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A COMPREHENSIVE REVIEW OF THE ANTI- RHEUMATOID ARTHRITIC POTENTIAL OF SELECTED MEDICINAL PLANTS

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ABSTRACT

Rheumatoid arthritis (RA) is a chronic inflammatory condition that usually affects diarthrodial joints. It causes inflammation, pain, swelling, and gradual cartilage and bone disintegration. The condition is caused by various factors, including genetics, environment, hormones, and immunity. Pro-inflammatory cytokines (TNF- α , IL-1, IL-6, and IL-17) lead to synovial inflammation, pannus development, and degenerative changes in the joint. Common pharmacological treatments, such as NSAIDs, corticosteroids, DMARDs, and biological agents, appear to be effective. Increasing attention has been directed toward medicinal plants as potential complementary therapeutic options due to their anti-inflammatory, antioxidant, and immunomodulatory properties. This review highlights several medicinal plants with promising anti-arthritis activity, including *Withania somnifera*, *Boswellia serrata*, *Piper nigrum*, *Aloe vera*, *Zingiber officinale*, *Curcuma longa*, and *Actaea racemosa*. These plants contain bioactive compounds such as withanolides, boswellic acids, curcuminoids, and gingerols, which modulate inflammatory mediators and prevent cartilage destruction. Experimental and clinical studies support their potential to reduce joint inflammation, improve mobility, and enhance overall quality of life. Although further large-scale clinical trials are warranted, herbal approaches may offer safer, cost-effective, and sustainable alternatives in the prolonged treatment of rheumatoid arthritis.

**Keywords: Medicinal plants, Rheumatoid arthritis, Ethnomedicinal uses, *invitro* and *invivo*
evaluation of anti-rheumatoid activity**

INTRODUCTION:

Arthritis is an inflammatory condition of the diarthrodial joints that causes swelling, inflammation, joint dysfunction, and loss of articular cartilage and synovial joint integrity. Arthritis may occur in every musculoskeletal joint, although it usually occurs in the knees, hips, shoulders, and hands. Age, obesity, trauma, smoking, and other conditions all increase the risk of developing arthritis. Being able to cause severe devastating deformities and functional limitations, rheumatoid arthritis is still a serious disorder.

The number of pro inflammatory chemicals generated by macrophages, such as reactive oxygen species and eicosanoids, causes cartilage degradation and frequently results in severe impairment [1]. Chronic inflammatory disorders may target the modulation of arachidonic acid metabolism by blocking enzymes like cyclooxygenase and lipoxygenase as well as the regulation

of these mediators released by macrophages and other immune cells [2].

Recent discoveries suggest the presence of new cytokines such as IL-17, IL-18 [3, 4]. These cytokines cause synovial fibroblasts and chondrocytes in the surrounding articular cartilage to release enzymes that breakdown proteoglycans and collagen, resulting in tissue degradation and RANK ligand (RANKL) in the development of chronic arthritis. When the synovial cells begin to grow and spread due to the production of numerous cytokines and mediators of inflammation, this condition is called pannus, and the final stage leads to loss of joint mobility, which is called ankylosis. Rheumatoid arthritis causes cartilage to deteriorate and the synovial membrane to thicken. When the synovial membrane invades these parts of the joints, the entire joint swells and makes mobility challenging.

Table 1: Medicinal Plants With Their Active Constituent Used in the Treatment of Rheumatoid Arthritis

PLANT SPECIES	FAMILY	ACTIVE CONSTITUENTS	ETHNOMEDICINAL USES
1. ASHWAGANDHA	Solanaceae	Alkaloids and steroidal lactones. The primary alkaloids discovered include withanine, pseudo-withanine, tropine, pseudo-tropine, somniferine, and somnine. The roots include sitoindosides 7 and 8, which are acyl glucosides.	Withania somnifera Linn. root powder was found to have anti-arthritic effects in rats induced with adjuvants [5, 6]
2. BOSWELLIA SERRATA	Burseraceae	The resin portion contains β -boswellic acid, volatile oil, terpenoids, and carbohydrates	The anti-inflammatory efficacy of a mixture of boswellic acids was investigated, and paw oedema was reduced by 25-46% in rats and mice. In addition, they reported that it exhibited 45-67% anti-arthritic activity in a similar dose range in a chronic formaldehyde arthritis test. The part was well tolerated by both adjuvant arthritis (35-59%), and chronic arthritis (54-84%).

3. <i>PIPER NIGRUM</i> :	Piperaceae	Pepper contains the alkaloid piperine, volatile oil, pungent resins, piperidine, and starch.	Piperine has been observed to provide anti-inflammatory and anti-arthritic effects at oral doses of 20 and 100 mg/kg/day for eight weeks. In carrageenan-induced acute paw arthritis, days lead to a decrease in symptoms [7]
4. <i>ALOE VERA</i> LINN:	Liliaceae	The Aloe vera plant contain anthraquinone, anthracene, cinnamic acid and anthranilic acid	Topical application of aloe vera extract alleviates inflammation and arthritis in Sprague Dawley rats with adjuvant-induced arthritis [8-10]
5. <i>BLACK COHOSH</i> :	Ranunculaceae	The black cohosh plant contains acteina, cimigosside, steroidal terpenes, and 27-deoxyacteina. Other components include tannins, salicylic acid, isoflavones, and formononetine..	Reduces arthritis related inflammation [11-13]
6. <i>GINGER</i> :	Zingiberaceae	Ginger consists of volatile oil, starch, fat, fiber, inorganic material, and residual moisture. Ginger oil contains monoterpene, hydrocarbons, sesquiterpene hydrocarbons, and oxygenated mono and sesquiterpenes.	Ginger extract is recommended by doctors as an effective treatment for arthritis joint discomfort [14-16]
7. <i>CALOTROPIS PROCERA</i> LINN	Asclepiadaceae	Cardenolides, steroids, triterpenoids, sugar s, tannins, glycosides, terpenoids, flavanoid s, alkaloids and saponins	Calotropis Procera Linn. roots at doses of 180 mg/kg (methanol extract) and 200 mg/kg (other extracts) have exhibited anti-inflammatory activity in cotton pellet and carrageenan-induced granuloma models [17-19]
8. <i>TINOSPORA GULANCHA</i>	Menispermaceae.	Tinosporine Tinosporide, tinosporaside, cordifolide, cordifol, and heptacosanol, Clerodane furano diterpene, diterpenoid furanolactone, tinosporidine, Columbin and beta-sitosterol.	At the dose of 100 mg/kg, it demonstrates a reduction in paw volume in collagen-induced arthritis in rats [20-21]
9. <i>GREEN TEA</i> :	Theaceae	Polyphenols (catechins and flavonols). Other ingredients include caffeine and aromatic oils. Green tea's most important catechin is (-)epigallocatechin, a powerful antioxidant.	Green tea drinking decreases collagen-induced arthritis in rats by decreasing inflammatory mediators cyclooxygenase 2 IFN γ , and Tumour Necrosis Factor α in the joints. Green tea-consuming animals showed lower levels of total immunoglobulin (IgG) and type II collagen in rats [22-25]
10. <i>ANACYCLUS PYRETHRUM</i>	Asteraceae	N-alkylamides (like pellitorine), pyrethrins, and inulin. It also contains chemical substances such as anacyclin, sesamin, phenylethylamine, polyacetylenic amides, and volatile oils.	It has anti-rheumatic and anti-arthritic properties, which enhance circulation and reduce rheumatic arthritis symptoms [26]
11. <i>AQUILARIA AGALLOCHA</i>	Thymeleaceae	Sesquiterpenes, 2-(2-phenylethyl)-4H-chromen-4-one derivatives (commonly called chromones), and flavonoids. Other substances include terpenoids, phenolic acids, and numerous other oxygenated sesquiterpenes.	Apply a paste to the afflicted joints to reduce pain and inflammation in osteoarthritis and rheumatoid arthritis [27]
12. <i>CARDIOSPERMUM HALICACABUM</i> LINN	Sapindaceae	Carbohydrates, proteins, fats, saponins, tannins, flavonoids, alkaloids, glycosides, and steroids. It also includes fatty acids (ricinoleic acid, oleic acid, linoleic acid, and stearic acid) and phytosterols (beta-sitosterol). It has also been shown to contain chemicals such as 1,2,4-trioxolane, apigenin-7-o-glucuronide, and chrysoeriol-7-o-glucuronide.	Experimental arthritis models have been used to imitate clinical Rheumatoid arthritis, including cartilage immunization and joint trophic organism infection [28, 29]
13. <i>CATUNAREGUM SPINOSA</i>	Rubiaceae	Polyphenols, flavonoids, terpenoids, triterpenoids, and saponins.	It is beneficial in rheumatism, ostealgia during fever, diarrhea, dysentery, bruising, cuts, and wounds

			[30]
14. <i>EUPHORBIA NERIIFOLIA L</i>	Euphorbiaceae	Triterpenoids, flavonoids, and diterpenoids. Key compounds include <u>euphol</u> , <u>neriifoliol</u> , <u>taraxerol</u> , <u>neriifolione</u> , and <u>cycloartenol</u> .	The plant has been used to treat inflammatory illnesses such as rheumatism and gout, reducing pain [31, 32]
15. <i>FLACOURTIA JANGOMAS</i>	Flacourtiaceae	Tannins, carbohydrates, fats (such as palmitic, hexadecadienolic, stearic, oleic, and linoleic acids), minerals, ascorbic acid, tartaric acid, proteins, amino acids, and phenolic compounds	This plant has proven effectiveness in treating medical conditions like gout and rheumatoid arthritis. The plant contains edible fruits, and when triturated with sesame oil, the bark can be used as a rheumatism liniment [33]
16. <i>HELIOTROPIMUM INDICUM LINN</i>	Boraginaceae	Pyrrolizidine alkaloids, but also includes triterpenes, sterols, and other compounds. echinatine, heleurine, lasiocarpine, supinine, heliotrine, indicatorine, and their N-oxides. Other compounds identified are cynoglossine, europine-N-oxide, helitridine-N-oxide, and putrescine. The plant also includes triterpenes such as lupeol, chalinasterol, stigmasterol, and campesterol, as well as rapanone and hexacosan-1-ol.	The plant's extract is used to treat inflammation, primarily in the joints [34]
17. <i>HYGROPHILA AURICULATA</i>	Acanthaceae	Flavonoids, terpenoids, alkaloids, sterols, and fatty acids. Specifically, it has been found to contain lupeol, betulin, stigmasterol, apigenin-7-O-glucuronide, and apigenin-7-O-glucoside. Additionally, the plant contains essential oils, as well as palmitic, stearic, oleic, and linoleic acids.	The plant's roots, seeds, and aerial portions were used to cure jaundice, hepatic blockage, rheumatism, inflammation, urinary infection, gout, and malaria [35]
18. <i>ILICIIUM VERUM</i>	Magnoliaceae	Phenylpropanoids, flavonoids, neolignans, monoterpenoids, and sesquiterpenes. The phenylpropanoid trans-anethole is the essential oil's major component, accounting for 70-90% of its composition. Notable chemicals include limonene, α -pinene, estragole, saffrole, lignans, and sesquiterpenes.	Oil is used in the east to treat rheumatism and colic. [36] <i>Illicium verum</i> tea has historically been used to treat rheumatism, and seeds can be chewed after meals to help digestion [37]
19. <i>INULA RACEMOSA</i>	Asteraceae	Sesquiterpene lactones, b-sitosterol, and D-mannitol. The most common sesquiterpene lactones are isoalantolactone and alantolactone. Further compounds include dihydroalantolactone,	An aqueous solution containing fresh or dried roots is administered orally for rheumatic aches and liver issues. Pain relief can be obtained through external application of a paste or liniment. [38]
20. <i>LANTANA CAMARA LINN</i>	Verbenaceae	Terpenoids, alkaloids, flavonoids, and other phytochemicals.	<i>Lantana camara</i> is a medicinal plant which is used for the treatment of arthritis in folklore medicine.[39]
21. <i>MADHUCA LONGIFOLIA KOENIG</i>	Sapotaceae	Sapogenins, triterpenes, steroids, saponins, flavonoids, and glycosides. Madhushazone, madhucic acid, madhusalmone, and madlongisides A-D have all been isolated. The plant also contains a variety of fatty acids (palmitic, stearic, oleic, linoleic, arachidic), amino acids(isoleucine, leucine, lysine, methionine, proline, serine, threonine), and other substances like as myricetin and quercetin.	To treat rheumatism, a decoction of boiled bark in water is used internally. Oil from seeds can be applied to affected regions. [40]

CONCLUSION:

Rheumatoid arthritis (RA) remains a debilitating autoimmune condition with significant physical and socioeconomic burdens. Although conventional therapies such as NSAIDs, DMARDs, corticosteroids, and biological agents have improved disease management, they are often limited by adverse effects, incomplete remission, and high costs. In recent years, medicinal plants have gained significant attention due to their potential as natural, safer, and more affordable alternatives. Compounds derived from plants such as *Withania somnifera*, *Boswellia serrata*, *Curcuma longa*, *Zingiber officinale*, *Aloe vera*, and *Piper nigrum* have demonstrated remarkable anti-inflammatory, analgesic, antioxidant, and immunomodulatory effects. These bioactive constituents target multiple molecular pathways, including cytokine regulation, inhibition of cyclooxygenase and lipoxygenase enzymes, and prevention of pannus formation and cartilage degradation. The evidence from experimental models and limited clinical studies suggests that herbal-based approaches can effectively complement existing treatment strategies by alleviating pain, reducing inflammation, and improving joint mobility. However, despite their potential, challenges such as variability in phytochemical content, lack of standardized dosages, and insufficient

large-scale clinical trials remain significant barriers. Future research should focus on optimizing formulation techniques, conducting rigorous clinical studies, and integrating herbal remedies into personalized treatment plans. Harnessing the therapeutic potential of medicinal plants may revolutionize RA management, offering a holistic, safer, and sustainable approach for improving patient's quality of life.

CONFLICTS OF INTEREST: No conflict of Interest

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