

HERBAL PLANTS USED IN TREATMENT OF RHEUMATOID ARTHRITIS: A REVIEW

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ABSTRACT

Rheumatoid arthritis is chronic, progressive, disabling autoimmune disease characterized by systemic inflammation of joints, damaging cartilage and bone around the joints. It is a systemic disease which means that it can affect the whole body and internal organs such as lungs, heart and eyes. Although numbers of synthetic drugs are being used as standard treatment for rheumatoid arthritis but they have adverse effect that can compromise the therapeutic treatment. Unfortunately, there is still no effective known medicinal treatment that cures rheumatoid arthritis as the modern medicine can only treat the symptoms of this disease that means to relieve pain and inflammation of joints. It is possible to use the herbs and plants in various forms in order to relieve the pain and inflammation in the joints. There are so many medicinal plants that have shown anti rheumatoid arthritis properties. So the plants and plant product with significant advantages are used for the treatment of rheumatoid arthritis. The present review is focused on the medicinal plants having anti rheumatoid arthritis activity.

Keywords: Rheumatoid arthritis, Autoimmune disease, Herbs, Joints, Medicinal plants, Systemic inflammation.

INTRODUCTION

Rheumatoid arthritis is a systemic disease and it involve rheumatoid nodules, vasculitis, eye inflammation, cardio pulmonary disease are manifestation of the disease¹. Rheumatoid arthritis is not an inherited disease. Researchers believe that some people have genes that make them susceptible to the disease. People with these genes will not automatically develop rheumatoid arthritis. There is usually a "trigger," such as an infection or environmental factor, which activates the genes. When the body is exposed to this trigger, the immune system responds inappropriately. Instead of protecting the joint, the immune system begins to produce substances that attack the joint. This is what may lead to the development of rheumatoid arthritis. It is autoimmune disease which means the body's immune system mistakenly attack on healthy tissues. The normal joint lining is very thin and it has very few blood vessels in it but in the rheumatoid arthritis joints the lining is very thick and crowded with the white blood cells. The white blood cells secrete chemical substances like interleukin-1 (IL-1) and tumor necrosis factor alpha (TNF-alpha) that produce pain, joint swelling and joint damage. Recent discoveries shows the presence of novel cytokines like IL-17, IL-18^{2,3} and RANK ligand (RANKL) in the pathogenesis of chronic arthritis.

These cytokines stimulate synovial fibroblasts and chondrocytes in the nearby articular cartilage to secrete enzymes that degrade proteoglycans and collagen, leading to tissue destruction⁴. By the release of various cytokines and mediators of inflammation, the

synovial starts proliferate and spreading, this is called as pannus. Fibrosis is the next stage and lead to the loss of joint mobility this stage is called as ankylosis.

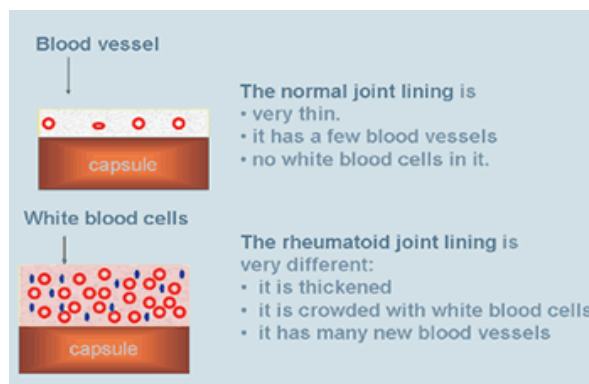


Fig. 1: Difference between normal joint lining and rheumatoid joint lining

In the rheumatoid arthritis the synovial membrane become thickened and cartilages are eroded. The synovial membrane invades the space between joints and the whole joint is swollen and become painful on movement.

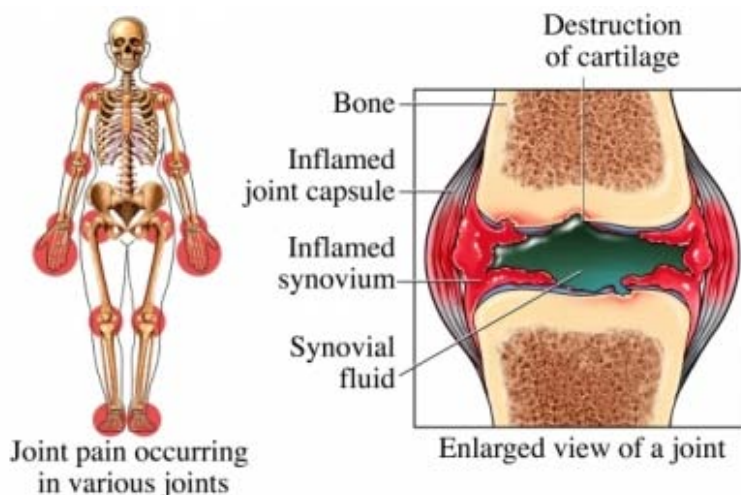


Fig. 2: Rheumatoid arthritis joint

Symptoms include joint swelling, pain, morning joint stiffness, poor sleep, fatigue, loss of weight and feeling of having flu symptoms. Rheumatoid arthritis is diagnosed by rheumatoid factor, these are abnormal antibodies (IgG) which are present in blood. These are reacted with antigen and form antigen-antibody complex that leads to pain and inflammation of synovial membrane. The American College of Rheumatology requires at least four of the following seven criteria to confirm the diagnosis^{6,7}:

- Morning stiffness around the joint that lasts at least 1 hour
- Arthritis of three or more joints for at least 6 weeks
- Arthritis of hand joints for at least 6 weeks
- Arthritis on both sides of the body for at least 6 weeks
- Rheumatoid nodules under the skin
- Rheumatoid factor present in blood testing
- Evidence of rheumatoid arthritis on X-rays

Affecting almost 1-2 % of the population globally and attacking women thrice as commonly as men. Rheumatoid arthritis is one of

those conditions on which billions of dollars are spent every year for the treatment and research.

Before the discovery of synthetic drugs man was completely depends on the medicinal plants for the treatment of disease. The medicinal value of plants has been recognized by every person of this society. In the nineteenth or earlier centuries natural product extracts, particularly those derived from botanical species, provided the main source of folk medicines. However, in the latter part of the nineteenth century, biologically-active organic molecules began to be isolated in relatively pure form for medicinal use. For example, salicylic acid, the precursor of aspirin, was isolated in 1874 from willow bark. There are numerous other examples. There are many synthetic drugs that are being used as standard treatment for rheumatoid arthritis but they have adverse effect that can compromise the therapeutic treatment so these adverse effects increase the chances for the use of herbal plants for the rheumatoid arthritis treatment. The present review is dedicated to the medicinal plants that are used in the treatment of rheumatoid arthritis.

List of medicinal plants used in the rheumatoid arthritis treatment: The plants possess the anti-rheumatoid arthritis properties are given below:

Aloe vera Linn.

Biological Name: *Aloe barbadensis*

Common Name: Curacao aloe, Lily of the desert

Family: Liliaceae



Fig. 3: *Aloe barbadensis*

Aloe barbadensis is cultivated in Europe and in many parts of India, including north-west Himalayan region. Aloe vera has been one of the most important plants used in folk medicine. Anthraquinone, anthracene, cinnamic acid and anthranilic acid are found in the Aloe vera plants that are responsible for its activity. Aloe vera is used in variety of skin ailments such as mild cuts, insect stings, bruises, poison ivy and eczema. It has also antibacterial and antifungal

properties, used as blood purifier, anti-inflammatory, diuretic, uterine tonic, spermatogenic, laxative, purgative and fever reliever. The anti arthritis property of aloe vera is due to the anthraquinone compound. Aloe vera stimulates the immune system and it is a powerful anti-inflammatory agent. Topical application of aloe vera extract result in the reduction of inflammation and arthritis in adjuvant induced arthritis in Sprague Dawley rats^{8,9,10}.

Ashwagandha

Biological Name: *Withania somnifera* Linn.

Common Name: Winter cherry, withania root

Family: Solanaceae

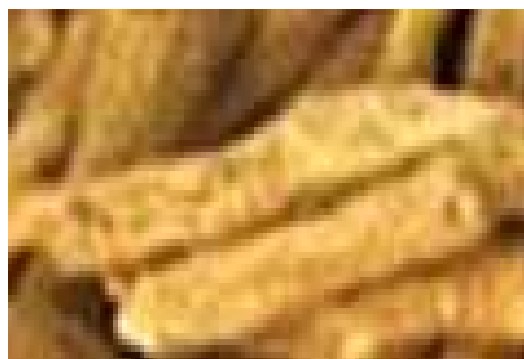


Fig. 4: *Withania somnifera* Linn. dried roots

Ashwagandha also known as Indian ginseng, is an important ancient plant. The roots of Ashwagandha have been employed in Indian traditional systems of medicine, Ayurveda and Unani. It grows in dry parts in sub-tropical regions, Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujarat, Maharashtra and Madhya Pradesh. The

pharmacological activity of the root is attributed to the alkaloids and steroidal lactones. Among the alkaloids, withanine, withanone, pseudo-withanine, tropine, pseudo-tropine, somniferine, somnine are mainly present. Two acyl glucosides viz sitoindoside-7 and sitoindoside-8 have been isolated from roots. The plant has been

used as an aphrodisiac, liver tonic, anti-inflammatory agent, and more recently to treat asthma, ulcers, insomnia, and senile dementia. Clinical trials and animal research support the use of Ashwagandha for anxiety, neurological disorders, inflammation, and Parkinson's disease. Incorporation of Ashwagandha in the diet may prevent or

decrease the growth of tumors in human. It helps in providing progressive, long lasting results for various health concerns like aging, anemia, arthritis, fatigue, sports fitness and stress-disorders. Oral administration of *Withenia somnifera* Linn., root powder showed the anti arthritic effect in adjuvant induced arthritic rats^{11,12}.

Shallaki

Biological Name: *Boswellia serrata* Linn.

Common Name: Boswellia/Indian Frankincense

Family: Burseraceae



Fig. 5: *Boswellia serrata* Linn.

Boswellia serrata Linn., is a moderate to large branching tree found in India, Northern Africa, and the middle east. In India it is found in Bihar, Madhya Pradesh and Gujarat. Strips of boswellia bark are peeled away, yielding a gummy-oleo resins. It contains β - boswellic acid in resin portion, which has shown anti-inflammatory, anti-atherosclerotic and anti-arthritic activities. Extract of this gummy oleo resins have also been used as astringent, stimulant, expectorant, anti-septic, juvenomimetic, anti-atherosclerotic, analgesic and sedative. It is also known to regain integrity of the

vessel in the joints from damage or spasm. Boswellia mainly contain volatile oil, terpenoids and sugars. Extract of *boswellia serrata* have natural anti-inflammatory activities at sites where chronic inflammation is present by switching off pro-inflammatory cytokines and mediators which initiates the process. Non steroidal anti inflammatory drugs can cause a breakdown of glycosaminoglycan synthesis which can accelerate the articular damage in arthritic conditions where as *Boswellia serrata* Linn., reduces the breakdown of glycosaminoglycan synthesis^{13,14,15}.

Black pepper

Biological Name: *Piper nigrum* Linn.

Common Name: Pepper

Family: Piperaceae



Fig. 6: Black pepper (peppercorns)

Black pepper is indigenous and cultivated in South India. It is also cultivated in Indonesia, Brazil, Malaysia and Shrilanka. India ranks first in the cultivation of this drug. Piper contains an alkaloid piperine, volatile oil, pungent resins, piperidine and starch. It is used as a aromatic, stimulant, stomachic and carminative. It increases the

secretion of gastric juices. It also increases the bio-availability of certain drugs. Piperine isolated from black pepper. Piperine administered orally at a dose of 20 and 100 mg/kg/day for eight days cause decrease in the arthritic symptoms in carrageenan-induced acute paw arthritis^{16,17}.

Black cohosh

Biological Name: *Actaea racemosa* Linn.

Common Name: Black snakeroot, bugwort

Family: Ranunculaceae



Fig. 7: *Actaea racemosa* Linn.

Black cohosh is a smooth herbaceous perennial herb. It is native to eastern North America from extreme south of Ontario to central Georgia, and west to Missouri and Arkansas. The roots and rhizomes of black cohosh have long been used medicinally by Native Americans. Several chemical compounds have been extracted from the black cohosh plant, including acteina, cimigoside, steroidal

terpenes, and 27-deoxyactein. Other constituents include tannins, salicylic acid, and an isoflavones, formononetine. It is used in arthritis, diarrhea, diuresis, dyspepsia, kidney problems, malaria, snake bite and as an insect repellent. It is used for treating a variety of female health problems, particularly menopause Black cohosh decrease the inflammation produce due to the arthritis^{18, 19, 20}.

Cat's claw

Biological name: *Uncaria tomentosa*

Common Name: Hawk's claw, saventaro

Plant family: Rubiaceae



Fig. 8: *Uncaria tomentosa*

Cat's claw is a woody vine that grows in the tropical jungle of South and Central America, and it derived its name from its claw shaped thorns. It contains several alkaloids, tannins that are responsible for its medical effects. It contain phytochemicals like Ajmalicine, akuammigine, campesterol, catechin, chlorogenic acid, cinchonain, corynantheine, corynoxine, daucosterol, epicatechin, harman, hirsuteine, hirsutine, iso-pteropodine, loganic acid, lyaloside, mitraphylline, oleanolic acid, palmitoleic acid, procyanidins,

pteropodine quinovic acid glycosides, rhynchophylline, rutin, sitosterols, speciophylline, stigmasterol, strictosidines²¹. It is used in the cancer, in HIV infection, anti-inflammatory, anti-oxidant^{22, 23}, gastric ulcers, chron's disease, tumors, diabetes, chronic fatigue disease. It is also used as anti bacterial agent. Animal study of anti inflammatory activity of cat's claw extract showed the ability to reduced paw edema in carragenan induced inflammation rat model^{24, 25, 26}.

Ginger

Biological Name: *Zingiber officinale*

Common Name: Ginger root

Family: Zingiberaceae



Fig. 9: Ginger rhizome

Ginger is the one of the most useful herbal supplement. It native of South East Asia, but it is cultivated in Caribbean island, Africa, Australia, Mauritius, Taiwan and Indi. More than 30 % production in India. Ginger is consists of volatile oil, starch, fat, fibre, inorganic material, residual moisture. Ginger oil contains monoterpene, hydrocarbons, sesquiterpene hydrocarbons, oxygenated mono and sesquiterpenes. Ginger is used as stomachic, an aromatic, a

carminative, stimulant, flavouring agent. It is used to treat nausea, vomiting, diarrhea. It is also used as antioxidant, anti-inflammatory, antiseptic, anticarcinogenic, antifungal, anti-microbial. Ginger extract is one of the effective arthritis joint pain remedies recommended by physicians. Main constituents are sesquiterpenoids, with (-) zingiberene. Sesquiterpene Lactones (SLs) are natural products responsible for its anti-inflammatory activity^{27, 28, 29, 30}.

Turmeric

Biological name: *Curcuma longa* Linn.

Common Name: Turmeric root, Indian saffron

Plant family: Zingiberaceae



Fig. 10: Turmeric rhizome

Turmeric is cultivated for its rhizome in India, China, Shrilanka, Indonesia, Jamaica, Peru. Turmeric contains volatile oil, resins, starch grains and yellow color substances known as curcuminoids. The chief component of curcuminoids is known as curcumin. Curcumin, a natural compound present in the rhizomes of plant *Curcuma longa*, demonstrated its anti inflammatory action³¹. It is

used in wound healing, hepatoprotection and neuroprotection etc. It has antimutagenic, antispasmodic, antimicrobial and anticancer activities. Daily ip administration of the low dose of purified curcuminoids (4 mg total curcuminoids/kg/d) inhibited joint inflammation in both the acute and chronic phases of arthritis^{32, 32, 33, 34}.

Milkweed

Biological Name: *Calotropis Procera* Linn.

Common name: Giant Swallow Wort

Family: Asclepiadaceae



Fig. 11: *Calotropis procera* Linn.

Calotropis procera Linn., is a species of flowering plant in the dogbane family Apocynaceae, that is native to North Africa, Tropical Africa, Western Asia, South Asia, and Indochina. Different parts of this plant have been reported to exhibit anti inflammatory, analgesic, antioxidant and antifungal activity. The latex of this plant has potent anti-inflammatory property in various animal models. The latex petroleum extract shows significant antimicrobial activity³⁵. Both latex and its

methanolic extract have been shown to inhibit the inflammatory cell influx and edema formation induced by various inflammagens. It also improves locomotor functions in experimentally induced monoarthritis in rats. In cotton pellet induced granuloma and carrageenan-induced paw edema model, roots of *Calotropis Procera* Linn., at doses of 180 mg/kg (methanol extract) and 200 mg/kg (other extracts), show anti-inflammatory activity^{36, 37, 38}.

Green tea

Biological Name: *Camellia sinensis* Linn.

Common Name: Green tea extract, Chinese tea

Family: Theaceae



Fig. 12: *Camellia sinensis* Linn.

Camellia sinensis Linn., is an evergreen shrub or small tree. *Camellia sinensis* Linn., is native to mainland China, South and Southeast Asia, now cultivated across the world in tropical and subtropical regions. The active constituents of *Camellia sinensis* Linn., are polyphenols (catechins and flavonols). Other constituents are caffeine and essential oils. The most important catechin in Green Tea is (-)

epigallocatechin that is a potent antioxidant. The reduced collagen induced arthritis incidence and severity was reflected in a marked inhibition of the inflammatory mediators COX-2, IFN γ , and TNF α in arthritic joints of green tea-fed mice. Total immunoglobulin's (IgG) and type II collagen-specific IgG levels were found to be lower in serum and arthritic joints of green tea-fed mice^{39, 40, 41}.

Banyan tree

Biological Name: *Ficus bengalensis* Linn.

Common name: Banyan tree or Barga

Family: Moraceae



Fig. 13: *Ficus bengalensis* Linn.

It is a large and extensive growing tree of the Indian subcontinent. It produces propagating roots which grow downwards as aerial roots. The active compounds isolated from this plant are considered to be very effective in various treatments such as dysentery, diarrhoea, diabetes, leucorrhoea, menorrhagia, nervous disorders, tonic and astringent. The bark, leaves and fruits of this group are used as astringent, haemostatic, anti-septic, anti-inflammatory, antioxidant and anticancer agent. The α -L rhamnoside and leucocynidin 3-0- α -D galactosyl cellobioside, glucoside, beta glucoside, pentatriacontan-5-one, beta sitosterolalpha-D glucose19-20. A glycoside of leucopelargonidin was also isolated from the bark and it has

antidiabetic effect. Anti rheumatic activity of the methanolic extract of the bark of *Ficus bengalensis* (MFB) were studied using Freund's complete adjuvant induced arthritis model, the formalin induced arthritis model and the agar induced arthritis model. The extract produced marked inhibitory effect on edema especially on secondary immunological arthritis and caused graded inhibition of both phases of formalin- induced pain. The methanolic extract contains several phytochemicals like terpenoids, alkaloids, glycosides, flavonoids, steroids. The presence of flavonoids, tannins, saponin, steroids may attribute to its anti-rheumatic activity as well as modifying the autoimmune system^{42, 43, 44}.

Deodar cedar

Biological Name: *Cedrus deodara*

Common name: Marathi Deodar, Devadaru, Cedar

Family: Pinaceae



Fig. 14: *Cedrus deodara*

Cedrus deodara is native of the western Himalayas in eastern Afghanistan, northern Pakistan, north-central India (Himachal Pradesh and Uttarakhand), southwestern most Tibet and western Nepal. The wood of *Cedrus deodara* has been used since ancient days in Ayurvedic medical practice for the treatment of inflammations and rheumatoid arthritis⁴⁵. The main constituents

present are alkaloids, flavonoids, glycosides, phenolic compounds, saponins and proteins. *Cedrus deodara* has been used for the treatment of inflammation and rheumatoid arthritis. *Cedrus deodara* effectively inhibited the polyarthritis phase as measured by the paw swellings on the injected limbs on complete adjuvant induced arthritis in rats^{46, 47}.

Barringtonia

Biological Name: *Barringtonia racemosa* Linn.

Common Name: Powder-puff tree

Family: Lecythidaceae



Fig. 15: *Barringtonia racemosa* Linn.

Barringtonia racemosa Linn., is found in coastal swamp forests and on the edges of estuaries in the Indian Ocean, India, Sri Lanka, Malaysia, Thailand, Laos, southern China, northern Australia, Ryukyu Islands and many Polynesian islands. Chemical constituent present in this plant are 3, 3'- dimethoxy ellagic acid, dihydromyricetin, gallic acid, bartogenic acid and stigmaterol. It

has anti-microbial, anti-oxidant activity, anti-inflammatory activity. It is used in rheumatoid arthritis and the active constituent responsible for this activity is bartogenic acid (BA). BA protects rats against the primary and secondary arthritic lesions, and haematological perturbations induced by Complete Freund's Adjuvant (CFA)^{48, 49, 50}.

Mango

Biological Name: *Mangifera indica* Linn.

Common name: Anbah, manga

Plant family: Anacardiaceae



Fig. 16: *Mangifera indica* Linn.

Mangifera indica Linn., a species of mango. It is now cultivated throughout the tropical and subtropical world for commercial fruit production. Main constituents present in it are polyphenols, flavonoids, triterpenoids, mangiferin, isomangiferin, tannin and gallic acid derivatives. Mangiferin is extracted from mango at high concentrations from the young leaves, bark and from old leaves. Mangiferin shows strong antioxidant effect. It has a number of

pharmacological actions and possible health benefits include antidiabetic, antioxidant, antifungal, antimicrobial, anti-inflammatory, antiviral, hepatoprotective, hypoglycemic, anti-allergic and anticancer activity. The methanolic extract of *Mangifera indica* possesses the anti-inflammatory activity shown in the arthritic parameter like arthritic index, paw edema and rheumatoid factor^{51, 52, 53}.

Tinospora gulancha

Biological Name: *Tinospora cordifolia* Linn.

Common name: Guduchi

Family: Menispermaceae



Fig. 17: *Tinospora cordifolia* Linn.

Tinospora cordifolia Linn., is distributed throughout the tropical Indian subcontinent and China. The principal constituents are tinosporine, tinosporide, tinosporaside, cordifolide, cordifol, heptacosanol, clerodane furano diterpene, diterpenoid furanolactone tinosporidine, columbin and β -sitosterol. The plant is used to improve the immune

system and the body's resistance to infections. The bitter principle present shows antiperiodic, antispasmodic, anti-inflammatory and antipyretic properties. It is used in the treatment of rheumatoid arthritis. At the dose of 100 mg/kg it shows reduction of paw volume in collagen induced arthritic rats^{54, 55}.

Night jasmine

Biological Name: *Nyctanthes arbortristis* Linn.

Common name: Coral Jasmine

Plant family: Oleaceae



Fig. 18: *Nyctanthes arbortristis* Linn.

Nyctanthes arbortristis Linn., is a shrub or a small tree. It is distributed in southern Asia, from northern Pakistan and Nepal through northern India. It contains mannitol, β -amyryn, β -sitosterol, benjoic acid and benjoic ester of longanin, nycthanic acid. It is used as laxative, diuretic, diaphoretic, used to expul roundworm and threadworm in children's, to relieve cough, also used for the treatment of rheumatoid arthritis. The leaves of *Nyctanthes*

arbortristis Linn., inhibited the acute inflammatory edema produced by different phlogistic agents, viz. carrageenin, formalin, histamine, 5-hydroxytryptamine and hyaluronidase in the hindpaw of rats. Acute and chronic phases of formaldehyde induced arthritis are significantly inhibited. *Nyctanthes arbortristis* Linn., also found to inhibit the inflammation produced by immunological methods, viz. Freund's adjuvant arthritis^{56, 57}.

Indian sarsaparilla

Biological Name: *Hemidusmus indicus* Linn.

Common name: Anantamul, Pseudosarsa

Plant family: Asclepiadaceae



Fig. 19: Root of *Hemidusmus indicus* Linn.

Hemidusmus indicus Linn., is a species of plant that is found in South Asia. It contains coumarin, essential oil, starch, tannic acid, triterpenoid saponin. It is used in the treatment of rheumatoid arthritis, nephritic complaints, chronic skin disease, chronic

ulcer, blood purifier. On oral treatment for 8 days with ethanolic extract of *Hemidusmus indicus* Linn., reducing the paw volume & paw thickness more than Diclofenac sodium^{58, 59, 60}.

Chaste tree

Biological Name: *Vitex negundo* Linn.

Common name: Huang Ping, Huang Ching, Man Ching

Family: Verbanaceae



Fig. 20: *Vitex negundo* Linn.

Vitex negundo Linn., is a large aromatic shrub. It is widely used in traditional medicine, particularly in South and Southeast Asia. It mainly contains many polyphenolic compounds, terpenoids, glycosidic iridoids and alkaloids⁶¹. It is used in the treatment of angina, cold and coughs. It is used as antibacterial agent. The fresh berries are pounded to a pulp and used in the form of a

tincture for the relief of paralysis, pains in the limbs, weakness etc. The root is expectorant, febrifuge and tonic. It is used in the treatment of rheumatic disorder. The petroleum ether extract of *Vitex negundo* Linn., cause inhibition of paw edema in 4 hours in a dose dependent manner in carrageenan-induced hind paw edema^{62, 63}.

Abuta

Biological Name: *Cissampelos pareira* Linn.

Common name: Velvet Leaf, Barbasco

Family: Menispermaceae



Fig. 21: *Cissampelos pareira* Linn.

Cissampelos pareira Linn., is a species of flowering plant. It contains alkaloids, moderate quantity of flavonoids and saponins. It is used as antibacterial, anti-inflammatory, antihistamine, antioxidant, antispasmodic, diuretic, hypotensive, muscle relaxant, uterine relaxant, antiseptic, aphrodisiac, analgesic, anti hemorrhagic, cardiostimulant, diaphoretic, expectorant, febrifuge, hepatoprotective stimulant and tonic. The roots are administered against dyspepsia,

diarrhoea, dropsy, cough, urinary difficulties like cystitis, dysentery, asthma and heart diseases. The leaves are used as an antiseptic against inflammation. The ethanolic extract of the roots are useful for relieving diarrhoea, pain and arthritis. The ethanolic extract of the roots of *Cissampelos pareira* Linn., significantly protective effect against complete Freund's adjuvant induced arthritis in dose dependent manner^{64, 65, 66}.

Aginbuti

Biological Name: *Ammania baccifera* Linn.

Common name: Acrid weed, Monarch red stem, Tooth cup,

Family: Lythraceae



Fig. 22: *Ammania baccifera* Linn.

Ammania baccifera Linn., is a glabrous, erect branching herb, found as weed in rice-fields and marshy localities throughout India. It contains sterols, glycosides, alkaloids, triterpenoids and saponin. Plant have hypothermic, hypertensive, anti urolithiasis, antibacterial, seminal

weakness, fever, flatulence and CNS depressant activities The aerial parts of *Ammania baccifera* Linn., possess' significant anti-inflammatory and anti arthritic activity in rats. Alcoholic extract inhibit of inflammation in Cotton pallet granuloma test and Adjuvant arthritis models^{67,68}.

Black adusa

Biological Name: *Justicia gendarussa* Linn.

Common name: Gandarusa, Warer willow

Family: Acanthaceae



Fig. 23: *Justicia gendarussa* Linn.

Justicia gendarussa Linn., is a shade loving, evergreen plant grows in the moist areas. It is believed to be native to China and is distributed widely across India, Sri Lanka, and Malaysia. The main constituents are alkaloids, flavonoids, phenolic, carbohydrates, tannins, sugar and starch. Chemical analysis of aerial parts of *Justicia gendarussa* Linn., shows the presence of β -sitosterol, b-Sitosterol-b-D-glycoside and aromadendrin.

Apigenin, flavonoid vitexin isolated from the ethanolic extract of *Justicia gendarussa* Linn., which is used in the treatment of inflammation and rheumatoid arthritis in folk medicine. The ethanolic extract of *Justicia gendarussa* Linn., plant leaves showed significant anti-arthritic activity similar to that of aspirin against Freund's adjuvant-induced and collagen-induced arthritic rat models^{69, 70, 71, 72}.

Bastard guelder

Biological Name: *Premna corymbosa* Rottl.

Common Name: Buas Buas

Family: Verbenaceae



Fig. 24: *Premna corymbosa* Rottl.

Premna corymbosa Rottl., is a small size tree or long shrub. The plant is widely distributed throughout the India. All the parts of the plant are useful. Preliminary phytochemical screening of leaves of *Premna corymbosa* Rottl., demonstrated the presence of alkaloids, glycosides, flavanoids, steroids and triterpenoids⁷³. The roots are astringent, bitter, acrid, sweet, thermogenic, anti inflammatory, alexeteric, cardiotoxic, alterant, expectorant, deputative digestive,

carminative, stomachic, laxative, febrifuge, antibacterial and tonic. The leaves are stomachic, carminative, galactagogue, are useful in dyspepsia, colic flatulence, agalactia, cough, fever, rheumatism, neuralgia, haemorrhoids and tumours. Upon long term treatment with *Premna corymbosa* Rottl., it significantly suppressed the development of chronic arthritis induced by Complete Freund's Adjuvant⁷⁴.

Kindal tree

Biological Name: *Terminalia paniculata* Roxb.

Common name: Kindal, Kinjal

Family: Combretaceae



Fig. 25: *Terminalia paniculata* Roxb.

Terminalia paniculata Roxb., is a tall tree and native to southwest India. It is used in cough, bronchitis, cardiac debility, diabetes, wound and skin disease. It contains alkaloids, triterpenes, flavanoids,

saponin, tannins⁷⁵. The aqueous extract of *Terminalia paniculata* Roxb., bark at a dose of 200mg/kg exhibits anti-rheumatic activity in Complete Freund's Adjuvant induced arthritis⁷⁶.

Thunder god vine

Biological Name: *Tripterygium wilfordii*

Common Name: Three-wing-nut

Family: Celastraceae



Fig. 26: *Tripterygium wilfordii*

Tripterygium wilfordii is a Chinese herb also called as Thunder God Vine. Triptolide is a major component of the herb *Tripterygium wilfordii*, extracts of which are used in traditional Chinese medicine and it has been found to possess immunosuppressive and anti-inflammatory properties. Extracts from the root of *Tripterygium wilfordii* inhibit the expression of proinflammatory cytokines, proinflammatory mediators,

adhesion molecules, and matrix metalloproteinases by macrophages, lymphocytes, synovial fibroblasts, and chondrocytes. The extract of root of *Tripterygium wilfordii* is used for the treatment of rheumatoid arthritis. Extract of *Tripterygium wilfordii* cause decrease in Arthritic joint counts, arthritic severity scores, and anticollagen antibody titers in type II collagen induced arthritis (CIA) in DBA/1LacJ mice⁷⁷.

African spider flower

Biological Name: *Cleome gynandra* Linn.

Common name: Spider plant, cat's whiskers, spider flower

Family: Capparaceae



Fig. 27: *Cleome gynandra* Linn.

Cleome gynandra Linn., occurs throughout the tropic and subtropic regions. It is used in the treatment of rheumatoid arthritis. It contains chemical constituents such as triterpenes, tannins, anthroquinones, flavonoids, saponins, steroids, resins, lectins, glycosides, sugars phenolic compounds and alkaloids and these compounds might be responsible for anti-arthritic properties.

Ethanol extract of *Cleome gynandra* Linn., possess anti-inflammatory activity on both acute and chronic inflammation. The ethanol extract of *Cleome gynandra* Linn., administered at the dose of 150 mg/kg body weight for 30 days to the Freund's complete adjuvant induced arthritic rats shows anti arthritic effect^{78, 79}.

Chhota halkusa

Biological Name: *Leucas aspera* Linn.

Common name: Gophaa, Tumba, Dronapushpi

Family: Lamiaceae



Fig. 28: *Leucas aspera* Linn.

Leucas aspera Linn., is a small erect, branched annual herb. It is distributed throughout India from the Himalayas down to Ceylon. The plant is used traditionally as an antipyretic and insecticide. Medicinally, it has been proven to possess various pharmacological activities like antifungal, antioxidant, antimicrobial, antinociceptive

and cytotoxic activity. It contains triterpenoids, oleanolic acid, ursolic acid and b-sitosterol, nicotine, sterols, glucoside, diterpenes and phenolic compounds. Ethanolic extract of *Leucas aspera* Linn., Show anti rheumatoid arthritis effect in Complete Freund's adjuvant induce arthritis^{80, 81}.

Headache tree

Biological Name: *Premna serratifoli* Linn.

Common name: Malbau

Family: Verbenaceae



Fig. 29: *Premna serratifoli* Linn.

Premna serratifoli Linn., is a large shrub or small tree. *Premna serratifoli* Linn., is widely distributed along the coasts and islands of tropical and subtropical Asia, Africa, Australia and the Pacific. In India it is growing throughout the India in wild planes. It consists of

alkaloids, flavonoids, tannins, glycoside, steroids and phenolic compounds. It is used in nerve pain, arthritis, indigestion, constipation, fever and tumours. In Freud's adjuvant induced arthritic albino rats the ethanol extract inhibited rat paw edema^{82, 83}.

Clearing nut tree

Biological Name: *Strychnos potatorum* Linn.

Common Name: Nirmali, Tetrankottai

Family: Loganiaceae



Fig. 30: *Strychnos potatorum* Linn. (seeds)

Strychnos potatorum Linn., is a moderate sized tree found in southern and central parts of India, Sri Lanka and Burma. It contains diaboline (major alkaloid) and its acetate, triterpenes sterols and mannogalactans responsible for its activity. The seeds are reported to have various

activities like anti-diabetic, anti-hypercholesterolemic, diuretic, anti-diarrhoeal, hepatoprotective, antiulcer and anti-arthritic. The extract of *Strychnos potatorum* Linn., seed at dose of 200 mg/kg, p.o. showed reduction in the paw volume in Freud's adjuvant induced arthritic rats^{84, 85}.

Ashok

Biological Name: *Saraca asoca* Roxb.

Common Name: Asok, Osaka

Family: Caesalpiniaceae



Fig. 31: *Saraca asoca* Roxb.

Saraca asoca Roxb., is found in the foothills of central and eastern Himalayas, in scattered locations of the northern plains of India. Preliminary phytochemical methanolic and ethanolic extracts indicate the presence Carbohydrates, tannin, flavonoid, saponin, glycosides, proteins and steroids ⁸⁶. It is used as

spasmogenic, oxytoxic, uterotonic, anti-bacterial, anti-implantation, anti-tumour, anti-progestational, anti-estrogenic, anti-cancer and anti-rheumatoid arthritis. Methanol extract of *Saraca asoca Roxb.*, reduced the paw thickness in adjuvant induced arthritic rats^{87, 88}.

Myrobalan

Biological Name: *Terminalia chebula* Retz.

Common Name: Haritaki

Family: Combretaceae



Fig. 32: *Terminalia chebula*

Terminalia chebula Retz., is a deciduous tree. It is a native to southern Asia from India and Nepal east to southwestern China and south to Sri Lanka, Malaysia and Vietnam. It contains phytochemical constituents such as tannic acid, chebulinic acid, gallic acid, resins, anthraquinone and sinnosides. It is used in chronic ulcer, leucorrhoea, fungal infections of skin. It is used as neuroprotective and antioxidant. Hydro-alcoholic extract of *Terminalia chebula* Retz., shows the anti-arthritis activity in formaldehyde or complete Freund's adjuvant induced arthritis. The anti-arthritis activity of *Terminalia chebula* Retz., is due to its modulatory effect on pro-inflammatory cytokine expression in the synovium^{89, 90, 91}.

From above review it is concluded that there are many plants that have anti rheumatoid arthritis properties comparable to synthetic antidepressants. As the synthetic antidepressants have many side-effects so we can use the plant based formulations for the treatment of anti rheumatoid arthritis which have fewer side effects than synthetic antidepressants.

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