the adverse effects of contemporary pharmaceuticals. Rheumatism is a prevalent autoimmune disorder characterized by the immune system's attack on healthy tissue and inflammation. Rheumatism is a chronic and severe condition that results in joint pain, swelling, stiffness, redness, and tenderness upon palpation. Approximately 180 million individuals in India are afflicted with rheumatic discomfort. In India, traditional medicinal knowledge is transmitted between generations. Numerous recognized herbs are utilized for antirheumatic discomfort by indigenous groups including the Naikpods, Koyas, and Gonds. The principal symptoms of rheumatoid arthritis include impaired mobility and pain, primarily experienced in the morning. The condition is identified and a physician or consultant provides treatment. While there is no definitive cure for rheumatism. Many medicines can effectively halt or decelerate disease progression. An individual afflicted with rheumatism loses the capacity to do tasks and attend to personal care. [11] Rheumatism does not refer to a specific ailment rather, it encompasses approximately 100 distinct conditions. Rheumatism, commonly referred to as 'regional pain syndrome' or 'soft tissue rheumatism,' describes the condition. Rheumatic disorders impact the joints, tendons, ligaments, bones, and muscles. It is occasionally referred to as a musculoskeletal disorder. The predominant symptoms include joint discomfort, restricted range of motion in joints, and inflammation characterized by swelling, redness and warmth in the affected area.

2. METHODOLOGY

Various key phrases, including “Indian traditional Rheumatism,” “ethnorheumatism,” “ethnobotany,” “Rheumatism,” “Ayurveda Rheumatism,” and “pharmacological activity,” were utilized in online search engines and databases such as Google Scholar (<https://scholar.google.com/>), ResearchGate (<https://www.researchgate.net/>), PubMed (<https://pubmed.ncbi.nlm.nih.gov/>), Scopus, and NISCAIR Online Periodicals Repository (NOPR) (<http://nopr.niscair.res.in/>), thereby employing the relevant databases and keywords. This study exclusively covered papers published in English from 2000 to October 2024 Fig. 1. A total of 1123 studies were included following an initial screening of 483 published papers. Based on data acquired from several online search engines, we developed numerous significant discoveries. Table 1 delineates plant species utilized in traditional medicine for rheumatism ailments in India.

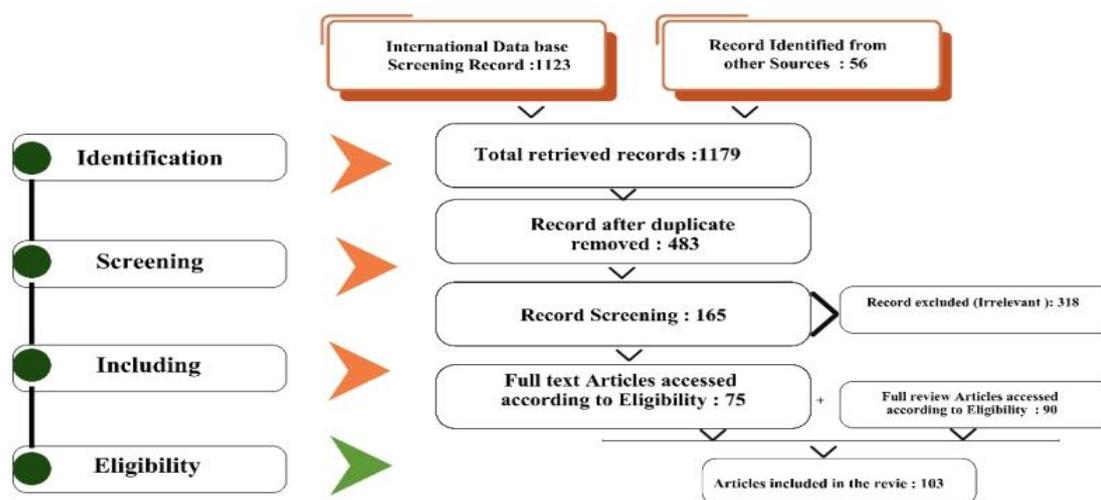


Figure 2: Screening research and review articles for the composition of review papers from 2000 to 2024.

3. Rheumatoid arthritis (RA)

3.1. Causes

Arthritis entails the degeneration of cartilage. Cartilage typically safeguards a joint and facilitates smooth movement. The procedure induces an inflammatory reaction in the synovial tissue (sinusitis) due to hyperplasia of synovial cells, surplus synovial fluid, and the formation of pannus in the synovial membrane. The disease process frequently results in the degradation of articular cartilage and joint alkalosis. Rheumatoid arthritis may induce widespread inflammation in the lungs, pericardium, pleura and sclera, as well as nodular lesions, predominantly in subcutaneous tissue. The aetiology of rheumatoid arthritis remains unidentified however, autoimmunity is crucial to its chronicity and progression, categorizing RA as a systemic autoimmune disorder Fig. 2.

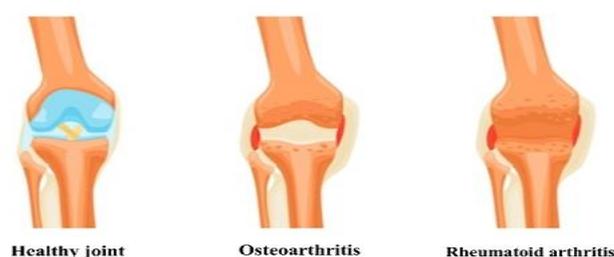


Fig. 2: a. healthy joint, b. osteoarthritis, c. rheumatoid arthritis.

3.2. Epidemiology

Approximately 1% of the global population suffers from rheumatoid arthritis with women being three times more affected than men. Arthritis is a common chronic health issue and a primary contributor to disability. In 2002, arthritis impacted 43 million adults in the United States, and by 2020, this figure is projected to rise to 60 million. It is up to three times more prevalent in smokers compared to non-smokers, especially in men with heavy smokers and individuals who are rheumatoid factor positive. A 2010 study revealed that those who used moderate amounts of alcohol consistently were four times less likely to develop rheumatoid arthritis compared to non-drinkers.^[19]

3.3. Prevalence of RA

Rheumatoid arthritis (RA) is significantly linked to the hereditary tissue type Major Histocompatibility Complex (MHC) antigen HLA-DR4, particularly DR0401 and DR0404; hence, familial history constitutes a crucial risk factor. The likelihood of initially having the condition seems to be highest for women aged 40 to 50 while for men it occurs somewhat later. The incidence and prevalence of rheumatoid arthritis typically increase with advancing age until approximately 70 years after which they diminish. Approximately twice the number of women compared to men are impacted. The incidence of rheumatoid arthritis (RA) is typically reduced in developing nations with limited or absent cases reported in several African studies.^[24] The incidence among Native American populations can be significantly elevated.^[25-27]

3.4. Symptoms and diagnosis

The ubiquitous presence of arthritic symptoms and their impact on physical, social, and occupational activities can be disheartening and lead to psychological consequences such as anxiety, despair, and feelings of powerlessness.^[28] Rheumatoid arthritis can be challenging to identify due to its initial presentation of minor symptoms including joint discomfort or mild stiffness. The rigidity observed in active rheumatoid arthritis is typically most pronounced in the morning. It may endure for one to two hours or maybe the entire day. Prolonged morning stiffness is indicative of rheumatoid arthritis as few other arthritic conditions exhibit this symptom. Multiple rheumatic diseases develop and are often characterized by pain, chronicity, and progression with occasional exacerbations of symptoms. The predominant rheumatic illnesses are:

Osteoarthritis: This is a prevalent form of arthritis and an age-related illness that deteriorates bone and cartilage, potentially resulting in disability. It primarily affects the knees, hips, lower back, neck, fingers, and feet. Joint instability arises from muscular and skeletal weakening.^[30,31]

Rheumatoid arthritis: It is an autoimmune and inflammatory illness that impacts the immune system or tissues, resulting in joint pain, stiffness, and edema. It impacts several joints simultaneously, typically involving the wrists, knees, and hands. Individuals have a loss of joint function because of a systemic disease that impacts various organs, including the eyes, lungs, skin, heart, kidneys, gastrointestinal system, and nervous system. It can also result in anemia.^[132-33] Lupus is a chronic autoimmune disorder that induces inflammation throughout the body. The immune system targets the body's organs and tissues, including the eyes, hair, joints, heart, kidneys, blood, liver, lungs and brain.^[34-35]

Spondyloarthropathies: Ankylosing spondylitis (AS) is an inflammatory arthritis. The condition initially manifests as lower back discomfort and affects the spine, namely the sacroiliac joints connected to the pelvis. If the condition deteriorates, the spine gets stiffer and more rigid, impeding everyday activities. It also induces inflammation in several organs including the hips, shoulders, ribs and occasionally the eyes.^[36]

Sjögren's syndrome: Sjögren's syndrome is an autoimmune disorder characterized by the immune system's assault on the glands responsible for saliva and tear production. The primary symptoms include xerostomia and xerophthalmia; nevertheless, it may also impact additional organs, including joints (arthralgia and myalgia), nerves, and skin (dermatological rashes). It is more prevalent in women than in men.^[37-38] Gout arises from the accumulation of uric acid in the body, leading to the formation of substantial crystals in the joints and skin. Primarily located in the big toe and other areas of the foot, it can also impact the ankles, knees, elbows, wrists, or fingers. The pains are occurring rapidly in the body.^[39]

Scleroderma: Scleroderma is a condition that affects the skin and other connective tissues, causing them to become hardened. Localized scleroderma predominantly occurs in children and primarily affects the skin. Systemic scleroderma impacts various body regions, including the skin, blood vessels, organs, muscles, and joints. The primary symptoms are subcutaneous calcium deposits, cardiac, renal, and pulmonary issues, xerostomia and xeroderma, rigidity, oedema, erythema, and skin tautness.

Infectious arthritis: Infectious arthritis is a type of septic arthritis caused by bacterial, viral, or fungal infections. If the infection disseminates in the joints. Inflammation induces discomfort and oedema. It mostly affects the knees but in

severe instances, it also impairs other body parts, including the ankles, hips, and wrists. Juvenile idiopathic arthritis is predominantly observed in youngsters and is caused by the immune system attacking its tissues and joints. Mild cases resulted in warmth, joint discomfort, stiffness, and swelling, whereas severe cases led to joint injury, stunted growth, chronic pain, limb asymmetry, ocular inflammation and anemia.^[40]

Polymyalgia rheumatica: The aetiology of the ailment remains unidentified; nonetheless, it is characterized as an inflammatory disorder that impacts the neck, shoulders, knees, and hips, resulting in pain and stiffness. In certain instances, it presents with flu-like symptoms, including fever and fatigue. It predominantly occurs in older persons.

3.5. Pathophysiology of Rheumatism The precise etiology of rheumatism remains unidentified however, it exhibits a propensity for hereditary inheritance. Certain circumstances and environmental conditions may provoke the immune system to attack its tissues and cells resulting in inflammation in numerous organs, including the eyes, wrists, hips, ankles, and lungs. Environmental variables appear to contribute to the onset of rheumatism. The consumption of tobacco elevates the likelihood of acquiring rheumatism.^[41]

3.6. Genetic Component

Approximately 60% to 70% of rheumatism patients globally possess a common epitope of the human leukocyte antigen (HLA) DR4 cluster which constitutes one of the peptide-binding sites of certain HLA-DR molecules associated with rheumatism hence increasing susceptibility.^[42] The major histocompatibility complex and other genes are implicated since the sequencing of genomes from families with rheumatism indicates the presence of multiple deleterious and susceptibility genes including PTPN22 and TRAF5 [43-44]. Juvenile rheumatoid arthritis (JRA) commonly referred to as juvenile idiopathic arthritis (JIA) constitutes a heterogeneous group of illnesses distinct from adult rheumatism. JIA is a genetically complex condition in which numerous genes have a significant role in the disease. The IL2RA/CD25 gene and the VTCNI gene have been identified as susceptibility loci for JIA. The future of rheumatism treatment and comprehension relies on imprinting and epigenetics. Rheumatism predominantly occurs in females rather than males and indicates genetic imprinting from parents to the expressing participants.^[47-48] Imprinting is characterized by distinct methylation patterns of chromosomes based on parental origin and leading to differential expression of maternal versus paternal genes. Epigenetics involves alterations in DNA expression due to environmental factors that trigger methylation without altering the DNA structure itself. The scientists are concentrating on environmental and immunological genetics.^[49-50]

3.7. Pathogenic Organisms

Various infectious agents have been implicated in the aetiology of rheumatism including Mycoplasma species, Epstein-Barr virus, and Rubella virus.^[51-52] Flu-like symptoms may manifest in rheumatism in certain instances. The induction of rheumatism in experimental animals using various bacteria or bacterial compounds. Bacterial compounds including bacterial RNA are present in the joints of patients. Numerous antimicrobial medicines have diverse efficacy against illnesses including modifying medications such as antimalarial compounds and gold salts.^[53-54]

Rheumatism is characterized by inflammation that affects various joints in the body including both small and medium-sized joints, resulting in localized and systemic inflammation. Variable activities are influenced by distinct autoimmune and inflammatory processes in rheumatism in clinical heterogeneity of the disorders.^[55]

3.8. Immunological Processes and Inflammation in Synovial Tissue

Synovitis arises when leukocytes permeate the synovial cavity. The increase of leukocytes primarily indicates movement rather than local proliferation. Cell migration is facilitated by endothelial activation in synovial microvessels which enhances the expression of adhesion molecules (integrins, selectins, cadherins, and other members of the immunoglobulin superfamily) and chemokines.^[56] Neo angiogenesis, triggered by local hypoxic circumstances and cytokines, together with inadequate lymph angiogenesis that restricts cellular interactions, are characteristics of both early and established synovitis. The micro-environmental alterations along with significant synovial structural reorganization and localized fibroblast activation facilitate the accumulation of synovial inflammatory tissue in rheumatism.^[57]

4. Ethno botanical plants with anti-arthritic potential

4.1. *Sophora flavescens* (Fabaceae)

Sophora flavescens, commonly referred to as Kushen in Chinese has played a significant role in Chinese medicine since the Qin and Han periods. The root of *Sophora flavescens* has a longstanding history in the traditional medicine of various nations including China, Japan, Korea, India, and several European countries. *Sophora flavescens* has been extensively utilized in traditional Chinese medicine (TCM) and primarily in conjunction with other medicinal plants in formulations to address fever, dysentery, hematochezia, jaundice, oliguria, vulvar swelling, asthma, eczema, inflammatory conditions, ulcers, and ailments related to skin burns.^[58] Dried roots of *Sophora flavescens* (*Sophora radix*) constitute a traditional oriental medication. The roots of *Sophora flavescens* have historically been utilized in Chinese medicine to treat fever, inflammatory conditions, ulcers, and skin burns. *Sophora flavescens* comprises flavonoids and alkaloids. Kushen primarily comprises alkaloids, flavonoids, alkyl xanthenes, quinones, triterpene glycosides, fatty acids, and essential oils.^[59-61] Jin et al. did research to produce a plant-derived anti-inflammatory drug targeting chronic inflammatory illnesses. To do this, the alkaloid-free prenylated flavonoid-enriched fraction (PFS) derived from the rhizomes of *Sophora flavescens* was produced, and its in vitro and in vivo anti-inflammatory effects were tested for the first time. The findings suggest that PFS from *Sophora flavescens* may be effective in treating chronic inflammatory conditions, including rheumatoid arthritis.^[62]

4.2. *Commiphora caudata* (Burseraceae)

Commiphora caudata (Wight & Arn.) Engl. is a little deciduous tree extensively found in South India and Sri Lanka. The local nomenclature includes kilimaram, riding, and kizhuvam. Renowned for its antibacterial, antifungal, analgesic, and anti-inflammatory properties.^[63-64] It is widely referred to as "hill mango." A phytochemical study revealed that the plant's leaves included flavonoids, glycosides, steroids, tannins, terpenoids, sugars, and lignans. The bark of *C. caudata* exhibited alkaloids, coumarins, tannins, glycosides, phytosterols, flavonoids, phenols, and saponins. The bark and leaves have been utilized in traditional medicine to address low back pain, sciatica, fever, arthritis, and urinary retention.^[65-66] Pashikant et al. observed that the ethanolic extract of *Commiphora caudata* leaves (EECCL) exhibited considerable anti-arthritic action in full Freund's adjuvant-induced arthritic rats. The EECCL-treated group had a notable decrease in paw volume, indicating the anti-inflammatory properties of the leaves.^[67]

4.3. *Cinnamomum zeylanicum* (Lauraceae)

It is referred to as Ceylon cinnamon or 'genuine cinnamon' and is native to Sri Lanka and southern India. The foliage and bark of *C. zeylanicum* are utilized as spices and for the extraction of essential oils. These principal bioactive differ

from the volatile oils found in other components of *C. zeylanicum*, including the leaves, flowers, buds, fruits, root bark, and stem bark. The primary components identified were eugenol, cinnamaldehyde, cinnamyl acetate, propane and camphor, in addition to many minor ingredients. In Ayurvedic medicine, the bark is characterized by its stimulant, antifatulent, antiemetic, and anti-diarrheal qualities.^[68-70] **Vetal et al.** extracted type-A procyanidin polyphenols (TAPP) from the bark of *C. zeylanicum*, which exhibited anti-inflammatory and anti-arthritis efficacy in an in vivo research. Carrageenan-induced rat paw oedema (CPE) and adjuvant-induced established arthritis (AIA) in rats served as the experimental models for inflammation and arthritis, respectively. The current study which lacks analgesic activity and immunomodulatory potential, identifies TAPP as a possible DMARD.^[71]

4.4. *Glycyrrhiza glabra* L. (Family: Fabaceae)

G. glabra is a tall herbaceous plant, generally referred to as liquorice, sweet wood, or mulaithi, native to Eurasia, northern Africa, and western Asia. The primary components are Glycyrrhizic acid, 18- β -glycyrrhetic acid, glycyrrhizin, and licochalcones. Pharmacologically, *G. glabra* and its primary ingredients have antibacterial, antiparasitic, antiviral, antitussive, immunomodulatory, antioxidant, anti-inflammatory, and anticancer properties. Additionally, they exhibit hepatoprotective, anticoagulant, antidiabetic, and spasmolytic properties.^[71] Liquorice is utilized as a flavoring agent in the tobacco and confectionery industries as well as to a degree in the medicinal and beverage sectors today. Leaves were employed topically for wound therapy. Rhizome and root were administered orally to address cystitis, nephrolithiasis, pulmonary disorders, diabetes, cough, abdominal pain, gastric ulcers, TB, and Addison's illness; they were also utilized as a mild laxative, contraceptive, and to enhance sexual function. It was utilized for sore throat, influenza, cold, bronchodilation, ophthalmic conditions, anti-syphilitic purposes, antidysentery, gastric imbalance, indigestion, vomiting, diarrhea, swelling abscesses, and as a diuretic. Mishra et al. reported the methanolic extract of *Glycyrrhiza glabra* rhizomes and the n-hexane extract of *Boswellia serrata* gum resin, both generated via cold maceration and conducted in vivo and in vitro studies. The antiarthritic efficacy of *Glycyrrhiza glabra* and *Boswellia serrata* was evaluated through a notable decrease in paw edema volume. The current investigation revealed a significant elevation in the activity of lysosomal enzymes and liver enzymes in the plasma of adjuvant-induced arthritic rats, which was notably diminished following treatment with *Glycyrrhiza glabra* at 150 mg/kg, *Boswellia serrata* at 50 mg/kg, and a combined formulation of both at 100 mg/kg.^[73]

4.5. *Monocellate cobra* (Bungarinae)

The monocelled cobra (*Naja kaouthia*) is accountable for several human envenomation in Eastern India and Southeast Asia. Cobras belong to the genus *Naja* within the subfamily Bungarinae. The Indian Monocellate cobra (*Naja kaouthia*) and Russell's viper (*Vipera russelli*) are prevalent serpents on the East Indian subcontinent. The anticarcinogenic properties of their crude venoms were examined in carcinoma, sarcoma, and leukemia models.^[74-76] Gomes et al. revealed that the venom of the Indian Monocellate Cobra (NKV) exhibited anti-arthritis efficacy in male albino rats with Freund's complete adjuvant (FCA) caused arthritis by regulating anti-inflammatory markers. This study demonstrated that NKV therapy at two distinct dosages provided considerable protection against FCA-induced arthritic alterations in various physical parameters including paw weight and paw and ankle diameters. NKV therapy elevates GSH levels and potentially prevents peroxidation in arthritis. Cobra venom not only regulates inflammatory activity but also exhibits anticomplementary properties.^[77]

4.6. *Euphorbia tirucalli* (Euphorbiaceae)

Euphorbia tirucalli L., a medicinal plant utilized for treating fractures, is classified within the Euphorbiaceae family. Also referred to as the pencil tree, it is found in the paleotropical regions of Madagascar, the Cape region of South Africa, and East Africa. It comprises tannins, saponins, and flavonoids. In East Africa, latex is utilized for treating sexual impotence, warts, epilepsy, toothache, hemorrhoids, snake bites, the removal of ectoparasites, and cough, among other ailments. In Peninsular Malaysia, a poultice made from the roots or stems is utilized for treating nasal ulcerations, hemorrhoids, and swellings. Root scrapings combined with coconut oil are administered for abdominal pain. **Kumar (1999)** observes that in India, this plant is ubiquitous in traditional homesteads and serves as a remedy for various ailments including spleen enlargement, asthma, dropsy, leprosy, biliousness, leucorrhoea, dyspepsia, jaundice, colic, tumors, bladder stones, and acts as a purgative in small doses. It is also utilized for toothaches, earaches, rheumatism, warts, cough, neuralgia, and scorpion bites.^[78-79] Chandrasekaran et al. identified a triterpenoid from *Euphorbia tirucalli* Linn. (TET) in a collagen-induced arthritis model (CIA). The oral dose of TET (200 mg/kg) showed considerable anti-arthritic efficacy by reducing paw volume and maintaining normal body weight gain in comparison to the CIA groups. This investigation indicated that TET administered at a dosage of 200 mg/kg could rectify the modified paw volume and hematological, and histological alterations. Furthermore, it has been demonstrated that triterpenoids derived from *E. tirucalli* may serve as an effective natural anti-arthritic drug.^[80]

4.7. *Saussurea lappa* (Asteraceae)

Saussurea lappa is a prospective tall erect herb from the Asteraceae family. It is predominantly located in the northern mountainous areas of Pakistan and India. Vernacular names include saw-wort and snow lotus; Malayalam: Kottam; English: Costus; Tamil: Kostum. The roots of *S. lappa* exhibited the presence of monoterpenes, sesquiterpenoids, flavonoids, lignans, triterpenes, steroids, and glycosides. Sesquiterpene lactones and triterpenes constitute the principal active constituents of *S. lappa*. The researchers examined various extracts of this plant and identified components demonstrating anti-inflammatory, antibacterial, antitumor, hepatoprotective, anti-ulcer, and immunomodulatory properties.^[81-83] A. B. Gokhale et al. conducted a study on the antiarthritic properties of *Saussurea lappa*, *Argyrea speciosa*, and *Achyranthes aspera*. The impact of ethanol extract from *Saussurea lappa* roots on acute and chronic inflammation generated in mice and rats was assessed using carrageenan and Freund's complete adjuvant. *S.lappa* significantly decreased paw oedema.^[84]

4.8. *Boswellia serrata* (Burseraceae)

Boswellia serrata is an oleo-gum resin, known as Salai, and is a plant exudate from the genus *Boswellia*. It is a somewhat to extensively big branching tree that thrives in arid mountainous areas of India, Northern Africa, and the Middle East. Also referred to as Salai or Salai guggul. The oleo gum resins comprise 30-60% resin, and 5-10% essential oils, which are soluble in organic solvents, while the remainder consists of polysaccharides (~65% arabinose, galactose, xylose) that are soluble in water. Resin is often gathered over the summer and autumn following the tree's injury in March or April. In Malayalam and Tamil, it is referred to as parangi and saambraani; in English, it is known as Indian frankincense or Indian olibanum. Research involving animals and clinical trials indicates the efficacy of *B. serrata* gum resin extract (BSE) in the treatment of inflammatory bowel disease, rheumatoid arthritis, osteoarthritis, and asthma. Extensively acknowledged for its efficacy in treating inflammatory illnesses, some malignancies, wound healing, and exhibiting antibacterial properties.^[85-86] Umar et al. examined the antioxidant and antiarthritic activities of *Boswellia serrata* gum resin extract (BSE) in collagen-induced arthritis (CIA) model, inducing arthritis in male Wistar

rats. *Boswellia serrata* extract (BSE) is believed to induce cartilage injury in experimental rats, suggesting it has potential antioxidant and free radical scavenging effects. BSE dramatically decreased the burden of free radicals, and inflammatory mediators, and markedly alleviated clinical manifestations of joint swelling in arthritic rats.^[87] Mishra et al. investigated the combined formulation of *Glycyrrhiza glabra* and *Boswellia serrata*, demonstrating strong synergistic effects in the evaluation of antiarthritic efficacy.^[88]

4.9. *Xanthium strumarium* L. (Asteraceae)

It is a perennial herb and is frequently cultivated in neglected areas, along roadways, and beside riverbanks in warmer regions. It is frequently referred to as chotagokhru because the shape of its fruit resembles a cow's toe. In several regions of India, it is referred to as adhasisi, as this herb is utilized for the therapy of the prevalent ailment hemicrania. Pharmacological and phytochemical investigations of *X. strumarium* have resulted in the isolation and identification of over 170 chemical components, including sesquiterpene lactones, phenols, glycosides, alkaloids, fatty acids, and others. Ayurveda posits that the plant possesses cooling, laxative, fattening, anthelmintic, alexiteric, tonic, digestive, and antipyretic properties, enhancing appetite, voice, complexion, and memory.^[89-90] Lin et al. examined the anti-arthritis properties of *Xanthium strumarium* fruit by administering full Freund's Adjuvant (CFA) to rats. This study identified a reduction in the spleen index, downregulation of COX-2, 5-LOX, and pro-inflammatory cytokines TNF- α and IL-1 β in the serum of CFA-treated rats, and an upregulation of the anti-inflammatory cytokine IL-10 in serum. The ethanolic extract of *Xanthium strumarium* exhibits significant anti-arthritis action.^[91]

4.10. *Merremia tridentata* Linn. (Convolvulaceae)

It is a perennial herb widely distributed in India, Sri Lanka, Angola, Mauritius, and Madagascar. It possesses a brief woody rhizome, elongated and prostrate stems, and an angular, glabrous structure. The phytochemical examination indicates that the plant comprises p-hydroxy benzoic acid, vanillic acid, syringic acid, tannins, saponins, quinone, and phenolic acids. The aerial components of *M. tridentata* encompass flavonoids, diosmetin, luteolin, and their 7-O- β -D-glucosides.^[92] It is referred to as "Mudiarkunthal," "Savulikodi," or "Thrippan Pullu" in Tamil and "Prasarini" in Sanskrit. It is utilized for conditions such as rheumatism, hemorrhoids, edema, and urinary disorders. In addition to serving as an effective laxative and astringent.^[93-94] Gopalakrishnan et al. investigated the ethanolic extract of the entire *Merremia tridentata* Linn plant. The ethanol extract of *M. tridentata* markedly diminished chronic inflammation in the knee joint of rats caused by complete Freund's adjuvant (CFA) relative to the conventional medication. It demonstrated substantial anti-inflammatory and anti-arthritis properties of the ethanol extract of *M. tridentata*.^[95] Rajashekhara N. et al. examined the effects of the herbs *Merremia tridentata* Hallier.f. and *Paederia foetida* Linn. administered as Kvatha (internally) and Taila (externally) on Amavata (rheumatoid arthritis). Prasarani is a prominent herb endorsed by Ayurvedic scriptures for the treatment of Amavata and Vata disorders. According to various sources from Prasarani, the plant *Paderia foetida* Linn. is predominantly used in North India whereas *Merremia tridentata* Hallier. f. is employed in South India. Both the species *Merremia tridentata* Hallier.f. and *Paderia foetida* Linn. Demonstrated a positive impact on the condition of Amavata.^[96]

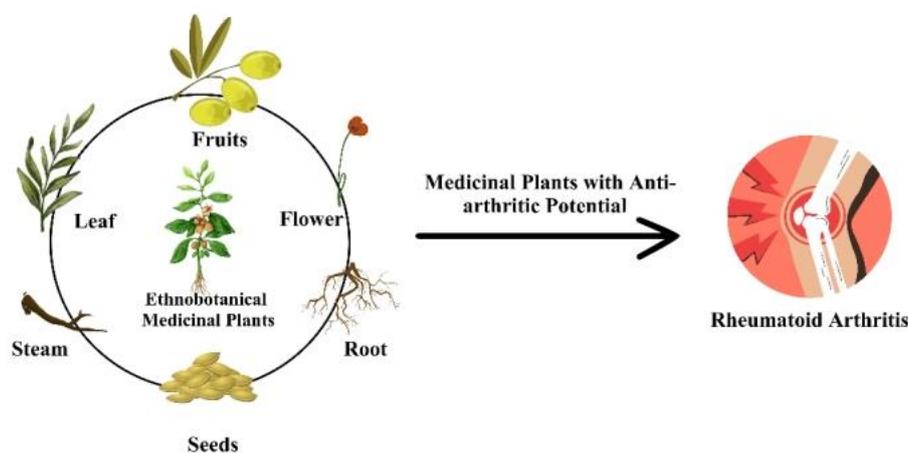
4.11. *Tridax procumbens* (Asteraceae)

It is a perennial species, commonly referred to as "coat buttons." identified as a weed across India. *Tridax* daisy in English, Jayanti Veda in Sanskrit, Ghamra in Hindi, Gaddi chemanthi in Telugu, and Thata poodu in Tamil The leaves included phytochemicals including alkaloids, carbohydrates, polyphenols, and tannins. This medicinal plant exhibited

phytochemical substances including b-amyron, b-amyryn, stigma sterol, lupeol, luteolin, campasterol, arachidic acid, fucosterol, palmitic acid, and lauric acid. Numerous bioactive substances, including procumbetin, 8,30-dihydroxy-3,7,40-trimethoxy-6-O- β -D-glucopyranosyl flavone, 6,8,30-trihydroxy-3,7,40-trimethoxyflavone, puerarin, centaurein, and centaureidin, have been effectively extracted from this plant. Traditionally, *Tridax procumbens* has been utilized to address typhoid fever, general fever, cough, epilepsy, asthma, diarrhea, anemia, colds, inflammation, liver diseases, antifungal and antiviral therapies, vaginitis, abdominal pain, and to promote hair development and alleviate mucosal inflammations.^[97-100] Petchi et al. produced arthritis with FCA and investigated the antiarthritic effects of the ethanolic extract of *T. procumbens*. The early phytochemical examination of the ethanolic extract of *T. procumbens* revealed the presence of alkaloids, tannins, flavonoids, and saponins. The ethanolic whole plant extract of *T. procumbens* has antiarthritic properties by markedly altering the aetiology of FCA-induced arthritis in female SD rats, without inducing any adverse consequences.^[101] Jain et al. utilized both *Tridax procumbens* ethanolic extract (TPEE) and *Tridax procumbens* ethyl acetate extract (TPEAE) suspensions for their experiment. Arthritis was assessed through hind paw swelling, body weight, histopathological examination of the knee joint, and several physiological and hematological parameters by administering 0.1 mL of CFA into the metatarsal footpad of male Wistar rats. It may be concluded that TPEE at a dosage of 300 mg/kg exhibits substantial anti-arthritic efficacy, whereas TPEAE demonstrates reduced activity. Steroids and flavonoids may be responsible for their anti-arthritic properties.^[102]

4.12. *Barringtonia racemosa* (Lecythideaceae)

It is sometimes referred to as Putat, a fish poison tree, or powder puff tree. Prevalently located across Eastern Africa, Polynesia, Africa, and Asia, particularly in Malaysia. It blooms biannually: in spring and from January to April. Different plant components exhibit numerous bioactivities and are consequently abundant in antioxidant potential. The seeds, stem bark, and roots possess saponin and are utilized to incapacitate fish. The bark, rich in tannins, is commonly utilized in powdered form for this purpose. It is commonly located on India's western coastline and generally thrives in black muck along riverbanks. It has been utilized in traditional medicine to treat ailments such as fever, rheumatism, and abdominal pain.^[101-102] Patil et al. extracted bartogenic acid (BA) from the fruits of *Barringtonia racemosa* and assessed Complete Freund's Adjuvant (CFA)-induced arthritis in mice. Bartogenic acid (BA), a pentacyclic triterpenoid, has demonstrated a considerable impact on the levels of endogenous pain mediators. Various pathological signs of CFA-induced arthritis in rats have been seen to respond positively to BA. It substantiates the application of *Barringtonia racemosa* fruits in the management of pain and inflammatory conditions.^[103]



5. CONCLUSION

Traditionally, numerous medicinal plants are utilized to treat people with arthritis. This review article compiles medicinal herbs with putative anti-arthritic properties. Plant components such as roots, rhizomes, leaves, gum resin, and entire plants exhibit anti-arthritic properties. This review concentrated on the advancement and research of traditional herbal remedies as anti-arthritic agents. This review determined that herbal remedies provide numerous benefits and represent a highly promising domain for antiarthritis medication development.

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