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HERBAL APPROACHES TO ARTHRITIS: MECHANISMS AND BIOACTIVE COMPONENTS INVOLVED IN THERAPY

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Abstract

Arthritis is a chronic autoimmune and inflammatory disorder marked by joint pain, swelling, and stiffness. It represents one of the major global health concerns, encompassing various rheumatic conditions. Although non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used for management, their long-term use often leads to adverse gastrointestinal effects. In recent years, there has been a growing shift toward herbal therapies as safer alternatives. Herbal medicines have gained attention due to their effectiveness and lower toxicity compared to conventional allopathic drugs. Medicinal plants serve as valuable sources for discovering bioactive compounds with therapeutic potential. Numerous plants and their constituents have been investigated for anti-inflammatory and anti-arthritic properties, though only a limited number have advanced to clinical evaluation. This review aims to summarize and discuss the pharmacological mechanisms of selected indigenous medicinal plants and their bioactive compounds exhibiting promising anti-arthritic activity.

Key words :- Anti-Arthritic, Inflammatory, Rheumatoid Arthritis, Herbal Remedies

1. Introduction

Now days different types of Inflammatory diseases i.e. rheumatic diseases known as the 'King of Human Miseries' are a major cause of morbidity of the working force throughout world. Rheumatoid arthritis (RA) is a chronic autoimmune inflammatory disease and it can be characterized by pain, swelling and stiffness, joint swelling, synovial inflammation and cartilage destruction persistent synovitis, systemic inflammation and auto antibodies and commonly leads to significant disability [1-4]. It has been found that approximately 1% of the world' population of female and male ratio of 2.5:1 affected by inflammatory disease i. e. Rheumatoid Arthritis. It is an inflammation of synovial joint due to immunomediated response. Rheumatoid arthritis has 19th century roots and a 20th century pedigree. The joints most commonly affected by arthritis are weight-bearing joints, such as feet, knees, hips, spine and other joints, such as finger and thumb joints. The key risk factors of arthritis includes age, gender, excess weight, injury, dietary pattern, consumption of excess alcohol, life style, heredity, hormonal factors, environmental factors and lack of physical activity [5].

2. Symptoms of Arthritis [5]

1. Reduced ability to move the joint
2. Stiffness, especially in the morning,
3. Difficulty performing daily activities and disability
4. Long-term (chronic) pain etc.

In India, many Ayurvedic practitioners are using various indigenous plants for the treatment of different types of arthritic conditions. Although the application of these medicaments has a sound tradition and a rational background according to the Indian system of medicine, perhaps it is essential to investigate the rationality of their use in modern scientific terms. Despite considerable progress in the treatment of arthritis by NSAIDs and other drugs, search for newer drugs continues because the existing synthetic drugs have several limitations. The modern medicine has also started admitting that ayurveda and herbal medicine, has a lot of positive influence on the treatment of arthritis. A large number of medicinal plants have been tested and found to contain active principles with curative properties against arthritis. Antiarthritic plants contain a variety of chemical constituents like phenols, coumarins, essential oils, monoterpenes, catechins, quinones, carotinoids, flavanoids, alkaloids, anthocyanins and xanthenes [6, 7].

Table 1:- List of Anti-arthritic Plant

S. No.	Botanical Name	Family	Parts Used	Solvents Used	References
	Abrus precatorius	Leguminosae	Seed	Ethanol	[8]
	Acalypha alopecuroides (jacq.),	Euphorbiaceae	Aerial parts	Chloroform, methanol and water	[9]
	Ajuga bracteosa	Labiateae	Whole plant	Ethanol	[10]
	Ammania baccifera linn	Lythraceae	Whole plant	Ethanol and water	[11]
	Anisomeles malabarica	Lamiaceae Labiatae	Leaves	Methanol	[12]
	Aristrolochia bracteata	Aristrolochiaceae	Whole plant	Methanol	[13]
	Asystatica dalzelliana	Acanthaceae	Leaves	Methanol	[14]
	Bacopa monniera	Scrophulariaceae	Fresh whole plant	Methanol	[15]
	Barringtonia racemosa	Lecythidaceae	Fruits	Methanol	[16]
	Borassus flabellifer	Areaceae	Male flowers	Ethanol	[17]
	Boswelia serrata	Burseraceae	Gum resin	N-hexane	[18]
	Capparis erythrocarpos	Capparaceae	Roots	Ethanol	[19]
	Capparis spinosa	Capparaceae	Fruits	Ethanol water	[20]
	Cassia uniflora	Cesalpinaceae	Leaves	Methanol, petroleum ether, ethyl acetate	[21]
	Centenella asiatica	Apiaceae	Fresh whole plant	Methanol	[22]
	Chlorophytum borivilianum	Liliaceae	Roots	Alcohol, water	[23]
	Cissampelos pareira	Menispermaceae	Roots	Aqeous ethanol	[24]
	Cleodendron inerme	Verbenaceae	Leaves	Petroleum ether, ethanol	[25]
	Cleome rutido rutidosperma	Capparidaceae	Whole plant	Ethanol (90%)	[26]
	Cocculus hirsutus	Menispermaceae	Leaves	Ethanol	[27]

	Coldenia procumbens	Boraginaceae	Leaves	Methanol	[28]
	Cyperus esculantus	Cyperaceae	Essential oil	Ethyl acetate	[29]
	Cyperus rotundus	Cyperaceae	Essential oil	Ethyl acetate	[29]
	Delonix elata	Caesalpiniaceae	Barks	Pet.Ether, chloroform and hydroalcohol	[30]
	Euphorbia antiquorum	Euphorbiaceae	Whole plant	Water and ethanol	[31]
	Euphorbia tirucalli	Euphorbiaceae	Stem, bark, leaves	Methanol	[32]
	Glycerriza glabra	Leguminosae	Rhizome	Methanol	[18]
	Gymnema sylvestre	Asclepiadaceae	Leaves	Petroleum ether, ethyl acetate and alcohol, chloroform water	[33]
	Hybanthus enneaspermus	Violaceae	Plant	Ethanol	[34]
	Jatropha gossypifolia	Euphorbiaceae	Leaves	Ethanol	[35]
	Justicia gendarussa burm	Acanthaceae	Leaves	Ethanol	[36]
	Lawsonia inermis	Lythraceae	Leaves	Aqueous ethanol	[37]
	Manilkara zapota	Sapotaceae	Leaves	Ethanol	[38]
	Merremia tridentate	Convolvulaceae	Root and aerial parts	Ethanol	[39]
	Naravalia zeylanica	Ranunculaceae	Aerial parts	Petroleum ether, chloroform and ethanol	[40]
	Newbouldia laevis	Bignoniaceae	Bark	Ethanol	[41]
	Portulaca oleracea	Portulacaceae	Leaves	Petroleum-ether	[42]
	Premna serratiflora	Verbenaceae	Wood (without bark)	Ethanol	[43]
	Rubia cordifolia	Rubiaceae	Roots	Ethanol	[44].
	Sesbania grandiflora	Leguminosae	Dried bark	Chloroform, petroleum ether, methanol	[45]

	Sesbania sesban	Leguminosae	Dried bark	Chloroform, methanol, petroleum ether	[45]
	Strobilanthus callosus nees	Acanthaceae	Stem	Pet ether, chloroform and Methanol	[46]
	Strobilanthus ixiocephala benth	Acanthaceae	Stem	Chloroform and Methanol	[46]
	Strychnous potatorum	Loganiaceae	Whole seeds	Water	[47]
	Tinospora cordiflora	Menispermaceae	Dry bark	Water	[48]
	Urginea indica	Lilliaceae	Whole plant	Ethanol	[49]
	Urtica pilulifera	Urticeacae	Leaves	Methanol	[50]
	Vernonia anthelmintica	Asteraceae	Seeds	Ethanol, acetonitrile	[51]
	Vitex negundo	Verbenaceae	Leaves	Ethanol	[52]
	Wedelia calendulacea	Asteraceae	Fresh leaves	Methanol	[53]

Anti-arthritis activity mechanism of plants and their bioactive compounds

2.1 Brassica oleracea L. seeds anti-inflammatory mechanism

Rheumatoid arthritis is a progressive autoimmune disorder that worsens over time. The present study demonstrated that Brassica oleracea L. seed extract contains twelve phenolic compounds with significant anti-arthritic potential. Both the extract and IL-1RA showed protective effects by reducing inflammation, oxidative stress, and joint damage. These findings highlight the extract as a potential nutraceutical and suggest IL-1RA as a novel therapeutic option for RA, warranting further clinical investigation [54].

2.2 Sargentodoxa cuneata

Sargentodoxa cuneata, a traditional Chinese medicinal plant, exhibits diverse pharmacological properties including anti-inflammatory, antioxidant, antimicrobial, antitumor, and anti-sepsis activities. Its long history of use in treating arthritis, sepsis, and other ailments is supported by modern studies, with over 110 bioactive compounds identified. However, detailed investigations into its active constituents and underlying mechanisms remain limited. Further research is needed to validate its therapeutic potential and promote its development as a source for new drug discovery [55].

2.3 Daphnetin

Daphnetin, a bioactive coumarin derivative, exhibits significant therapeutic potential due to its diverse pharmacological activities including anticancer, anti-inflammatory, anti-arthritis, and neuroprotective effects. Its established clinical applications, particularly in China, along with numerous patents, highlight its biomedical importance. Continued research on its mechanisms, structural modifications, and synthesis strategies will further enhance its value as a promising lead for developing novel coumarin-based therapeutics [56].

2.4 p-Coumaric acid and its derivatives

p-coumaric acid and its conjugates exhibit diverse therapeutic potentials, including antioxidant, anticancer, antimicrobial, anti-inflammatory, and metabolic disease–modulating effects. While conjugation enhances its biological activities, limited absorption of these derivatives poses a challenge, highlighting the need for further research to improve their bioavailability and clinical applicability [57].

2.5 Achyranthes

Achyranthes species, particularly A. bidentata and A. aspera, exhibit significant ethnomedicinal and pharmacological potential due to their diverse bioactive compounds such as saponins, polysaccharides, polypeptides, and ketosteroids. They demonstrate broad therapeutic effects, including blood-activating, anti-inflammatory, antioxidant, and wound-healing properties, with low toxicity at therapeutic doses. However, further research is essential to validate traditional uses, explore other species, clarify pharmacokinetic pathways, and establish long-term safety, which will support their future application in nutraceutical and pharmaceutical development [58].

2.6 Madecassoside

Madecassoside shows strong anti-rheumatoid arthritis activity despite its low bioavailability. Its therapeutic effect in collagen-induced arthritis is mainly mediated through the intestine rather than systemic absorption, promoting IL-10 secretion and increasing Foxp3(+) T lymphocytes. Thus, its anti-arthritic action relies on an intestine-dependent immunomodulatory mechanism rather than direct systemic effects [59].

2.7 Angelica biserrata

A. biserrata holds significant medicinal potential, supported by traditional use and validated pharmacological studies. Its bioactive compounds are mainly coumarins and volatile oils, exhibit diverse therapeutic effects, including neuroprotective, anti-inflammatory, and anti-

arthritic activities. However, further research is needed to isolate active constituents, clarify molecular mechanisms, establish safe and effective doses, and assess toxicity. Comprehensive investigations will enhance its therapeutic value and support the development of novel medicines [60].

2.8 Boldine

Boldine, a natural aporphine alkaloid from Peumus boldus, demonstrates wide-ranging pharmacological activities including antioxidant, hepatoprotective, anti-inflammatory, neuroprotective, anticancer, and nootropic effects. Its ability to modulate diverse biological pathways highlights its therapeutic potential. Supported by both preclinical and limited clinical evidence, boldine and its derivatives show promise for future development as novel agents for various health conditions [61].

2.9 Morin hydrate

Morin hydrate, a flavonoid from Moraceae family plants, demonstrates diverse pharmacological properties including antioxidant, anti-inflammatory, anticancer, antimicrobial, antidiabetic, and organ-protective effects. Its therapeutic actions are mediated through multiple signaling pathways, highlighting its potential as a dietary agent and drug candidate. However, further clinical studies are essential to confirm its efficacy, safety, and dose-response profile for effective therapeutic application [62].

2.10 Dehydrozingerone

Dehydrozingerone (DHZ) demonstrated significant anti-arthritic activity in CFA-induced rats by reducing inflammatory responses, oxidative stress, and liver dysfunction markers. The results highlight its potential as a natural therapeutic agent for managing rheumatoid arthritis [63].

2.11 Euphorbia Factor

In conclusion, this study demonstrates that EFL2, a diterpenoid derived from *Euphorbia* seeds, exhibits significant therapeutic potential against rheumatoid arthritis. Intraperitoneal administration of EFL2 effectively alleviated disease severity by suppressing inflammatory cell infiltration, reducing cytokine and chemokine expression, and inhibiting TLR7-mediated signaling pathways. These findings highlight EFL2 as a promising candidate for the treatment of rheumatoid arthritis and other TLR7-dependent inflammatory disorders [64].

2.12 Costus afer leaves in arthritic rats.

The hexane fraction of Costus afer leaves (CAHLF) demonstrated significant hematological and lipid profile improvements in formaldehyde- and CFA-induced arthritic rats. Treatment with CAHLF, particularly at 250 mg/kg, reduced hematocrit, white blood cell, and platelet counts, while also improving lipid balance by lowering total cholesterol, LDL, and triglycerides and raising HDL. These results suggest that CAHLF exhibits notable immunomodulatory and hypolipidemic effects, supporting its potential as a promising candidate in anti-arthritis drug development [65].

3. Demand of current Research work and future prospective

The research will proceed to the extraction, characterization, and screening of bioactive compounds. The extracts will then be evaluated for their anti-inflammatory properties using established in vitro and in vivo assays. The combination of these approaches ensures that the research follows a validated and scientifically rigorous methodology, providing reliable and reproducible results for further pharmacological and therapeutic exploration of the selected herbs [66-71]. There is potential for major progress in the use of herbal medicines and their bioactive substances to treat arthritis. The medicinal potential of natural chemicals is being discovered by ongoing study, and it is anticipated that future investigations will offer more profound understandings of their mechanisms of action and clinical uses. As regulatory frameworks and scientific validation advance, herbal medicine could play a significant role in arthritis therapy plans [72-77].

5. Conclusion

Arthritis stand as one of the foremost health troubles worldwide, leading cause of disability in western and developing countries. Plants continue to serve as possible source for new drug and chemicals. They are extremely useful as a lead structure for synthetic modification and optimization of bioactivity. Plants have been a prime source of highly effective conventional drugs for the treatment of many forms of arthritis. In this review article, an attempt has been made to compile the reported antiarthritic plants from India and may be useful to the health professionals, scientists and scholars working in the field of pharmacognosy and therapeutics to develop evidence-based alternative medicine to cure different kinds of arthritis in man and animals.

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7. Conflict of Interest

The authors declare no conflict of interest related to this review.

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