

Exploring The Anti-Arthritic Potentials Of Herbal Medicine: A Pharmacological Review Of Medicinal Plants

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ABSTRACT

Arthritis is a prevalent chronic inflammatory condition presenting a significant global health burden. Despite extensive research, its exact etiology remains unclear, though various contributing factors have been suggested. Conventional pharmacological treatments often come with limitations such as adverse effects, poor bioavailability, and high costs, prompting demand of alternative methods of therapies. Herbal medicine had become a viable avenue for the arthritis management due to the anti-inflammatory and analgesic properties of numerous medicinal plants. Some of the plants described in this article are *Aristolochia bracteata*, *Boswellia serrata*, *Cinnamomum zeylanicum*, *Coriandrum sativum*, *Curcuma longa*, *Glycyrrhiza glabra*, *Piper longum*, *Saussurea lappa*, *Tribulus terrestris*, *Zingiber officinalis*. Traditional Indian medical systems have long employed these herbs for both treatment and prevention of arthritic conditions. The pharmacological processes that underlie the effectiveness of some medicinal plants that have shown anti-arthritic activity in clinical and preclinical investigations are examined in this study. The article highlights the role of bioactive phytochemicals and crude plant extracts in alleviating common arthritic symptoms such as pain, stiffness, swelling, and inflammation. When administered under medical supervision, these natural remedies may significantly improve rheumatic symptoms. Additionally, the review offers therapeutic insights based on recent advances in herbal medical studies and the possible function of food supplements in reducing joint inflammation and chronic pain. Emphasis is also placed on the importance of early diagnosis, appropriate treatment, and dietary interventions in managing the disease effectively.

Keywords: Anti-arthritic, Joint pain, Inflammation, Rheumatic discomfort, Medicinal herbs, Phytochemicals.

INTRODUCTION

One or more joints become inflamed when someone has arthritis.[1] The symptoms of arthritis, an autoimmune disease, include pain, stiffness, and swelling. Cartilage deterioration is a feature of arthritis.[2] Normally, cartilage shields a joint, enabling effortless movement. Additionally, when pressure is applied to the joint, as it occurs while walking, cartilage absorbs stress.[3] The bones rub against one another when there is insufficient cartilage, which results in discomfort, stiffness, and oedema. The rate of occurrence of disease varies with age.[4] It is a synovial joint inflammation brought on by an immune-mediated reaction. Arthritis can afflict people of any age; however, it often first appears

around the ages of 25 and 50, spiking in the 40s and 50s.[5]

Nevertheless, these allopathic medicines are seldom completely successful, and many medications may have adverse consequences.[6] Anti-inflammatory drugs don't belong to anti-arthritic because they don't stop the reaction that T-cells and B-cells initiate.[7] 350 million people worldwide suffer from arthritis, making it as one of the most misunderstood illnesses.[8] According to a latest study, one in four American people has arthritis, which causes excruciating joint pain. Cartilage, which typically shields joints, breaks destroyed because of arthritis.[9] In addition to the proliferation of synovial cells, arthritis causes a reaction of inflammation.[10]

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As a result, excess synovial fluid build-up in the joints results in the formation of synovial cell sheets that inflame the joint areas. The pathophysiology of the illness process frequently shows that it adversely

impacts the joint's alkalosis and articular cartilage.[11]

1. Types of Arthritis

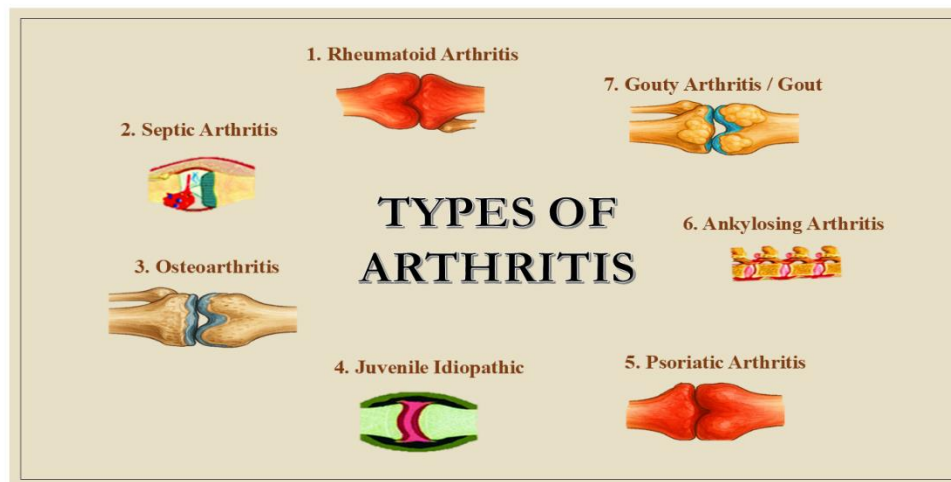


Fig. 1 Types of Arthritis

There are 7 types of Arthritis namely, Rheumatoid Arthritis, Osteoarthritis, Gout, Septic arthritis, Juvenile idiopathic, Psoriatic arthritis, Ankylosing spondylitis.

But the majorly found cases of arthritis are of Rheumatoid arthritis, Osteoarthritis and Gout so we will discuss them in detail. **(Figure 1)**

1.1 Rheumatoid Arthritis

The main cause of RA, a chronic systemic immune-mediated illness, is inflammation of the synovial tissue, which is found in the joints of the hand and feet.[12] Premature death and impairment result with neglected RA.[13] An excessive flare-up and abnormal inflammatory regulation processes result from the immune system modulation being impaired in RA.[14]

It is characterized by both systemic & localized oedema, in addition to elevated plasma levels of cytokines that trigger inflammation such as IL-6, TNF- α , IL-1b, acute phase proteins.[15] The ECM is broken down by metalloproteinases secreted by synoviocytes and chondrocytes that are stimulated by these cytokines, in either the direct or indirect way.[16] Furthermore, articular and peri-articular tissues can be degraded by CD4+CD28-T cells due to their cytotoxicity and autoreactive characteristics.[17]

Joint injury results from a flow of neutrophil granulocytes and a rise in free radicals, which upset the equilibrium of cells.[18]

The activation of pro-inflammatory cytokine-activated signalling pathways such as JAK/STAT, PI3K/AKT, MAPK, NFKB occurs in tandem with oxidative processes.[19] Synoviocytes proliferate when those pathways become operational, and mesenchymal cells and cells of the innate and adaptive immune systems are stimulated.[20] Consequently, inflammation in the synovial fluid and increased angiogenesis are brought on by the activation of IL-6, TNF- α and IL-1.[21]

NSAIDs, DMARDs and corticosteroids are examples of conventional therapy for RA that try to lessen joint inflammation and discomfort, limit function damage, and slow the course of joint destruction.[22]

1.2 Osteoarthritis

OA is more common as people age, trauma and obese can exacerbate the condition.[23] Age-related joint cartilage deterioration results in joint discomfort, rigidity, and oedema. Reduced bodily activity and joint deformities are the results of all these signs.[24] Despite multiple research efforts, little is understood about the pathophysiology of OA. However, inflammation is the initial pathogenic process for

ailments to develop the disease.[25] Synoviocytes, Macrophages in addition to Osteoblasts forms the major transmitters of the process of inflammatory arthritis. Women are 2-3 times as likely as males to have OA.[26]

Extensive cartilage degradation is often seen when cytokines targeting chondrocytes, causing them to undergo apoptosis.[27] Aggrecans and extracellular matrix metalloproteinases are essential in the development of arthritis because they break down aggrecan and other kinds of collagen, especially classes II, IX, and XI.[28]

Anabolic and catabolic cytokines are balanced in a functioning joint, resulting in a steady metabolism of cartilage.[29] Regulating cytokines and anabolic growth factors are not as prevalent in OA as pro-inflammatory (catabolic) cytokines and TNFs.[30]

The increase of COX-2, nitric oxide, and reactive oxygen species in the swollen joint further highlights the significance that oxidative stress plays in the onset of OA.[31] This suggests that inflammation is connected to the complicated system involved in the progression of OA, exhibiting a wide range of fascinating pathologic events.[32]

1.3 Gouty Arthritis

Another pain-related condition is gout, which is brought on by the accumulation of uric acid crystals in a severely inflamed joint.[33] Gouty arthritis often affects a single joint in its initial phases, but it can eventually spread across various joints and become quite debilitating.[34] Gout frequently causes the joints to swell and grow dysfunctional.[35] The inability to successfully manage gout can make gouty arthritis highly discomforting and even incapacitating.[36] Refractory chronic gout can take place when levels of uric acid and symptoms of gout are uncontrolled by conventional gout medications that either improve the body's ability to eliminate uric acid by means of the kidney (e.g. probenecid) or lessen the generation of it (e.g. allopurinol, febuxostat).[37]

2. Pathophysiology of Arthritis

The percentage of arthritis patients has sharply increased because of increasingly hectic lifestyles and

pressures on motion.[38] According to research, about 25% of people worldwide will have arthritis of some kind by 2030.[39] Arthritis is caused by several non-changeable variables, including age, sex, and specific genes.[40]

Arthritis is more common in females, and risk factors that may be changed, such as being obese, greatly raise the probability, particularly for osteoarthritis of the knee.[41] Infectious arthritis, which starts with characteristics like common fever, cold and joint pain, can be brought on by pathogenic microbes that invade joints.[42] Early identification and management are essential to preventing irreversible joint injury since these germs frequently come from other regions of the body.[43] Multiple medical conditions involving insulin resistance, cardiovascular illness, stroke, and asthmatic are frequent in people with arthritic conditions, and important risk factors include high blood pressure, cigarette consumption, elevated cholesterol levels, lack of physical activity, and being overweight.[44] Pro-inflammatory cytokines such as RANK and RANKL produced by Th17 cells and osteoblasts are among the aberrant immune systems reactions that cause rheumatoid arthritis (RA), a progressive inflamed joint condition.[45][46] Rheumatoid factor is present in the bloodstreams of around 80% of RA patients, and RANKL causes osteoblasts to activate osteoclasts, which damages joints.[47][48]

IL-17 along with additional cytokines that cause inflammation are released by Th17 cells (CD4+ T-helper cells), which are prevalent in damaging bone joints and aid in responses from the adaptive immune system.[49] These mediators cause persistent reconstruction of bone and destruction by activating NFκB-driven channels that increase swelling in joints and upset the equilibrium amongst osteoblasts that produce bone and skeletal-resorbing osteoclasts.[50][51] While there is no known cure for RA, the signs can be gradually regulated with rest and moderate exercise. In more severe instances, however, continued care or operation may be necessary.[52][53] O₂- generated free radicals contribute to cellular destruction in RA, and because therapeutic plants are naturally occurring and have less adverse consequences, fascination with them is rising.[54][55] Recent advancements in natural arthritic remedies are highlighted in this article, which

also points out that conventional practices such as Ayurveda, Chinese medicine, and Siddha medicine comprise conventional medicinal compositions that

could ultimately result in novel anti-inflammatory therapies for controlling inflammation and joint pain.[56][57][58] (Figure 2, 3, 5)

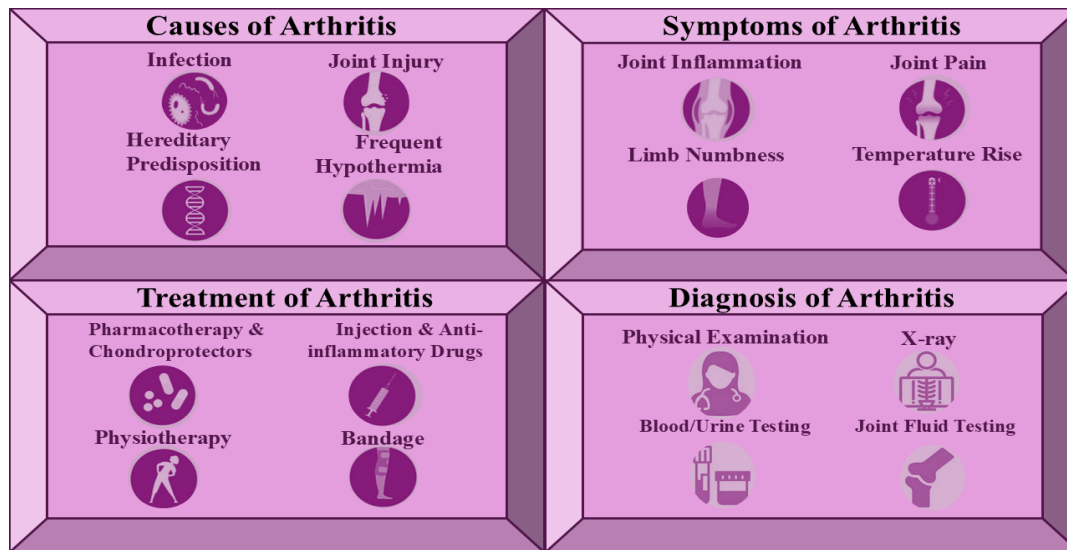


Fig. 2 Arthritis management

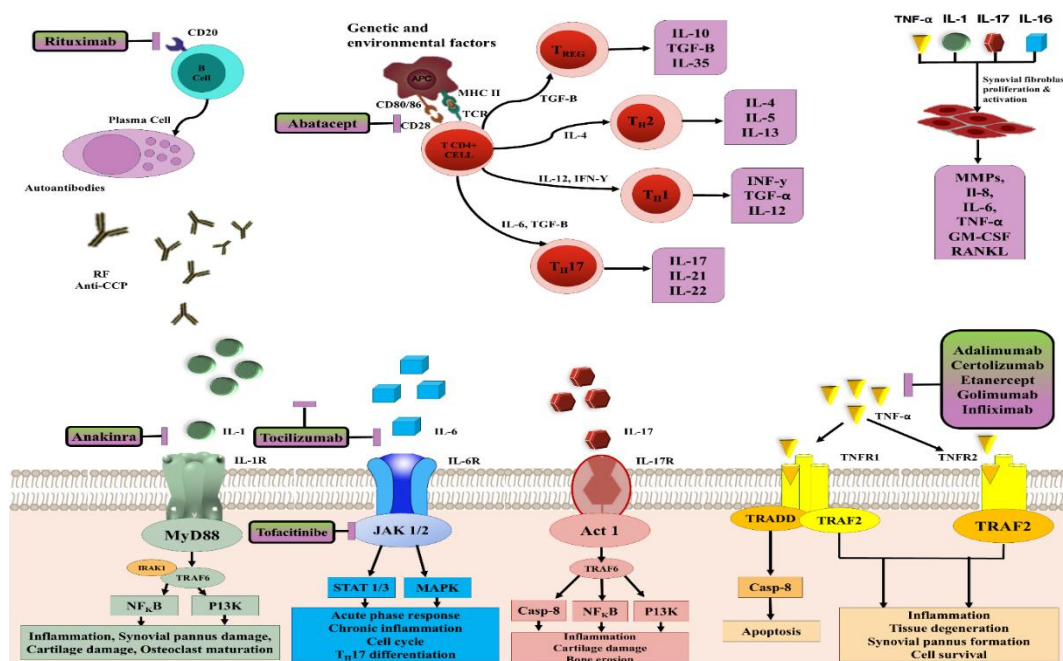


Fig. 3 Pathogenesis in treatment of arthritis

3. Traditional Therapies Used to Manage Arthritis

Therapy's main objectives are to minimize joint destruction, lower the disorder's recurrence or, if possible, lower the degree of inflammation with a prejudiced rehabilitation, and eventually improve bodily health and standard of society.[59]

Pharmacological Strategies - Distinct pharmacological classes—NSAIDs, DMARDs, corticosteroids and biological agents—are often used in a systematic therapy strategy to manage illness.[60] Because women are more vulnerable than men to develop this illness, remedies for women who are fertile should be especially careful because the medications utilized for managing their arthritis may

interfere with their ability to conceive and throughout childbirth.[61]

3.1 Non-Steroidal Anti-inflammatory Drugs: e.g. Ibuprofen, Celecoxib, Diclofenac, Aspirin, Naproxen, Ketorolac, Indomethacin.

By blocking COX-1 and COX-2, NSAIDs lessen RA discomfort and swelling, but their efficacy is restricted and they are unable to stop the disorder's progressive course. In addition to impairing liver, kidneys, and heart functions, prolonged usage frequently results in GI issues, ulceration, and haemorrhaging.[62][63][64][65]

3.2 Corticosteroids: e.g. Prednisolone, Methyl Prednisolone, Prednisone.

For many years, glucocorticoids were used extensively to treat arthritis. By preventing PG formation, they provide temporary comfort from synovitis.[66][67] However, because of adverse consequences including osteoporosis and a greater likelihood of infection, prolonged usage has an unfavorable hazard-benefit ratio.[68] When patients switch to more slowly acting, comparatively low-risk medications like DMARDs, they are most helpful in controlling transient flare-ups.[69] Furthermore, injections into the articular capsule offer efficient localised therapy for certain hyperactive joints.[70]

3.3 Disease Modifying Anti Rheumatic Drugs: e.g. Methotrexate, Leflunamide, Cyclosporine, Chloroquine, Auranum salts, Sulfasalazine, Hydroxychloroquine.

DMARDs are a broad class of drugs that delay or halt the course of arthritis by focusing on various immune-mediated components.[71][72] Whereas their precise processes are unclear, they enhance joint functionality, minimize swelling, and aid in preventing a longer-term damaged joints.[73] DMARDs can be employed collectively or alone; however, different nations have different usage trends. Blood sugar levels and liver function must be regularly monitored throughout therapy since adverse reactions may vary between minor to major.[74][75]

3.4 Cytotoxic drugs: e.g. Cyclophosphamide.

Cyclophosphamide specifically inhibits the function of B lymphocytes and has fatal impacts on B cells as

well as T cells.[76] Individuals receiving modest doses of cyclophosphamide in autoimmune disorders are being reported to exhibit diminished immunoglobulin production.[77] The medication shouldn't be taken when pregnant or nursing since it is teratogenic for and detrimental to several organs in foetus, involving the renal system and the cardiac system.[78]

3.5 Biological therapies in rheumatoid arthritis: e.g. Infliximab, Etanercept, Anakinra, Adalimumab, Abatacept, Golimumab, Rituximab, Certolizumab.

By focusing on important inflammation-related processes, biologic treatments include T-cell stimulating blocking agents, TNF inhibiting agents, IL-1 receptor antagonists and B-cell-depleting drugs aid in the management of RA.[79][80] Synovial macrophage generate TNF- α and IL-1, which are essential for the development of RA because they promote bone resorption along with cartilage deterioration. [81] TNF inhibitors, such as Etanercept, Infliximab, and Adalimumab, can halt structural deterioration and alleviate the signs in approximately a span of 2 weeks. If one TNF inhibitor fails to relieve symptoms, it is recommended to switch to another.[82][83]

3.6 Complementary Alternative Medications:

DMARDs, corticosteroids, NSAIDs, and biologics are examples of traditional arthritis therapies that lessen discomfort and inflammation but don't halt the disorder's development.[84] Substantial adverse reactions from these drugs can include cancer, severe sicknesses, osteoporosis, & GI ulceration.[85] As a result, after several symptomatic alleviation is attained, many individuals resort to complimentary and different medications (CAMs), which include dietary modifications, practicing yoga, exercise, meditation, and phytochemicals.[86][87]

4. Natural Sources as Anti-Arthritic Agent

In India's formally acknowledged substitutes medical practices, comprising Ayurveda, Siddha, Homeopathy, Unani, Naturopathy remedies made out of herbs have been used through antiquated times.[88] As many as two thousand five hundred botanical genera are employed as medicinal products within

India.[89] The use of natural treatments dates back nearly three thousand years, either straight as conventional healthcare or through intermediary processes the manufacturing of modern medications.[90] Therefore, a few may be capable to find innovative, more accessible, and efficient medications by using their understanding gained from conventional plants.[91]

The cure of people's illness has traditionally relied on herbal remedies derived from plants, animals, and minerals as well.[92] Approximately eighty percent of the population in underdeveloped nations continue to obtain their main medical treatment from conventional medical care, which is mostly focused on species of vegetation and animals. Because of the toxicities & negative consequences of allopathic medications, the utilization of natural remedies is growing in popularity.[93] Medicinal herbs and plants are essential for the creation of powerful medicinal substances.[94]

An estimated 1.5 million individuals follow the ancient medical structure, which uses herbal remedies for therapeutic, preventative, and advertising purposes.[95] It is obvious that compounds made from herbs which have the ability to alter the regulation of pro-inflammatory signalling may be able to prevent arthritis.[96] Terpenes, flavonoids, catechins, quinones, anthocyanins, anthoxanthins, alkaloids are among them; they are all recognized to decrease inflammation.[97]

Almost prehistoric times, plant-based remedies have been utilized extensively as medical treatment.[98] Such natural compounds are promising contenders for lead molecule discovery due to their wide range of chemical variety, physiological selectivity, and molecular characteristics.[99] Investigations and reports have been made on numbers of plant isolations with anti-arthritic activities.[100] A pure substance derived from the herbal extracts, a plant isolate has an identifiable configuration that gives it its physiological function and assists in the creation of novel, powerful molecules.[101] (Table 1, 2), (Figure 4)

5. Herbal Anti-arthritic Drugs:

5.1 *Aristolochia bracteata*:

Family-Aristolochiaceae

Kidamari, often referred to as worm killer, are the shrubs that grows in the state of Bengal, Sindh, southern and western parts of India, and Deccan Gujarat.[102] Aristolochic acid, aristolactams, ester, protoberberine, aporphine, benzyl-isoquinoline, isoquinoline, biphenyl ether, amide, lignan, tetralone, coumarin, benzenoid, terpenoid are the drug's main chemical components that make up.[103]

Nitrophenanthrene carboxylic acid is one of the main aristolochic acids that has anti-arthritic properties.[104] Syphilis, gonorrhoea, ulcers, inflammation, skin conditions, amenorrhoea, leprosy, dermatitis, jaundice, helminthiasis were among the conditions for which the medication had been traditionally used.[105] The medication's anti-arthritic effects are mostly caused by controlling the immune system and reactive ROS reduction.[106] In particular, it was successfully shown to inhibit the production of inflammatory molecules like NO and TNF- α , whilst simultaneously increasing the generation of collagen along with various extracellular matrix proteins.[107] Researchers have shown that the extract has anti-allergic, antipyretic, anti-arthritic, anti-inflammatory, antifungal, antiulcer, antioxidant, antimicrobial, abortifacient and wound-healing properties.[108] At dosages of hundred, two hundred, and four hundred mg/kg depending on body mass, entire plant extracts in petroleum ether, methanol, and chloroform exhibit similar anti-arthritic properties.[109]

5.2 *Boswellia serrata*:

Family-Burseraceae

For several 1000 years, Chinese and Ayurvedic medicine systems have utilized the herb *Boswellia* as a herbal therapy to relieve the symptoms of inflammation and swelling.[110] They are a medium-sized perennial trees that grows in tropical regions of Africa as well as Asia.[111] The initial component of terpenoid to be separated from oleo gum resins was Boswellic acid.[112] Rheumatism, bronchitis, cough, asthma, syphilis, digestive issues, dysentery, jaundice, pulmonary disorders are among the folk remedies for *Boswellia serrata*. [113] It has expectorant, stomachic, diuretic, internal and exterior stimulating properties. The medication has

hepatoprotective, immunomodulatory, anti-inflammatory, analgesic, anti-cancer, anti-asthmatic, hypolipidemic, hypoglycaemic, osteoarthritis properties.[114] Microsomal prostaglandin E2 synthase-1 and 5-lipoxygenase are inhibited by the aforementioned plant, which also reduces the generation or stimulation of inflammatory chemicals such MMP-13, COX-2, MMP-9 and NO.[115]

The main biochemical component of *Boswellia serrata* that has anti-arthritic properties is boswellic acid, more especially acetyl-11-keto-beta-boswellic acid (AKBA).[116] It mainly works via blocking 5-LOX enzymes to provide powerful anti-arthritic benefits.[117] β -pinene is a key ingredient among the monoterpenoids that make up the majority of the medicinal product's oil of essence.[118] α -copaene being the sole sesquiterpene found, although additional monoterpenoids comprise trans-pinocarveol, cis-verbenol, myrcene, borneol, limonene, p-cymene and verbenone.[119] When given to male wistar rat at dosages of 50 or alternatively 100 mg/kg, the n-hexane extract of BS gum resins and the methanolic extract of *Glycyrrhiza glabra* rhizomes had anti-arthritic efficacy.[120] The primary mechanisms of the anti-arthritic action include the inhibition of leucocyte movement in the inflammatory region and the reduction of the activity of membrane marker enzymes such alkaline phosphatase, SGOT, and SGPT.[121] In conclusion, BS significantly reduces the incidence of arthritis in male albino wistar rats.[122]

5.3 *Cinnamomum zeylanicum*:

Family-Lauraceae

The drug is often referred to as Mulethi or Cinnamon.[123] In its milder condition, these perennial evergreen trees may reach an elevation of 7 to 10 meters. Its oval, dark-green foliage bears strong veining. The medicinal plant is grown in southern Indian coastal regions as well as Sri Lanka.[124] Its conventional applications include management of leukorrhea, neuralgia, rheumatism, toothaches, wounds, diabetes, impotence, inflammation of the eyes and vaginitis.[125] Additionally, the medication had been employed to relieve stomach discomfort brought on by amenorrhea, dysmenorrhea, and diarrhoea.[126] Eugenol and cinnamaldehyde

constitute the drug's key components.[127] Several in vitro, in vivo, and cellular docking investigations have shown that cinnamaldehyde, as most prominent phytochemicals in medicine extract, has anti-inflammatory efficacy against RA by inhibiting inflammatory mediators like IL-1 β , TNF- α , IL-6.[128] Sabinene, camphene, fenchone, myrcene, bornyl acetate, nerol, geranial and cinnamonyl acetate are the remaining ingredients.[129] Antipyretic, analgesic, anti-inflammatory, antifungal, insecticidal, antimicrobial, antioxidant and anti-diabetic properties are all claimed for the medication.[130] In male Wistar rats in the CFA model, the polyphenolic extract of the plant bark at a concentration of 8 mg/kg demonstrated anti-arthritic ability by increasing body mass index and serum C-reactive protein levels in comparison to the control group.[131]

5.4 *Coriandrum sativum*:

Family-Umbelliferae

This perennial herb commonly known as Coriander or Dhaniya, is found across India along with that it is utilized for the fruits, seeds and leaves it provides us.[132] The herb has historically been used as an aphrodisiac, diuretic, stomachic, stimulant, carminative, and tonic.[133] When used as an emulsion in doses of 1-4 minim, the oil is particularly helpful in treating rheumatism.[134] The volatile & essential coriander oil is made from the fruit and includes geraniol, borneol and linalool/coriandrol. When employed outwardly, seeds may be utilized as a lotion or, if damaged, as poultice for managing arthritis.[135] Linoleic acid, which is found in coriander, & cineole, one of the eleven constituents of the essential oils of coriander, have antirheumatic and antirheumatic qualities.[136] Another of the compounds contained in *Coriandrum sativum* seeds, γ -Linolenic acid, has successfully shown in a randomly assigned, placebo-controlled study to prove helpful towards RA.[137] Using 2 models—formaldehyde along with Complete Freund's adjuvant (CFA)-induced arthritis—the hydroalcoholic concentrate of *Coriandrum sativum* seed has been shown to reduce paw edema in male Wistar rats by suppressing TNF- α and inflammatory cytokines. The medication has hypolipidemic, antimicrobial, antispasmodic, antioxidant, and anticarcinogenic properties.[138]

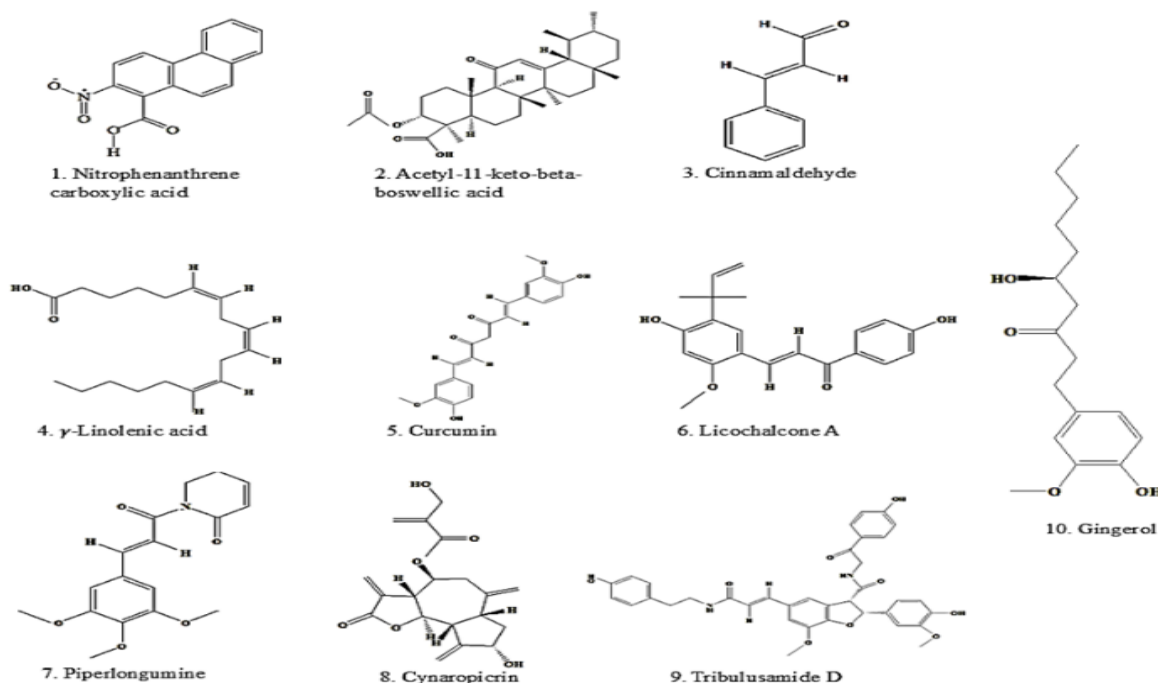


Fig. 4 Structures of chief chemical constituents of herbal anti-arthritic drugs

5.5 *Curcuma longa*:

Family-Zingiberaceae

The herbal drug is often referred to as Haldi or Turmeric.[139] This annual herb, which grows a maximum of one meter tall and boasts shorter stems, is found in tropical & subtropical areas of the globe.[140] It is primarily grown in China and India. Turmeric comes in 2 distinct varieties: 1st of them with consumable, milder, bigger, & lighter-coloured elongated rhizomes, and another having ovoid in shape, rich-coloured rhizomes. For rheumatic conditions, a paste of turmeric blended with saltpeter and lime might be utilized topically.[141] Curcumin, demethoxycurcumin, methylcurcumin, ar-turmerone and sodium curcumin are the main chemical components.[142] Turmeric has been utilized for centuries to treat hepatic illnesses, helminthic infections, a high body temperature, dermatitis eruptions, conjunctiva, coughing, healing of wounds, and infections caused by parasites.[143] The impact of a herbomineral formulation—a combination of turmeric, ashwagandha, jasad bhasma and sallai guggul on ninety individuals experiencing arthritis had been subsequently examined using the methods of Ayurvedic medicine.[144] In both the clinical as well as laboratory conditions, curcumin have been shown to suppress cytokines associated with

inflammation and the pro-inflammatory transcription factor NF- κ B.[145] Additionally, curcumin blocks amino acids, such as PGE-2, 5-LOX and COX-2. In OA rats, curcumin therapy has additionally been shown to lower IL-6, NF- κ B, IL-1 β transcription in addition to reducing joint width and oedema.[146] Discomfort as well as impairment were found to have significantly decreased.[147] The herb's hepatoprotective, nematocidal, antiprotozoal, anticancer, antibacterial and anti-inflammatory properties are said to have been widely recognized.[148] The drug's rhizomes' essential oils demonstrated anti-arthritic properties.[149] In patients with arthritis caused by streptococcal cell walls, the essential oil of turmeric rhizomes demonstrated anti-arthritic properties. We may infer that the essential oil of turmeric has anti-inflammatory and anti-arthritic properties.[143]

5.6 *Glycyrrhiza glabra*:

Family-Fabaceae

The herb is also called Yestimadhu, Mulethi, Liquorice, and Jeshthamadh.[150] This 2-meter-tall plant occurs primarily in warm or subtropical climates. It has several rhizomes and a small taproot, making it very branching.[151] Across England, Sicily, & Spain, glycyrrhiza has been cultivated for

industrial uses. The plant is mostly grown within Punjab & the Sub-Himalayan regions of India.[152] Gout, Anaemia, epilepsy, asthma, cough, fever, rheumatism, skin conditions, haemorrhagic disorders and paralysis are among the ailments for which the herb is said to have been historically employed.[153] In inflamed circumstances, plant roots taken as an extracts, a decoction an infusion, or lozenge can be helpful as a demulcent.[154] The medicinal herb contains a naturally occurring substance called licochalcone-A, which inhibits the production of NLRP3, IL-18, IL-1 β . [155] Licochalcone-A promises a treatment for OA because it reduces the chondrocyte pyroptosis brought about by lipopolysaccharide. Another in vitro investigation involving IL-1-stimulated human being OA chondrocytes additionally demonstrated that licochalcone-A reduces the synthesis of PGE2, COX-2, NO, as well as iNOS.[156] Therefore, it has been proposed fact that liquorice's primary function is to enhance endogenous steroids instead of to imitate those.[157]

Glycyrrhizin, which is found within both K⁺ & Ca⁺ salts of glycyrrhizic acid, is its active pharmaceutical component.[158] In addition, the medication consists of fat, mannites, asparagines, resins, sucrose, glucose, as well bitter principles.[159] Hypolipidemic, antimicrobial, hypotensive, antiviral, anti-diuretic, anti-ulcer, anti-mutagenic, anti-inflammatory, hepatoprotective, expectorant, antipyretic & antioxidant, properties have been successfully demonstrated by the medication.[160] When administered to male wistar rats at a dosage of 150 mg/kg, the drug's rhizomes' methanolic extracts have anti-arthritis properties via preventing leukocyte migration and autoantigen formation activity.[161] The study found that glycyrrhiza have a strong anti-arthritis effect.[161]

5.7 *Piper longum*:

Family-Piperaceae

The drug is widely recognized as Pipali or Long Pepper. It's a thin bush that climbs, creeps, as well as roots underneath.[162] The oval, cordate leaves have expansive, curved lobe towards the bottom and were sub-acute & whole, measuring 5–10 cm in length and 5 cm in width. The herbal medication is native to

Ceylon and northern as well as southern parts of Indian subcontinent.[163] Throughout prehistoric times, the medication has been widely employed to treat snake bites, a rasping sound, cold and coughing, asthma.[164] Methyl 3,4,5-trimethoxycinnamate, piperine, along with piperlongumine are the main ingredients.[165] A substance called piperlongumine inhibits the growth of T cells, monocyte chemoattractant protein- TNF- β , IL-6, TNF- α , IL-12p70, IL-23.[166] Additionally, in a RA animal model, piperlongumine has recently been shown to decrease the generation of ROS within the cell as well as the NF- κ B and JNK signaling systems.[167] Resin, volatile oil, carbohydrate, fatty oil, and inorganic materials are some more. In terms of medicine, the medication's antamoebic, anti-inflammatory, hepatoprotective, anti-asthmatic, and immune-modulatory properties make it significant.[168] By preventing neutrophil adhering to endothelial monolayer and preventing TNF- α -induced production of intercellular adhesive molecule-1, vascular cell attachment molecule-1, E-selectin, along with NF- κ B, the water-soluble extract of *piper longum* seeds at two doses (200 and 400 mg/kg) exhibits a 46.32% reduction in paw inflammation in rats with Freund's complete adjuvant-induced arthritis.[169] In summary, *piper longum* significantly reduces arthritis in male wistar rats.[170]

5.8 *Saussurea lappa*:

Family-Compositae

The medicinal plant is generally known as Costus root, Kushtya, Kushtha.[171] In the Kashmir valley territory and the mountains of the Himalayas, the herbs are widely grown.[172] The smelly essence found in root is made up of manganese-containing ashes, a dense resin, along with a valeric acid salt. Helminthiasis, asthma, cough, fever, rheumatism, skin conditions, leprosy and malaria are its primary uses.[173] For the sake of persistent rheumatic conditions, plant roots can be utilized as an infusion along with small cardamoms. Aplotaxene, phellandrene, costene, costol, camphene and costic acid make up the root's oil.[174] One sesquiterpene lactone found in the drug, cynaropicrin, decreases the synthesis of LPS-induced NO whereas a different sesquiterpene lactone prevents the generation of TNF- α from LPS-stimulated murine macrophage cell line

and dehydrocostus.[175] In a double-blinded contextualized, comparable research design, the combination of *Saussurea lappa*, *Tinospora cordifolia*, and *Cyperus rotundus* shown a substantial decrease in pain, indicating anti-arthritic action.[176] Anti-ulcerogenic, anti-diarrhoeal, anticancer, antibacterial, hepatoprotective, anticonvulsant, anti-inflammatory, antiviral, and anti-arthritic and antioxidant, properties were among the additional biochemical properties demonstrated by the medicinal product extracts.[177] Strong anti-arthritic effects were demonstrated by the plant's ethanol-based extract at doses ranging from 50 to 400 mg/kg.[178] The drug's "cynaropicrin," a sesquiterpene lactone, significantly reduced the production of TNF- α from a lipopolysaccharide (LPS)-stimulated murine macrophage cell line and dose-dependently decreased the development of activated lymphocytes.[179]

5.9 *Tribulus terrestris*:

Family-Zygophyllaceae

The drug is often called as Gokharu, Gokshura, Puncture wine.[180] In many nations, the medication has proved widely utilized in Ayurveda and other forms of conventional medical practices for dealing with a wide range of conditions, such as high BP, oedema and inflammation illnesses.[181] Reports state that the plant's ethanolic extract inhibits IL-6, NO synthase 2, COX-2, TNF- α , MMP-9, and -2 in an animal mouse model of OA brought on by monosodium iodoacetate.[182] The extraction and digestion of the drug and its pharmacological component, N-trans-p-caffeoyl tyramine, have been found to decrease the production concerning COX-2, TNF- α , and IL-6 in the LPS-stimulated RAW264.7 cells.[183] In an in vitro trial, the main goal of the chemical compounds in the medication, tribulusamide-D, was demonstrated to possess anti-inflammatory properties in RAW 264.7 macrophages activated by LPS.[184] By suppressing the synthesis of COX-2 & NO synthase, tribulusamide-D was shown to reduce LPS-induced NO & PGE2.[185] Furthermore, it was shown the fact that tribulusamide-D reduced the generation of TNF- α , IL-6, and IL-10.[186] Therefore, maximum in vivo and clinical studies are needed to examine the plant extract's potent anti-OA qualities.[187] Utilizing Complete Freund's adjuvant-induced arthritis, the anti-arthritic

effects of the methanol-based fruit extraction of *Tribulus terrestris* at 200 and 300 mg/kg were evaluated.[188]

5.10 *Zingiber officinalis*:

Family-Zingiberaceae

The common names for the drug include Ginger and Adrak.[189] A well-known medicinal plant in Ayurvedic and various conventional therapies, it has several pharmacological qualities, which comprises as immune-stimulating, anti-inflammatory, along with antioxidant actions.[190] According to reports, the medication works well to treat arthritis by inhibiting proinflammatory chemical messengers, cytokines, and enzymes. Experimental in vitro investigation utilizing human synoviocyte cells and an in-vivo investigation employing CIA rat paw oedema in rats have shown that the extract of ginger also inhibits COX-2 and NF- κ B, as well as reduces inflammatory markers which might involve TNF- α , IL-6, MCP-1, and PGE2.[191] The main ingredients responsible for ginger's anti-arthritic properties are gingerols and shogaols.[192] Several chemical compounds, including 10-gingerol, 8-gingerol, 10-shogaol, yakuchinone-A as well as gingerdione, were investigated for having the capability to suppress COX-1 and COX-2 in an in vitro experiment.[193] While they failed to block COX-1, they did block COX-2, that eventually minimizes swelling.[194] In addition to its anti-inflammatory properties for arthritis, plant increases the effectiveness of various medications that are similar.[195] Diclofenac dosing in combination to the medication has already been shown to be more effective compared administering the medication alone.[196] Consequently, ginger is possibly considered a powerful anti-inflammatory therapeutic plant, thus its constituent phytochemicals might be investigated as a potential anti-arthritis medication.[197]

6. Clinical Trials Involving Herbal Combinations:

A pilot, randomly assigned, double-blind, and placebo-treated human clinical trial assessing the standard *Boswellia serrata* plant extract in individuals with osteoarthritis in the knee is described in the paper. 42 of the 48 people having recently recognized or untreated knee OA, ages 35 to 75, finished the 120-

day trial. Participants were given either a matched placebo or two tablets of *Boswellia serrata* extract (169.33 mg each, including about 30% AKBA coupled alongside additional β -boswellic acids) every day. The study, which was carried out in compliance with ICMR, GCP, and Declaration of Helsinki protocols and filed through Clinical Trials Registry of India (CTRI/2014/03/004498), showed that *Boswellia* administration produced statistically significant benefits when compared to placebo.[198] These included significant improvements in physical function and decreases in pain and stiffness, as seen by lower VAS pain ratings (6.4 to 3.7), lower WOMAC scores (~69 to ~42), and better physician global pain evaluations ($p < 0.001$). Along with a notable improvement in EQ-5D quality-of-life scores, mobility parameters were also greatly enhanced, with

the six-minute walking distances rising from around 218 m to 297 m.[199] Serum hs-CRP levels were much lower, suggesting a systemic anti-inflammatory impact, while radiographic X-ray evaluations revealed improved joint space width and decreased osteophyte growth solely in the *Boswellia* group, providing objective human proof for these conclusions.

The extract was well tolerated, with no serious adverse events or clinically significant changes in vital signs, haematological, hepatic, or renal parameters, supporting the conclusion that standardized *Boswellia serrata* extract is a safe and clinically effective option for long-term management of knee osteoarthritis in humans.[200]

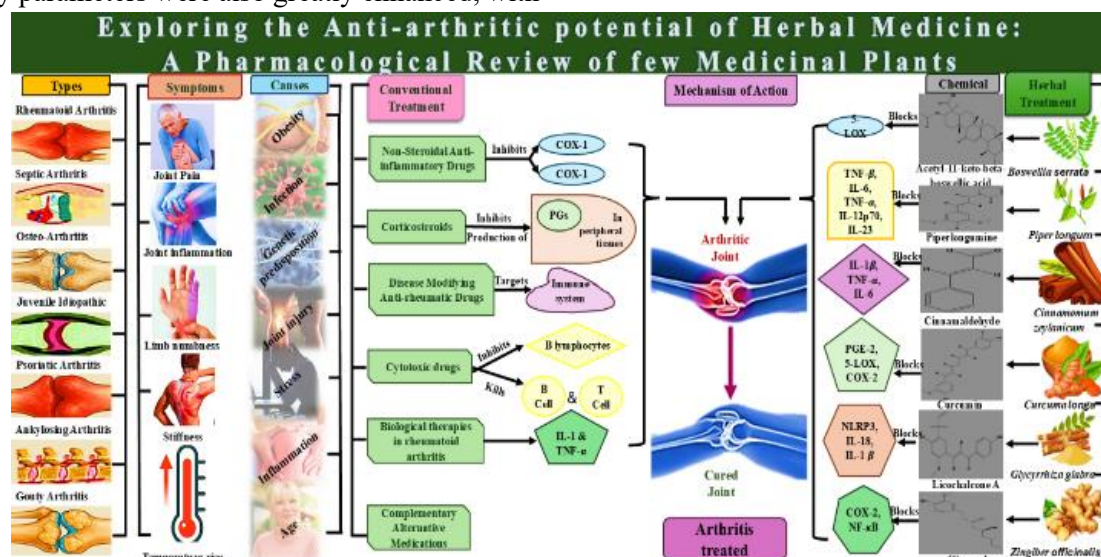


Fig. 5 Graphical Abstract

7. Safety considerations:

Medical plant life, regardless of the centuries of conventional usage and broad impression as "natural and safe," offer substantial safety risks because of the their complicated chemical makeup and lack of systematic regulation. Adverse effects from medicinal products can range from minor responses to serious, potentially fatal illnesses like cancer, hepatotoxicity, nephrotoxicity, cardiovascular problems, and genotoxicity.[201] Incorrect classification of plant species, variations in active ingredients attributed to geographical location and cultivation circumstances, contaminating via chemicals, heavy metals, and pathogens, or substitution with synthetic pharmaceuticals, as well as incorrect processing,

dosage, as well as simultaneous administration of involving traditional medicines, are some of the factors that pose a risk to safety.

Herbal remedies can cause major toxicological hazards along with potentially dangerous drug–herb combinations, as evidenced by a number of established cases, including *Aristolochia bracteata* and *Ginkgo biloba*. [202] Additionally, a lot of medicinal substances are released into the marketplace lacking required toxicological investigations or established control of quality, which makes post-marketing safety monitoring challenging. In order to assure the secure utilization of herbs for medicinal purposes, the article argues that "natural" does not equate to "safe" and

emphasizes the need for scientific evaluation, precise medicinal plant recognition, standardised production methods, efficient pharmacovigilance, and more robust regulatory frameworks.[203]

CONCLUSION:

The signs of OA affect about two hundred million individuals worldwide; while in 2020, it was anticipated that 17.5 million individuals worldwide suffered with RA annually. This figure is anticipated to jump to 31.7 million until 2050.

The degree of arthritis-related discomfort and swelling can be controlled with an alteration in lifestyle, consistent physical activity, a nutritious meal plan, right medicine. Allopathic medicine-based treatments are frequently ineffective, fraught with negative consequences, & prohibitively expensive, particularly for underdeveloped nations. Therefore, persons with arthritis may get treated using herbal medications made from plant-based nature's ingredients.

In order to present herbs and their components that have a special pharmacological usage for management of arthritis, this article of review has been written. Cross-validation was done on data regarding the ethno evidence of the historically utilized anti-arthritic herbs from a variety of research papers and reviews. The information included in study could prove very helpful in locating plant monographs & usage guidelines. The health risk profile and MOA of herbal extracts are primary topics of this review. Considering fewer adverse reactions, botanical extracts and polyherbal preparations could be used as an alternative medicine for management of arthritis.

Abbreviations:

OA-Osteoarthritis

RA-Rheumatoid arthritis

CD-Cluster of differentiation

APC-Antigen Presenting Cells

COX-Cyclooxygenase

NO-Nitric Oxide

RCG-Refractory Chronic Gout

Th-T Helper cells

IL-1b-Interleukin-1b

IL-6-Interleukin-6

IL-17-Interleukin-17

ECM-Extracellular Matrix

NSAIDs-Non-Steroidal Anti-inflammatory Agents

DMARDs-Disease Modifying Anti-Rheumatic Drugs

CAM-Complementary Alternative Medications

MOA-Mechanism of Action

MMP-Matrix Metallo Proteinase

5LOX-5-Lipoxygenase

ROS-Reactive Oxidative Species

JNK-Jun N terminal kinase

CIA-Carrageenan Induced Arthritis

GI-Gastrointestinal

BP-Blood Pressure

SGOT-Serum Glutamic Oxaloacetic Transaminase

SGPT-Serum Glutamate Pyruvate Transaminase

Sr. No.	Name	Individual constituent	Plant part used	Mechanism of Action	References
1.	<i>Aristolochia bracteata</i>	Nitrophenanthrene carboxylic acid	Whole plant	Inhibits the synthesis of TNF- α & NO; Increase collagen formation	[104][106]
2.	<i>Boswellia serrata</i>	Acetyl-11-keto- β -boswellic acid	Resin, Gum	Blocks 5-LOX enzyme	[116][117]

3.	<i>Cinnamomum zeylanicum</i>	Cinnamaldehyde	Bark	Inhibits inflammatory mediators like IL-1 β , TNF- α , IL-6	[123][127]
4.	<i>Coriandrum sativum</i>	γ -linoleic acid	Leaf, Flower, Seed	Suppress TNF- α & Inflammatory cytokines	[132][137]
5.	<i>Curcuma longa</i>	Curcumin	Rhizome	Blocks PGE-2, 5-LOX, COX-2	[142][146]
6.	<i>Glycyrrhiza glabra</i>	Licochalcone-A	Bark, Root, Rhizome	Inhibits production of NLRP3, IL-18, IL-1 β	[155][156]
7.	<i>Piper longum</i>	Piperlongumine	Fruit, Root	Inhibits the growth of T cells, monocyte chemoattractant protein-TNF- α , IL-6, TNF- β , IL-12p70, IL-23	[165][166]
8.	<i>Sassurea lappa</i>	Cyanopicrin	Root, Resin	Decreases the synthesis of LPS-induced NO & prevents formation of TNF- α from LPS-stimulated murine macrophage	[175][177]
9.	<i>Tribulus terrestris</i>	Tribulusamide D	Fruit & Aerial parts	Reduces the synthesis of COX-2 activated NO synthase, which blocks LPS-induced NO & PGE2	[184][185]
10.	<i>Zingiber officinalis</i>	Gingerol	Rhizome	Inhibits COX-2, 7NF κ B	[192][193]

Table 1 Bioactive chemical compounds with Anti-arthritic potential and it's mechanism.

Sr. No	Common name	Biological source	Family	Chemical constituents	Therapeutic activities	References
1	Worm killer, Birth wort	<i>Aristolochia bracteata</i>	Aristolochiaceae	Aristolochic acid, Aristolactam, Protoberberine, Benzyloquinoline, Isoquinoline, Tetralone	Anti-pyretic, Anti-inflammatory, Anti-ulcer, Anti-arthritic, Antimicrobial, Antifungal, Wound healing, Antioxidant, Anti-implantation	[102] [103] [108]
2	Salai gugul	<i>Boswellia serrata</i>	Burseraceae	Boswellic acid, Monoterpenoids like Verbenol, β - pinene, Borneol, Verbenone, Myrcene, P-cymene,	Anti-inflammatory, Analgesic, Immunomodulatory, Anticancer, Hepatoprotective,	[110] [114] [116]

				Limonene; Sesquiterpene like α - copane	Hypolipidemic, Anti-asthmatic, Anti-osteoarthritic, Hypoglycaemic	[117]
3	Dalchini, Cinnamon	<i>Cinnamomum zeylanicum</i>	Lauraceae	Cinnamaldehyde, Eugenol, Camphene, Sibinene, Myrcene, Fenchone, Nerol, Bornyl acetate, Cinnamyl acetate, Geranial	Vaginitis, Anti-rheumatic, Neuralgia, Wounds, Toothache, Diabetes, Anti-inflammatory, Anti-pyretic, Analgesic, Antifungal, Antimicrobial, Insecticidal, Impotence, Leucorrhoea	[123] [129] [130]
4	Coriander, Dhaniya	<i>Coriandrum sativum</i>	Umbelliferae	Cineole, Linoleic acid, Geraniol, Borneol, Linalool/Coriandrol	Anti-rheumatic, Anti-arthritic, Antibacterial, Antispasmodic, Antioxidant, Anticarcinogenic, Anti-inflammatory	[136] [137] [138]
5	Turmeric, Haldi, Varnavat	<i>Curcuma longa</i>	Zingiberaceae	Curcumin, Methylcurcumin, Demethoxycurcumin, Sodium curcumin, Ar-turmerone, Turmerone	Cough, Liver diseases, Anti-inflammatory, Antiprotozoal, Nematocidal, Antibacterial, Hepatoprotective, Anti-tumour, Anti-arthritic	[139] [142] [148]
6	Liquorice, Mulethi, Yastimadh	<i>Glycyrrhiza glabra</i>	Fabaceae	Glycyrrhizin, Glycyrrhizic acid, Glycyrrhithinic acid, Potassium and calcium salts of glycyrrhizic acid, Resins, Glucose, Mannites, Bitter Principles, Fat, Aspargines	Anti-rheumatic, Antimicrobial, Paralysis, Antiviral, Hypotensive, Anti-diuretic, Anti-mutagenic, Anti-inflammatory, Antipyretic, Hepatoprotective, Expectorant, Antioxidant	[150] [155] [160]

7	Long pepper, Pipali	<i>Piper longum</i>	Piperaceae	Piperene, Piperlongumine, Piperlonguminine, Methyl-3,4,5- trihydroxycinnamate	Cough & cold, Anti-asthmatic, Anti-rheumatic, Anti-inflammatory, Antamoebic, Immunomodulatory , Hepatoprotective	[162] [165] [168]
8	Costus root, Kushtha	<i>Sassurea lappa</i>	Compositae	Salt of Valeric acid, Camphene, Phellandrene, Costene, Costol, Costic acid, Cynaropicrin, Aplotaxene	Anti-rheumatic, Anti-inflammatory, Anticonvulsant, Hepatoprotective, Anti-arthritis, Anticancer	[175] [177]
9	Gokharu, Gokshur	<i>Tribulus terrestris</i>	Zygophyllaceae	N-trans-p-caffeoyl tyramine, Tribulusamide D	Anti-osteoporotic, Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Analgesic	[184] [185]
10	Ginger, Adrak, Sunthi	<i>Zingiber officinalis</i>	Zingiberaceae	10-gingerol, 8- gingerol, 10-shogaol, 8-shogaol, Gingerdione, Yakuchinone-A	Anti-inflammatory, Antioxidant, Anti- arthritis, Immune boosting, Analgesic	[192] [193] [195] [196]
11	Saptaparni, Devil's tree	<i>Alstonia scholaris</i>	Apocyanaceae	Amino acids, Phenols, Tannins, Flavonoids, Glycosides, Saponins, Steroids, Fats, Fixed oils, Alkaloids like Echitamine, Echitamidine, Tubotaiwine, Akaummicine, Picrinine, Strictamine	Anti-inflammatory, Anti-arthritis, Analgesic, Antihypertensive, Antidiabetic, Antibacterial, Antioxidant, Immunomodulatory , Anticancer, Anti- asthmatic, Anti- anxiety, Hepatoprotective, Anti-plasmodial	[204] [205] [206]
12	Punarnava, Raktapurna	<i>Boerhaavia diffusa</i>	Nyctaginaceae	Potassium nitrate, Alkaloids like Punarnavine	Anti-inflammatory, Antistress, Adaptogenic, Antioxidant, Immunosuppressant, Anti- carcinogenic,	[207]

					Hepatoprotective, Diuretic, Antidiabetic, Antiviral	
13	Sappanwood, Bakam, Patang	<i>Caesalpinia sappan</i>	Leguminosae	Brazilin, Brazilein, Flavonoids, Homoisoflavonoids, Flavones, Anthraquinones, Phenolic compounds like Xanthones, Coumarins, Chalcones	Anti-rheumatic, Anti-inflammatory, Anti-arthritic, Anti- ulcer, Anti- diarrhoeal, Antifungal, Anticoagulant, Antibacterial, Antiviral, Immunostimulant, Anti-epileptic, Dysentery, Anticonvulsant, Leucorrhoea, Odontopathy	[208]
14	Ganja, Charas, Indian Hemp	<i>Canabis sativa</i>	Urticaceae	Resin, Volatile oil composed of Canabene, Canabene hydride, Canabinon, Canabin; which consists of Cannabinol, Pseudo- cannabinol, Cannabinin, Terpenes	Anti-inflammatory, Antioxidant, Neuralgia, Acute mania, Whooping cough, Asthma, Antispasmodic, Anticarcinogenic, Hypolipidemic, Antibacterial, Dysmenorrhea, Menorrhagia, Eye infection	[209]
15	Hadjod, Devil's backbone	<i>Cissus quadrangularis</i>	Vitaceae	Steroids, Flavonoids, Iridoids, Stilbenes, Triterpenoids, Gallic acid and its derivatives	Anti-rheumatic, Anti-inflammatory, Antioxidant, Anti- arthritic, Antimicrobial, Gastroprotective, Weight management	[210]
16	Crepe ginger, Cane reed, Spiral/Malay ginger	<i>Costus speciosus</i>	Costaceae	Steroidal saponins like Diosgenin and its derivatives like Dioscin, Gracillin; Sterols like β -sitosterol & its glucoside; Various fatty acids,	Anti-rheumatic, Anti-inflammatory, Antioxidant, Anti- arthritic, Antidiabetic, Anthelmintic, Anti- asthmatic, Urinary	[211]

				Essential oils, Phenolic compounds	issues, Cough, Fever, Worm infestations, Filariasis, Skin diseases	
17	Lilac, Blue	<i>Daphne genkwa</i>	Thymelaeaceae	Diterpenoids, Flavonoids, Coumarins, Lignans, Phenolic compounds	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Anticancer, Diuretic, Phlegm resolving, Cough suppressant, Wound healing	[212]
18	Hibiscus, Gudhal, Jaswand	<i>Hibiscus plantifolius</i>	Malvaceae	Flavonoids, Anthocyanins, Terpenoids, Steroids, Naphthalenes, Polysaccharides, Alkaloids, Quinone, Aminomacids, Lipids, Sesquiterpene	Anti-inflammatory, Anti-arthritic, Antidiabetic, Hepatoprotective, Cough, Skin problems, Diuretic, Menstruation issues	[213]
19	Jungly erandi, angula leaved physic nut	<i>Jatropha curcas</i>	Euphorbiaceae	Diterpenoids, Sesquiterpenoids, Lignans, Flavonoids, Coumarins, Alkaloids	Anti-inflammatory, Anti-arthritic, Skin diseases, Digestive issues, Respiratory problems, Infectious diseases, Antimicrobial, Oral health, Hair care, Wound healing	[214]
20	Wild sage, Red/Yellow sage, Shrub verbena, Tickberry	<i>Lantana camara</i>	Verbinaceae	Flavones, Isoflavones, Anthocyanins, Coumarins, Lignans, Alkaloids, Tannins, Saponins, Catechins, Triterpenoids, Isocatechins	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antihypertensive, Antifungal, Antibacterial, Antidiabetic, Antioxidant, Anti- fertility, Anticancer, Wound healing, Larvicidal, Sores, Chickenpox, Measles, Fever, Cold, Anti-ulcer,	[215]

					Anti-asthmatic, Anti-motility	
21	Peppermint, Pudina, Gamathi	<i>Mentha piperata</i>	Labiataeae	Menthol, Menthone, Menthofuran, 1,8- cineole, Methyl acetate, Limonene, Isomenthone, α & β pinene	Anti-inflammatory, Anti-arthritic, Anti- spasmodic, Digestive issues, Respiratory problems, Aromatherapy, Analgesic, Antipyretic, Antimicrobial	[216]
22	Ravipriya, Neem, Nimb	<i>Melia azadirachta</i>	Meliaceae	Terpenoids, Limonoids, Flavonoids, Steroids, Tannins, Anthraquinones, Spathulenol, Fraxinellone, Kulactone, Apigenin- 5-O- β -D- galactopyranoside	Anti-inflammatory, Anti-arthritic, Anti- spasmodic, Antifungal, Antibacterial, Rodenticidal, Insecticidal	[217]
23	Kadhi patta, Meetha neem, Curry leaves	<i>Murraya koenigii</i>	Rutaceae	Carbazole alkaloids, Terpenoids, Coumarins, Girinimbine, Bismahanine, Bispyrayafoline, Mahanimbine, Koenimbine, Murrayanine, Murrayacine, Murrayazolidine, Murrayazoline, O- methyilmahanine, Isomahanine	Anti-inflammatory, Anti-arthritic, Analgesic, Indigestion, Antioxidant, Dysentery, Antimicrobial, Diabetes management, Hair & Skin health	[218]
24	Chancapiedra	<i>Phyllanthus amarus</i>	Euphorbiaceae	Alkaloids, Glycosides, Flavonoids, Ellagitannins, Phenolpropanoids, Glycosides, Plant asignans	Anti-inflammatory, Anti-arthritic, Analgesic, Antiseptic, Antimicrobial, Anticancer, Anti- fertility, Antidiabetic, Anti- diarrhoeal, Antioxidant,	[219]

					Jaundice, Leprosy, Wound healing	
25	Black pepper, Kali mirch	<i>Piper nigrum</i>	Piperaceae	Alkaloids, Amides, Piperene, Terpenes, Phenolic compounds, Piperidine, derivatives like Guineensine, Piperamide, Piperamine, Piperettine	Anti-inflammatory, Anti-arthritic, Antioxidant, Antibacterial, Digestive aid, Improves metabolism	[220]
26	Pomogranate, Anaar	<i>Punica granatum</i>	Lythraceae	Aregallic acid, Anthocyanins, Ellagitannins, Flavones, Flavonoids, Anthocyanidins, Sterols, Quercetin, Rutin, Fatty acid	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Hypotensive, Hypolipidemic, Anti- atherosclerotic, Anticancer, Antibacterial, Blood tonic, Antidiabetic	[221]
27	Rue	<i>Ruta graveolens</i>	Rutaceae	Rutin, Quercetin, Rutacridone, Rutacridone epoxide, Graveoline, Gravacridonodiol	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Anthelmintic, Antispasmodic, Analgesic, Anticancer	[222]
28	Broomjute sida, Queensland hemp	<i>Sida rhombifolia</i>	Malvaceae	B-phenethylamine, N-methyl- β - phenethylamine, Vasicinol, Vasicinone, Vasicine, Choline, Hypaphorine methyl ester, Hypaphorine, Betaine	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Antimicrobial, Antipyretic, Antibacterial, Gonorrhoea, Nutritive tonic, Piles, Diuretic, Aphrodisiac, Cytotoxic	[223]

29	Haritaki, Hirda, Kadukkai	<i>Terminalia chebula</i>	Combrataceae	Tannins, Flavonoids, Resins, Fixed oils, Amino acids, Sterols, Chebolic acid, Ellagic acid, Chebulagic acid, Chebulinic acid, Gallic acid	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Antibacterial, Antiviral, antifungal, Anti- amoebic, Anti- neoplastic, Anti- plasmodial, Anti- ulcerogenic, Cardioprotective	[224]
30	Fenugreek, Methi	<i>Trigonella foenum graceum</i>	Papilionaceae	Choline, Trigonelline, 4- hydroxyisoleucine, Diosgenin, Galactomannan, Linoleic acid, Palmitic acid, Trimethylamine, Neurin, Gentianine, Carpaine, Betaine, Linolenic acid	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Antidiabetic, Antihyperglycemic, Anticancer, Estrogenic, Wound healing, Hyperlipidaemic, Gastrointestinal ailments	[225]
31	Nirgundi, Gida, Chaste tree	<i>Vitex negundo</i>	Verbenaceae	Nishidine, Flavones, Luteolin-7-glucoside, Casticin, Iridoid glycosides, Vitamin C, β -sitosterol, Phthalic acid	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Headache, Enlarged liver, Syphilis, Cholera, Analgesic, Anticonvulsant, Insecticidal	[226]
32	Chota Datura, Gokhru, Cochlebur, Burdock Datura	<i>Xanthium strumarium</i>	Compositae	Xanthanol, Isoxanthanol, Xanthosin, 4-oxo- bedfordia acid, Hydroquinone, Xanthanolides, Decetylxanthumin, Sesquiterpene lactones like Xanthinin, Xanthumin, Xanthatin; Sulphated glycoside like	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Laxative, Anthelmintic, Tonic, Antipyretic, Antibacterial, Anti- tumour, Anticancer, Anti-tussive, Antifungal, Anti- malarial, Anti- allergic, Anti-	[227]

				Xanthostrumarin, Atractyloside, Carboxyatractyloside	trypanosomal, Hypoglycaemic, Vasorelaxant, Improves appetite	
33	Devil's horsewhip, Apamarga	<i>Acyranthus aspera</i>	Amaranthaceae	Saponin A & B, Oleanolic acid, Ecdysterone, Sterols like β -sitosterol, Spinasterol	Anti-inflammatory, Anti-arthritic, Antioxidant, Antidiabetic, Respiratory disorders, Gastrointestinal issues	
34	Hophead	<i>Barleria lupulina</i>	Acanthaceae	Iridoid glycosides, Phenylpropanoid glycosides, Phenylethanoid glycoside	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant	[228]
35	Huang Cao Wu	<i>Aconitum vilmorinianum</i>	Ranunculaceae	C18-, C19- & C20- diterpenoid alkaloids like Yunaconitine, Vilmorrianine A, Crassicauline A, Bulleyaconitine	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Analgesic	[229]
36	Ground Pine	<i>Ajuga bracteosa</i>	Labiatae	Neo-clerodane diterpenoids, Flavonol glycosides, Iridoid glycosides, Phytoecdysones, Ergosterol-5,8- endoperoxide	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant	[230]
37	Bugle weed	<i>Ajuga decumbens</i>	Lamiaceae	Phytoecdysteroids, Neo-clerodane diterpenoids, Apigenin, Iridoid glycosides	Anti-inflammatory, Anti-arthritic, Anti- osteoporotic, Cartilage repair, Improves joint function, Bone metabolism regulation	[231]
38	Cheese wood, Pattern wood	<i>Alstonia boonei</i>	Apocyanaceae	Triterpenoids like α - amyrin, β -amyrin, Tannins, Flavonoids, Alkaloids	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Analgesic, Anti- pyretic, Anti- malarial, Chronic	[232]

					diarrhoea, Insomnia, Antivenom for snakebites	
39	Acrid weed, Toothcup	<i>Ammania bracifera</i>	Lythraceae	Flavonoids, Tannins, Steroids, Polyphenols, Triterpenes	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Blistering, Analgesic, Antimicrobial, Antimalarial, Wound healing	[233]
40	Elephant creeper	<i>Argyreia speciosa</i>	Convulvulacea e	Ergoline alkaloids, Ergine, Isolysergic acid amide, Sterols like β -sitisterol, Stigmasteryl p- hydroxycinnamate, Oleic acid	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Analgesic, Rejuvenator	[234]
41	Jack in the pulpit	<i>Arisaema rhizomatium</i>	Aroideae	Lectins, Alkaloids, Flavonoids, Steroids, Polysaccharides	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Analgesic, Cartilage protector, Immunomodulation , Cytokine regulation	[235]
42	Pink arnebia, Demok	<i>Arnebia euchroma</i>	Boraginaceae	Shikonin, Acetyl- shikonin, Arnebinone, Arnebin-7, Plumbagin, Naphthaquinones, Phenolic compounds	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Analgesic	[236]
43	Chay	<i>Artocarpus tonkinensis</i>	Moraceae	Quercetin, Kaempferol, Glycosides, Flavonoids, Lignans, Phenols, Phenylated flavones like Artocatoxone	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Antioxidant, Analgesic, Backache, Immunomodulation	[237]

44	Violet asystasia	<i>Asystasia dalzelliana</i>	Acanthaceae	Luteolin, Quercetin, Steroids, Alkaloids, Tannins, Flavonoids	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Antioxidant, Analgesic, Protein denaturation	[238]
45	Carqueja	<i>Baccharis genistelloid es</i>	Asteraceae	Flavonoids, Cirsimaritin, Chlorogenic acid, Diterpenoids like Kingidiol	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Antihypertensive, Antidiabetic, Stomach aches, Kidney infections	[239]
46	Kachnar, Chingthrao	<i>Bauhinias variegata</i>	Caesalpiniacea e	Quercetin, Kaempferol, Flavonoids, Tannins, Terpenoids, Saponins, Phenolic acid	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Antioxidant, Cytokine modulation	[240]
47	Paashaanbhe d	<i>Bergenia stracheyi</i>	Saxifragaceae	Bergenin, Gallic acid, Catechin, Arbutin	Anti-inflammatory, Immunomodulation , Headache, Antihypertensive, Stomach-ache, Kidney & Urinary disorders, Diarrhoea	[241]
48	Punarnava	<i>Boerhaavia diffusa</i>	Nyctaginaceae	Boeravinones, Punarnavine, Rotenoids, Flavonoids, Glycosides, Syeroids, Ecdysteroids, Lignans	Anti-inflammatory, Anti-arthritis, Antioxidant, Digestive issues, Kidney issues, Liver issues	[242]
49	Palash, Keshu	<i>Butea monosperm a</i>	Fabaceae	Butrin, Isobutrin, Palasitrin, Butein, Chalcones	Anti-inflammatory, Anti-arthritis, Antioxidant, Anti- autophagy, Used in treatment of Gout and Joint pain	[243]
50	Sappanwood	<i>Caesalpi ni a sappan</i>	Leguminosaceae	Brazilin, Protosappanin A, Sappanol, Sappanone A, Sappanchalcone,	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Anti- osteoarthritic,	[244]

				Neoprotosappanin, Homoisoflavonoids	Antioxidant, Antidiabetic, Anticancer, Wound healing, GIT protection, Blood purifier, Cardioprotective	
51	Milkweed, Sodom apple	<i>Calatropis procera</i>	Apocynaceae	Cardenolides, Steroids, Glycosides, Flavonoids, Terpenoids	Anti-inflammatory, Analgesic, Anti- arthritic, Detoxification	[245]
52	Kingcup, Marsh marigold	<i>Caltha palustris</i>	Ranunculaceae	Phenolic compounds, Flavonoids, Polysaccharide	Anti-inflammatory, Antioxidant, Immunomodulatory , Anti-arthritic	[246]
53	Odabirni	<i>Smithia sensitiva</i>	Fabaceae	Flavonoids, Tannins, Steroids, Alkaloids	Anti-inflammatory, Anti-arthritic, Headache, Cooling agent, Galactagogue	[247]
54	Flamingo Lily	<i>Capparis erythrocarp us</i>	Capparaceae	Sterols like Daucosterol, β - sitosterol 3- myristate, Betulinic acid	Anti-inflammatory, Anti-arthritic, Anti- rheumatic, Blurred vision, Urinogenital pain, Otitis	[248]
55	Balloon plant	<i>Caediosper mum halicacabu m</i>	Spindaceae	Apigenin, Luteolin, Chryseriol, Chlorogenic acid, Caffeic acid, Coumaric acid, Oleic acid, Linoleic acid	Anti-inflammatory, Anti-arthritic, Antioxidant	[249]
56	One leaf senna	<i>Cassia uniflora</i>	Caesalpiniacea e	Plant sterols like β - sitosterol, Lupeol; Anthraquinones, Flavonoids, Tannins, Alkaloids, Terpenoids	Anti-inflammatory, Analgesic, Anti- arthritic, Antioxidant,	[250]
57	Tayuya	<i>Cayaponia tayuya</i>	Cucurbitaceae	Cucurbitacins, 23,24- dihydrocucurbitacin B, Cucurbitacin R,	Anti-inflammatory, Analgesic, Antioxidant, Anti- arthritic, Detoxification, Blood purifier	[251]

58	Gua shan fena	<i>Celastrus aculeatus</i>	Celastraceae	Triterpenes like Celastrol, Flavonoids like Epiafzelechin, Sesquiterpenes like Orbiculin F	Anti-inflammatory, Anti-arthritic, Anti-rheumatic, Antioxidant, Bone-protective, Anti-osteoarthritis, Immune modulation,	[252]
59	Brahmi Booti	<i>Centella asiatica</i>	Mackinlayaceae	Terpenoids like Asiaticoside, Madecassoside, Asiatic acid, Medacassic acid, Phenolic compounds, Phytosterols	Anti-inflammatory, Anti-arthritic, Anti-rheumatic, Antioxidant, Protection against cartilage damage, Immunomodulation	[253]
60	Abuta, Barbacso, Bututa	<i>Cissampelos pareira</i>	Menispermaceae	Isoquinolines alkaloids like Magnoflorine, Magnocurarine, Cycleanine, Hayatinine; Tropanoisoquinoline alkaloids like Pareirubrunes A & B	Anti-inflammatory, Anti-arthritic, Antioxidant, Anti-rheumatic, Analgesic	[254]
61	Tetterwort	<i>Chelidonium majus</i>	Papavareceae	Chelidonine, Berberine, Sanguinarine, Chelerythrine, Hydroxycinnamic acid amides, Flavonoids, Phenolics	Anti-inflammatory, Anti-arthritic, improves eyesight, Mild sedative, Antispasmodic, Bronchitis, Whooping cough, Asthma, Jaundice, Gallstones, Gallbladder pain	[255]
62	Shone cabbage	<i>Cleome gyandra</i>	Clomaceae	Flavonoids like Quercetin, Rutinoside, Kaempferol; Phenolic compounds like p-coumaric acid, Caffeic acid; Steroids like Stigmasterol, Campsterol, β -sitosterol; Carotenoids like α , β , γ , δ carotene;	Anti-inflammatory, Anti-arthritic, Antioxidant, Anti-rheumatic, Analgesic, Restoration of biochemical parameters, Anticancer, Antifungal Antiparasitic	[256]

				Saponins, Tannins, Glycosides		
63	White gilmohar, Waykaran	<i>Delonix elata</i>	Ceasalpinoidea	Flavonoids like Quercetin; Phenolic compounds like Gallic acid, Coumaric acid; Tannins, Saponins, Steroids, Glycosides	Anti-inflammatory, Anti-arthritis, Antioxidant, Anti-rheumatic, Analgesic, Abdominal pain	[257]
64	Japanese teasel root	<i>Dipascus asperoides</i>	Dispsacaceae	Saponins like Akebia saponin D; Iridoids like Loganin, Sweroside; Phenolic acid like Chlorogenic acid	Anti-inflammatory, Anti-arthritis, Antioxidant, Anti-rheumatic, Analgesic, Bone fractures and Anti-osteoporotic, Lumbar and knee pain, preserve cartilage, Inhibits MMPs	[258]
65	Oak leaf fern	<i>Drynaria quercifolia</i>	Polypodiaceae	Flavonoids and Phenolics like Naringin; Saponins, Coumarins, Steroids, Triterpenes, Fatty acids like 9-octadecanoic acid and Ketostearic acid	Anti-inflammatory, Anti-arthritis, Antioxidant, Anti-rheumatic, Analgesic, Reduced tissue damage,	[259]
66	Rudraksha, Blue marble tree, Indian oil fruit	<i>Elaecarpus sphaericus</i>	Elaecaepaceae	Alkaloids like Eloecarpidine, Eloecarpine; Flavonoids, Glycosides, Tannins like Gallic acid, Ellagic acid; Steroids, Fatty acids	Anti-inflammatory, Anti-arthritis, Antioxidant, Anti-rheumatic, Analgesic	[260]
67	Ma Haung, Somalata	<i>Ephedra sinica</i>	Ephedraceae	Ephedranin A & B, Acidic polysaccharides like ESP-B4, Ephedrine, Pseudoephedrine, Flavonoids, Phenolic compounds	Anti-inflammatory, Anti-arthritis, Antioxidant, Anti-rheumatic, Respiratory relief, Oedema, Fever, Hypotension	[261]

68	Antique spurge	<i>Euphorbia antiquorum</i>	Euphorbiaceae	Igenane-type diterpenoids, Triterpenoids like Euphol, Cycloartenol, Cycloeucalenol, Taraxerol, Friedelanol; Tannins, Flavonoids, Coumarins	Anti-inflammatory, Anti-arthritic, Antioxidant, Anti-rheumatic, Analgesic, wound healing, Stomach ailments, Diabetes, Skin infections, As Purgative	[262]
69	Banyan tree, Bargad	<i>Ficus bengalensis</i>	Moraceae	Flavonoids, Phenols, Terpenoids, Saponins, Steroids like Taraxosterol, β -sitosterol; Rutin, Quercetin-3-galactoside, Lupeol	Anti-inflammatory, Anti-arthritic, Antioxidant, Anti-rheumatic, Immunomodulatory, Analgesic	[263]
70	Maidenhair	<i>Ginkgo biloba</i>	Ginkgoaceae	Rutin, Quercetin, Kaempferol, Isorhamnetin, Ginkgolide B, Ginkgolide C, Bilobalide	Anti-inflammatory, Anti-arthritic, Antioxidant, Anti-rheumatic, Improves blood flow, Cartilage protection	[264]
71	Orange berry	<i>Glycomis pentaphylla</i>	Rutaceae	Flavonoids, Phenolic compounds, Alkaloids, Tannins	Anti-inflammatory, Anti-arthritic, Antioxidant, Anti-rheumatic, Protection against oxidative stress, Fever, Cough, Anaemia, Bronchitis, Liver disorders	[265]
72	European ivy	<i>Hedera helix</i>	Araliaceae	Flavonoids like Rutin, Quercetin, Kaempferol; Triterpene saponins like Hederagenin; Phenolic compounds like Caffeic acid, Chlorogenic acid	Anti-inflammatory, Antioxidant, Analgesic, Anti-osteoarthritic, Anti-rheumatic, Respiratory disorders	[266]
73	Indian sarasparila	<i>Hemidesmus indicus</i>	Asclepiaceae	Terpenoids, Flavonoids, Polyphenols, Sterols	Anti-arthritic, Anti-inflammatory, Anti-rheumatic,	[267]

				& Phenolic compounds like Stigmasterol, β -sitosterol; Aldehyde – 2-hydroxy-4-methoxybenzaldehyde, Lupeol	Analgesic, Anticancer, Hepatoprotective, Antioxidant, Snake bites, Leprosy, Fever, Syphilis, Dysentery	
74	Mata piojo cancerina	<i>Hippocratea excelsa</i>	Hippocreataceae	Canophyllol, Canophyllic acid, Friedelin, Galactitol, Triterpenes like Pristimerin, Tingenone,	Anti-inflammatory, Anti-arthritic	[268]
75	Humpback flower	<i>Hybanthus enneaspermus</i>	Violaceae	Alkaloids, Flavonoids, Tannins, Glycosides, Steroids & Triterpenes like Isoarborinol & β -sitosterol	Anti-inflammatory, Anti-arthritic, Antimicrobial, Antidiabetic, Urinary issues, Dysentery, Wounds	[269]
76	Physic nut	<i>Jatropha isabellei</i>	Euphorbiaceae	Jatrophone	Anti-inflammatory, Anti-arthritic, Analgesic, Anti-rheumatic, Antinociceptive effect, Hypouricemic effect	[270]
77	Willow leaved justice	<i>Justicia gendarussa</i>	Acanthaceae	Flavonoids like Luteolin, Naringenin, Kaempferol; Alkaloids like Justridisamide A, B, C, & D; Terpenoids and steroids like Friedelin, Lupeol, β -sitosterol; Fatty acids, Phenolic compounds	Anti-inflammatory, Anti-arthritic, Analgesic, Anti-rheumatic	[271]
78	Mukago-irakusa	<i>Laportea bulbifera</i>	Urticaceae	Phenolic compounds like chlorogenic acid, Neochlorogenic acid, Isobarbutenol; Flavonoids like Rutin, Quercetin, Luteoloside; Coumarins	Anti-inflammatory, Anti-arthritic, Analgesic, Anti-rheumatic, Immunosuppressive, dispelling dampness, Promoting blood circulation	[272]

79	Henna, Mehendi	<i>Lawsonia inermis</i>	Lytharaceae	Lawson, Flavonoids like Apigenin, Luteolin, Quercetin; Phenolic compounds, Alkaloids	Anti-inflammatory, Anti-arthritis, Analgesic, Anti-rheumatic, wound healing, Skin infections, Microbial infections, Diabetes, Ulcers, Digestive issues, Liver protection, Immunomodulation	[273]
80	Thumbai	<i>Leucas aspera</i>	Lamiaceae	Phenolic compounds like Procyanidin, Epicatechin; Phytosterols like β -sitosterol; Sterols, Glycosides, Terpenoids	Anti-inflammatory, Anti-arthritis, Analgesic, Antioxidant, Analgesic, Anti-pyretic, Wound healing, Antimicrobial	[274]
81	Flax	<i>Linum usitatissimum</i>	Linaceae	α -linolenic acid, Omega-3-fatty acid, Lignans, Phenolic compounds like Chlorogenic acid and Ferulic acid	Anti-inflammatory, Anti-arthritis, Analgesic, Antioxidant, Analgesic, Anti-osteoarthritis, helps to lose weight, improves digestion, Regulates blood sugar levels and cholesterol levels	[275]
82	Japanese honey suckles	<i>Lonicera japonica</i>	Caprifoliaceae	Phenolic acid like Caffeic acid, Chlorogenic acid; Iridoids like Vogeloside, Secologanin; Flavonoids like Luteolin, Quercetin	Anti-inflammatory, Antibacterial, Anti-arthritis, Anti-rheumatic, Analgesic, Antiviral, Antioxidant, Hepatoprotective	[276]
83	Geisel	<i>Malotus oppositifolium</i>	Euphorbiaceae	Phloroglucinol derivatives like Mallotojaponin B, C & D, Acronyculatin U & T; Flavonoids, Sterols, Saponins, Glycosides, Anthocyanins	Anti-inflammatory, Antioxidant, Anti-arthritis, Anti-rheumatic, Analgesic, wound healing, Eye infection, Depression, Infections, Headache,	[277]

					Paralysis, Antibacterial, Antifungal, Kidney infections, Spasms, Aphrodisiac, Oral hygiene	
84	Kupit-kupit, Mudiarkunthal	<i>Merremia emarginata</i>	Convolvulaceae	Phenolic compounds, Flavonoids like 3,4-dicaffeoylquinic acid, 3,5-dicaffeoylquinic acid, 4,5-dicaffeoylquinic acid; Terpenoids	Anti-inflammatory, Antioxidant, Anti-arthritic, Anti-rheumatic, Analgesic, Diuretic, Antimicrobial, Antidiabetic, Nephroprotective	[278]
85	Turpeth	<i>Operculina turpethum</i>	Convolvulaceae	Turpethinic acids A-E, Turpethin, Flavonoids, Glycosides, Saponins, Scopoletin, Steroids like Betulin, Lupeol, β -sitosterol	Anti-inflammatory, Analgesic, Autoimmune modulation, Protein denaturation, Laxative, Ulcer protection, Anti-diarrhoeal, Hepatoprotective	[279]
86	Ginseng	<i>Panax ginseng</i>	Araliaceae	Terpenoid saponins like Ginsenoside Rg1, Rg3 & compound K	Anti-inflammatory, Immunomodulatory, Anti-arthritic, Analgesic, Anti-rheumatic, Anti-osteoporotic	[280]
87	Fisalia	<i>Physalis angulate</i>	Solanaceae	Withanolide, Physalin, Ursolic acid, Emodin, Flavonoids like Quercetin	Anti-inflammatory, Antioxidant, Anti-arthritic, Anti-rheumatic, Analgesic, Wound healing, Immunomodulation	[281]
88	Maritime pine	<i>Pinus maritime</i>	Pinaceae	Procyanidins, Polyphenols, Taxifolin, Catechin, Phenolic acids like Benzoic acid, Cinnamic acid, Ferulic acid	Anti-inflammatory, Antioxidant, Analgesic, Anti-arthritic, Anti-rheumatic, Anti-osteoporotic, Chondroprotective, Enzyme inhibition, Improved circulation & Physical function	[282]

89	Tambula, Paan	<i>Piper betel</i>	Piperaceae	Chavibetol, Chavicol, Hydroxychavicol, Eugenol, Camphene, Caryophyllene, Saffrole, Terpenoids	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Dietary uses, Topical application	[283]
90	Grand devil's-claw	<i>Pisonia grandis</i>	Nyctaginaceae	Pinitol, Allantoin, β - sitosterol, Quercetin, Flavonoids, Steroids, Glycosides	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Prevents joint damage	[284]
91	Water lettuce	<i>Pistia stratiotes</i>	Araceae	Alkaloids, Glycosides, Flavonoids, Saponins, Triterpenoids, Sterols and Phytosterols like Stigma-sterol, Stigma-steryl, Palmitic acid	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- pyretic, Anti- rheumatic, Antifungal, Antibacterial, Antidiabetic, Expectorant	[285]
92	Oyster mushroom	<i>Pleurotus sajorcaju</i>	Pleurotaceae	Polysaccharides like Mannose, Mannogalactan, Galactose, 3-O- methyl-galactose, β - 1,3- glucanooligosachharid es; Phenolic compounds like Chlorogenic acid, Vanillic acid	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- rheumatic, Anti- osteoporotic, Bone protection, Inhibition of inflammatory mediators, Immunomodulation	[286]
93	Agnimantha	<i>Premna serratifolia</i>	Verbenaceae	Iridoid glycosides, Flavonoids, Alkaloids, Phenolic compounds, Phenylethanoid glycosides like Isoacteoside	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Antiparasitic, Skin diseases, Cardiovascular health, Gastrointestinal issues, Jaundice, Anti-rheumatic, Anorexia	[287]
94	Hard cedar, Senegals basari	<i>Pseudocdre a kotschy</i>	Meliaceae	Limonoids like Phragmalin, Orthoacetates, 7- deacetylgedunin; Triterpenes,	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- rheumatic	[288]

				Kotschyins, Flavonoids, Alkaloids, Steroids, Tannins		
95	Chinese lacquer tree	<i>Rhus verniciiflua</i>	Anacardeaceae	Sulfuretin, Fisetin, Fustin, Butein	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Reduced synovial and cytokine cell activity, Anti- allergic, Liver protective, Neuroprotective	[289]
96	Khothala himbutu	<i>Salacia reticulate</i>	Celastraceae	Polyphenols like Epicatechin, Leucopelargonidin, Epicatechin, Mangiferin; Triterpenoids like Salacinol, Katalanol, Neokotalanol, 26- hydroxy-1,3- friedelanedione; Tannins	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- rheumatic, Osteoclast regulation, Cell proliferation inhibition, Skeletal protection, Diabetes, Skin diseases, Gonorrhoea, Antibacterial	[290]
97	Black willow	<i>Salix nigra</i>	Saliaceae	Salicin, Salicylic acid, Salicortin, Flavonoids, Tannins	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- rheumatic,	[291]
98	Sorrow less	<i>Saraca asoca</i>	Rubiaceae	Flavonoids, Steroids, Glycosides, Tannins, Saponins, Phenolic compounds like Gallic acid, Ellagic acid	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- rheumatic, Biochemical regulation, Cartilage protection, Immunomodulation	[292]
99	Bhallatak	<i>Semecarpus anacardium</i>	Anacardiaceae	Phenolic compounds like Anacardic acid, Bhilawanols, Cardol; Bioflavonoids like Amentoflavone, Nallaflavanone,	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Immunomodulation , COX inhibition,	[293]

				Galluflavanone, Jeediflavone	Carminative, Tonic, Aphrodisiac, Leucoderma, Asthma, Nervous debilities	
100	Tudurafuji	<i>Sinomeniu m acutum</i>	Menispermaceae	Sinomenine, Sinomenium, Morphine, Aporphine, Protoberberine, Lignans, Triterpenes, Sterols, Phospholipids	Anti-rheumatic, Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Histamine release, Immunomodulation , Gout, Ankylosing spondylitis, Inhibition of Synovial Hyperplasia	[294]
101	Kurara worm killer	<i>Sophora flavescens</i>	Fabaceae	Prenylated flavonoids like Sophoraflavanone G, Kurarinone, Kurardin, Matrine, Oxymatrine	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- rheumatic, Anti- osteoporotic	[295]
102	Marudona	<i>Strobilanthes callosus</i>	Acanthaceae	Triterpenoids like Lupeol, Taraxerol; Flavonoids, Phytosterol, Tannins	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- rheumatic, Anti- osteoporotic	[296]
103	Clearing nut tree	<i>Strychnos potatorum</i>	Loganiaceae	Alkaloids like Diaboline, Tannins, Phenolic compounds, Saponins, Glycosides	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Haematological and biochemical normalization, Improved lysosomal stability	[297]
104	Upright hedge parsley	<i>Troilium japonica</i>	Apiaceae	Troilium, Flavonoids, Terpenes, Fatty acids, Steroids	Anti-inflammatory, Antioxidant, Analgesic, Anti- arthritic, Anti- rheumatic, Anti- osteoporotic, Skin conditions, Antiviral, Antibacterial Dysentery,	[298]

					Haemorrhoids, Spasms	
105	Atlantic poison oak	<i>Toxicodendron pubescens</i>	Anacardiaceae	Urushiol, Flavonoids, Alkaloids, Triterpenes, Polysaccharides	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Analgesic, Immunomodulation	[299]
106	Gambhari, Prathinidhi	<i>Trewia polycarpa</i>	Euphorbiaceae	Terpenoids, Quinones, Glycosides, Alkaloids, Flavonoids	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Analgesic, Antioxidant, Antinociceptive	[300]
107	Ghamra	<i>Tridax procumbens</i>	Asteraceae	Flavonoids like Catechins, Centaurein, Bergenins; Alkaloids, Tannins, Saponins, Fatty acids, Steroids, Carotenoids	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Analgesic, Antioxidant, Bone resorption inhibition, Bone formation promotion, Gout	[301]
108	Roman nettle	<i>Urtica pilulifera</i>	Urticaceae	Flavonoids like Quercetin, Kaempferol; Phenolic acid like Ferulic acid, p- coumaric acid, Lignans, Polysaccharides, Glycosides	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Analgesic, Antioxidant	[302]
109	Bitterleaf	<i>Veronica cinerea</i>	Asteraceae	Sesquiterpene lactone like Vernolide A & B; Flavonoids like Resveratrol, Quercetin, Catechin; Terpenoids like β - amyrin, Lupeol, Sitosterol; Alkaloids, Steroids, Phenolics	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Analgesic, Antioxidant	[303]
110	Indian winter cherry	<i>Withania somnifera</i>	Solanaceae	Ashwagandhanolide, Quercetin, Withaferin A, Withanone, Withanolide A	Anti-inflammatory, Anti-arthritis, Anti- rheumatic, Analgesic, Antioxidant, Anti- osteoporotic, Cartilage protection	[304]

111	Spanish dagger	<i>Yucca schidigera</i>	Liliaceae	Steroidal saponins, Polyphenolic compounds like Resveratrol, Yuccaols	Anti-inflammatory, Anti-arthritic, Anti-rheumatic, Analgesic, Antioxidant, Animal feed additive	[305]
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Table 2 Herbal drugs containing Anti-arthritic potential**REFERENCES**

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