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NATURAL HERBAL TREATMENT FOR RHEUMATOID ARTHRITIS -A REVIEW

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ABSTRACT: Rheumatoid arthritis is an immune mediated inflammatory disease (IMID). Rheumatoid arthritis occurs when our immune system attacks the tissues near joints, this is due to release of certain chemicals and enzymes that begin to eat away the cartilage and bones. Rheumatoid arthritis affects all the joints in the body, some forms of arthritis can also affect the body's internal organs. The symptoms of Rheumatoid arthritis include inflammation, pain, swelling and stiffness of the joints, it can also lead to deformity and disability of the joint in severe cases. There are several causes for Rheumatoid arthritis these causes are unknown but some include genetic factor, family history, age, environmental factors, hormones, smoking etc. This paper gives an overview of the medicinal plants with phytoconstituents which can be used in the treatment of RA and different treatments available for Rheumatoid arthritis. These medicinal plants can be extracted and phytoconstituents can be isolated, pharmacological studies can be carried out and the plants can be further explored for future studies. Even modern drugs used for the better improvement of the symptoms, offer only temporary relief and produce severe side effects, so researchers rely on natural remedies, for treatment of various diseases, with efficacy and safety, and with fewer side effects.

INTRODUCTION: Rheumatoid arthritis is an autoimmune inflammatory disorder affecting almost 1-3% of the world population. The word Arthritis means inflammation of the joint ("artho" means the joint and "it is" meaning inflammation of the joint). RA occurs when our immune system attacks the tissues near joints, this is due to release of certain chemical and enzymes that begin to eat away the cartilage and bones. RA is the result of a malfunctioning immune system, although its cause is still unknown.

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Inflammation in the joints causing pain, swelling, damage to the joints and also leads to deformity. It can occasionally affect other internal organs, such as the eyes, lungs or heart and nerves. The symptoms vary widely from person to person. In many cases RA starts' infecting few joints and then spreads to other joints in the body over a few weeks or months. However, RA can also progress extremely and rapidly; the non-specific symptoms of RA, includes tiredness, soreness in and around the joints, fever, weight loss/poor appetite. As time goes on, RA can spread to more and more joints on both sides of the body, often in a "symmetrical" manner.

Inflammation is a medical term which describes pain, swelling, redness and stiffness. Arthritis is a disease that can affect multiple joints in the body, often occurring in the spine, hip, knee or other

joints in the body, but can also affect the other weight bearing and non-weight-bearing joints. Symptoms of arthritis include joint pain, stiffness, swelling and fatigue. Inflammation if untreated can lead to joint damage, destruction and disability. The onset of RA usually starts over a period of weeks to months, with more joints affected. [1]

The most commonly involved joints that are affected by Rheumatoid Arthritis include: Arthritis also affects small joints of the hands and feet, wrists, elbows, shoulders, knees and ankles. There are several factors which may contribute to development of RA.

Some people who develop RA have family history, largest genetic risk factor described for RA, estimated to contribute approximately 30% of the genetic risk for the disease. RA affects women more often than men. Hormonal changes are also related to be an increased risk of RA. The risk increases with age it commonly develops between ages 40 to 60, anyone can get RA at any age. Most commonly RA affects the old age. However, it's important to remember that it is not an infectious disease, it is not contagious. There are many environmental factors contributing to RA, but smoking is most convincingly related to RA.

Treatments for Rheumatoid Arthritis

The general approach of treating RA is to prevent long-term damage to the joints and reduce inflammation. Pain management is also important in the treatment of RA. The keystone is a medication therapy for RA in disease-modifying anti-rheumatic drugs (DMARDs) and a newer class of medications called biologics.

Corticosteroids Cortisol is a steroid hormone produced naturally by the body's adrenal glands. One of important function of cortisol is its anti-inflammatory action. Since, steroids have more potential long term side effects. Therefore, they are often used as a measure to help control inflammation while slower-acting DMARDs can take effect or may be used in the case of inflammatory arthritis. Ideally, steroids should be used for the shortest period of time at the lowest dosage to avoid side effects.

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs): Non-steroidal anti-inflammatory drugs (NSAIDs) are a class of drugs used to treat inflammation and pain of arthritis. These medications can control the symptoms, but they do not prevent progression or damage. NSAIDs can suppress or relieve pain in the joints but they cannot cure or prevent the disease. [1]

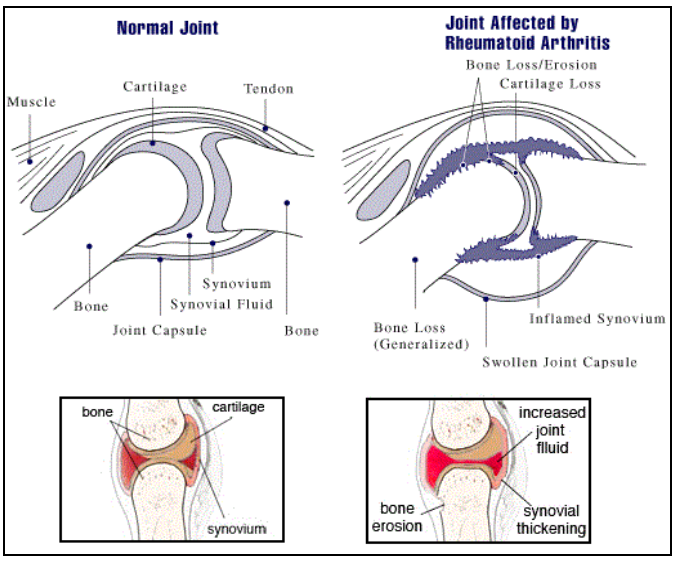

FIG 1: A DIAGRAMMATIC REPRESENTATION OF THE NORMAL JOINT AND RHEUMATOID ARTHRITIS AFFECTED JOINT

The synovium is a thin delicate lining that serves several important functions. Synovial cells synthesize joint lubricants such as hyaluronic acid, as well as collagens that constitute the structural framework of the synovium. *Synovial lining or intimal layer is* only 1-3 cells thick. In RA, this lining is increased to 8-10 cells thick. The synovial blood vessels are located *in the Subintimal area of synovium* this area normally has very few cells. In RA, the subintimal area is heavily infiltrated with inflammatory cells, including T and B lymphocytes, macrophages, mast cells, and mononuclear cells. The cartilage is primarily composed of type II collagen, this is normally a very flexible tissue that absorbs considerable impact and stress. The bone is primarily composed of type I collagen, bony destruction is a characteristic of RA. There may also be bony destruction from mediators derived from activated synovial cells. The synovial cavity is a space with 1-2ml of highly viscous (due to hyaluronic acid) fluid with few cells. In synovial fluid the prevalent cell is the neutrophil. The synovial fluid is highly inflammatory. [2]

TABLE 1: THE PLANTS USED ARE ENLISTED BY THEIR BOTANICAL NAMES, FAMILIES, LOCAL NAME AND PLANT PARTS USED.

S. no	Plant name, family name, local name	Plant part used	Plants used in treatment of rheumatoid arthritis
1	*Alpinia galangal* Linn, Zingiberaceae, Arattai, Perarattai	Rhizomes	Osteoclastic bone destruction and osteoclastogenesis effect. [4]
2	*Anacyclus pyrethrum*, Asteraceae, Akkirakkaram	Roots	Anti-rheumatic & Anti-arthritic, It gives relief in rheumatic arthritis by increasing circulation. [5]
3	*Aphanamixis polystachya* wall, Meliaceae, Malampuluvan	Bark	Analgesic activity was evaluated by Hot plate method Acetic acid-induced writhing test and Tail immersion test [6].
4	*Aquilaria agallocha*, Thymeleaceae, Agalicundanam, Krsnaguru	Wood and Oil	In rheumatoid arthritis and osteoarthritis, its paste is applied over the joints to relieve pain and inflammation. [7]
5	*Argemone mexicana*, Papaveraceae, Kutiyotti,	Whole plant, Latex	Seeds are also useful in vitiated conditions of cough, asthma, pertussis, skin diseases, leprosy, wounds, odontalgia, dentalcaries, constipation, rheumatalgia, colic and flatulence. The oil is useful in indolent ulcers, wounds, leprosy and skin diseases, constipation, flatulences, colic and rheumatalgia. [9]
6	*Callicarpa macrophylla* Vahl, Verbenaceae, Nallai	Flowers and fruits	Its leaves are reported to have anti-inflammatory, analgesic and antipyretic effects. while roots have are anti-inflammatory and analgesic effects.[10]
7	*Capparis deciduas*, Capparaceae, Senkam, Sirakkali	Roots	In folk medicine, mixture of equal quantity of fruit powder and sugar is prescribed in rheumatism. Root bark in the form of powder or infusion is used in rheumatism, gout, dropsy, intermittent fever, etc. [12]
8	*Cardiospermum halicacabum* Linn, Sapindaceae, Mudukkottam, Modikkottan	Roots	Several experimental arthritis models have been used to mimic human RA, ranging from immunization with cartilage components to infection with joint trophic organisms.[13, 14]
9	*Carthamus tinctorium* Linn, Asteraceae, Senturakam, Kusumba	Seed oil	Potential of C. Tinctorius in Phytotherapies Anti-inflammatory and Analgesic Properties. [15,16]
10	*Cassia fistula*, Caesalpiniaceae, Konnai	Fruits	The analgesic activity of *Cassia fistula* methyl alcohol extract was investigated. [17]
11	*Catunaregum spinosa*, Rubiaceae, Madkarai		It is useful in rheumatism, ostealgia during fever, diarrhea, dysentery, bruises, cuts and wounds.[18]
12	*Citrullus colocynthis* Linn, Paitummatti	Roots	Is widely used in folk medicine for treating many diseases such as hypertension and inflammation diseases, including rheumatism and rheumatoid arthritis. [20]
13	*Commiphora myrrha* Nees, Burseraceae, Vellaippapolam	Gum	It is useful for the treatment of acne, boils and arthritis. The resinous exudates of different *Commiphora* tree species have been used for arthritis, hyperlipidemia, and pain, inflammatory conditions, healing of wounds, obesity, schistosomiasis, and gastrointestinal diseases. [21]
14	*Commiphara wightii*, Burseraceae, Kiluvai	Leaves	Guggulu has been used to treat obesity, osteoarthritis, rheumatoid arthritis, gout, facial paralysis, sciatica, constipation, haemorrhoids, liver disorders, inflammation, cyst, cervical lymphadenitis, coronary thrombosis, anaemia, diabetes, urinary calculus, increased frequency and turbidity of urine, and skin diseases. [22]
15	*Cordia dichotoma* Forst, naruvili	Fruits	[25]
16	*Coriandrum sativum*, Apiaceae, Kottamalli	Friuts	In the traditional systems of medicine, formulations containing CS seed extract have been used as stimulants, carminatives, antispasmodics, diuretic and anti-rheumatic. [26]
17	*Euphorbia neriifolia* L., Euphorbiaceae, Saturakkalli	Leaf	The plant is reported to be used traditionally in inflammatory disorders such as rheumatism and gout, to relieve pain in rheumatism and toothache (the juice, which flows from the branches), in nervine diseases, dropsy, palsy and deafness, and as a purgative. [28]
18	*Euphorbia antiquorum L*	Whole plant	Thura milk boiled in neem oil is applied externally on affected parts in treatment of rheumatism.
	Euphorbia ligularia, Roxb, Euphorbiaceae, Ilaikkalli		Latex is used to de-root skin warts, earache and in arthritis. [29, 30]
19	*Ficus benghalensis*, Moraceae, Alamaram	Latex	[32, 33]
20	*Flacourtia jangomas*,	Fruits	This plant has been reported as an answer for the treatment of

	Flacourtiaceae, Vaiyyankarai		functional disorders like rheumatoid arthritis and gout. The areal part of plant i.e., its fruits are edible; the bark triturated in sesamum oil is used as a liniment in rheumatism. [34]
21	*Fritillaria roylei* Hook, Orchidaceae, Kakoli	Bulbs	Fritillaria roylei possess peimine, peiminine, peimisine, peimiphine, peimidine, peimitidine, propeimin, sterol, etc and has been reported for antiasthmatic, antirheumatic, febrifuge, galactogogue, haemostatic, ophthalmic and cytotoxic properties, etc. [35]
22	*Glycosmis arborea*, Rutaceae, Konchi, Anam	Roots	It is well evident that the roots are useful in the treatment of arthritis. [36]
23	*Gossypium herbaceum* Linn, Malvaceae, Panju	Leaves	The leaves are emollient, mucilaginous, haematinic, diuretic, cooling, constipating and used in gastric irritation, diarrhoea, dysentery, dysuria, rheumatoid arthritis and Otalgia. [37]
24	*Heliotropium indicum* Linn, Boraginaceae, Telkodukkai	Whole plant	The plant is used for the treatment of inflammation especially inflamed joints. [38]
25	*Hiptage benghalensis* Linn, Malpighiaceae, Madhavi	Barks, Leaves and Flowers	The plant is also used in the treatment of chronic rheumatism and asthma. [40]
26	*Holarrhena pubescens*, Apocynaceae, Kutasappalai, Veppalai	Barks, Seeds and Leaves	Traditionally, the plant has been used in the treatment of asthma, leprosy, eczema, colic dyspepsia, dysentery, and many other inflammatory diseases.[41]
27	*Hygrophila auriculata*, Acanthaceae, Nirmulli	Roots, Leaves and Seeds	As per our tradition, roots, seeds, and aerial parts of the plant has been used in the treatment of jaundice, hepatic obstruction, rheumatism, inflammation, urinary infection, gout and malaria [42]
28	*Hyoscyamus niger* Linn, Solanaceae, Kurassaniyomam	Leaves and Seeds	They are useful in odontalgia, bleeding gums, dental caries, mamillitis, orchitis, rheumatoid arthritis, worm infection, colic, dyspepsia, flatulence, cardiac debility, epistaxis, haematemesis, haemoptysis, whooping cough, asthma, bronchitis, catarrh, conjunctivitis, otalgia, cephalalgia, fever, meningitis, anxiety, insomnia, scabies, urinary calculi, diabetes, spermatorrhoea, dysmenorrhoea, leucorrhoea, amenorrhoea, neuralgia, beneficial in irritable affections and urinary tract. [43]
29	*Illicium verum*, Magnoliaceae, Anusappu	Friuts	Oil is used in rheumatism, in east it is used to combat colic and rheumatism. [44]
			Illicium verum has been used in a tea as the traditional remedy of rheumatism and the seeds are sometimes chewed after the meals to aid the digestion.[45]
30	*Inula racemosa*, Asteraceae, Puskkaramulam	Roots	The aqueous extract of the fresh or dry roots is given orally in rheumatic pains and liver problems. Externally a paste or liniment is used for relieving pain. [46]
31	*Ipomoea cairica* Linn, Convolvulaceae, Kakkattan	Seeds	These species are used in different parts of the world for the treatment of several diseases, such as, diabetes, hypertension, dysentery, constipation, fatigue, arthritis, rheumatism, hydrocephaly, meningitis, kidney ailments and inflammations. [47]
32	*Jasminum lanceolarium* Roxb, Oleaceae, Makarandam	Leaves and Flowers	Its stems and roots have been used for the treatment of rheumatism and fever while the leaves are used as an anti-inflammatory agent to relieve pain.[48]
33	*Jatropha curcas* Linn, Euphorbiaceae, Katalamanakku	Oil	Jatropha curcas leaves have been proven to be anti-inflammatory and antioxidant. In this study we examined the antiarthritic effects of ethanolic extract of J. curcas leaves using adjuvant induced arthritis (AIA) in rats.[49]
34	*Juglans regia* Linn, Juglandaceae, Akrottu	Fruits	The poultice that is prepared from the stem bark of *J. regia* is used to treat inflammation in north east Italy. [50] J. regia leaves are used for rheumatic pain in human adult in Turkey. [51]
35	*Justicia gendarussa* Burn, Acanthaceae, Vataikkutti	Roots and Leaves	In Indian and Chinese traditional medicine, the leaf of the plant is recommended to treat ailments such as fever, hemiplegia, rheumatism, arthritis, headache, earache, muscle pain, respiratory disorders, and digestive trouble.[53]
36	*Kaempferia galangal* Linn, Zingiberaceae, kaccolam	Rhizomes and Leaves	It is indigenous to tropical Asia, where it is commonly used in traditional medicine for the management of swelling, rheumatism, cough, dysentery, diarrhea, and stomachache. [54]

37	*Lantana camara* Linn, Verbenaceae, Arisimalar, Unnicceti	Frutis	*Lantana camara* is a medicinal plant which is indicated for the treatment of arthritis in folklore medicine.[57]
38	*Lawsonia inermis* Linn, Lythraceae, Marutani	Leaves	Lawsonia inermis plant have traditional claim for use in arthritic disorder. [58]
39	*Lilium polyphyllum* D, Liliaceae, Ksirakakoli	Bulb	They are used in traditional and modern medicines and used as refrigerant, galactogogue, expectorant, aphrodisiac, diuretic, antipyretic and tonic in cough, bronchitis, vitiated conditions, seminal weakness, strangury, burning sensation, hyperdipsia, intermittent fever, hematemesis, rheumatalgia and general disability. [62]
40	*Madhuca longifolia* Koenig, Sapotacae, Illuppai	Oil	A decoction is prepared by boiling bark in water and taken internally to get relief from rheumatism. Oil obtained from seeds can also be applied on the affected areas. [63]
41	*Mangifera indica* Linn, Anacardiaceae, Mamaram, Mankai	Roots and Barks	Help to prevent colon cancer, Calming inflammation, Fruit Juice is act as a restorative tonic used in heat stroke. [64]
42	*Mimosa pudica* Linn, Mimosaceae, Tottalcurunki	Whole plant	Some studies indicate that the roots are in homeopathic treatments for many illnesses such as urinary and vaginal infections, asthma, inflammations, and diarrhea, skin rash, neurological disorders, and the symptoms of rheumatoid arthritis. [65]
43	*Momordica charantia* Linn, Cucurbitaceae,	Fruits	Leaves are used for treating catarrh, constipation, dermatitis, diabetes, diarrhoea, eczema, fever, leprosy, malaria, rheumatism, breast cancer, snake bite, anaemia, dysentery, gonorrhoea, measles, and rheumatoid arthritis. [66]
44	*Myxopyrum serratulum*, Oleaceae, Caturamullai	Leaves	It is widely used in the treatment of cuts, wounds, scabies, cough, nerve complaints, head ache, back ache, arthritis. [67]
45	*Naravelia zeylanica* Linn, Ranunculaceae, Vatamkolli	Whole plant	From the literature survey and ethnomedical studies, observed that the aerial parts of Naravelia zeylanica traditionally used in vitiated vata, pitta, inflammation, skin diseases, rheumatoid arthritis, arthritis, headache, colic, wounds and ulcers. [69]
46	*Nilgirianthus ciliatus* Nees, Acanthaceae, Kurunji	Roots	Traditionally, the plant has been used for the treatment for rheumatalgia, lumbago, sciatica, limping, chest congestion, strangury fever, leucoderma, skin diseases, inflammation, cough, bronchitis, odontalgia and general debility. [71]
47	*Ocimum basilicum* Linn, Lamiaceae, Tirunittru	Whole plant	Tulsi plants (family Lamiaceae) are widely used in the Ayurvedic system of medicine for bronchitis, bronchial asthma, skin diseases, arthritis, inflammation, fever etc. The study was carried out to corroborate the traditional claims for anti-arthritic activity of tulsi. [72]
48	*Oroxylum indicum* Linn, Bignoniaceae, Palaiyudaycci	Roots	The plant is claimed to possess anti-inflammatory, diuretic, anti-arthritic, antifungal and antibacterial activity. [73]
49	*Pandanus odoratissimus* Linn, Pandanaceae, Tttilaialai	Oil	Plants are widely used in the various traditional system of medicine like Ayurveda, Siddha, and Unani for their analgesic, and anti-inflammatory, antipyretic activity. [77]
50	*Piper betel* Linn, Piperaceae, Vettalai	Whole Plant	Applied locally, betle leaves are beneficial in the treatment of inflammation such as arthritis. [80]
51	*Piper nigrum*, Piperaceae, Milaku	Fruits	Pepper is also used in folk medicine as aphrodisiac, carminative, stomachic, antiseptic diuretic and for the treatment of cough, rheumatoid arthritis, peripheral, acetic acid, neuropathy, melanoderma and leprosy due to the presence of volatile compounds, tannins, phenols, alkaloids, and other unknown substances. [81]
52	*Plumeria rubra* Linn, Aponacynaceae, Alari, Kallimandarai	Milky juice	The plant is used traditionally in rheumatism, gum troubles, toothache, diarrhea, gonorrhea and also as purgative. [83]
53	*Pongamia pinnata* Linn, Fabaceae, Punkumaram	Leaves	The seeds paste of P. pinnata is used for leporus sores, skin disease and painful rheumatic joints. [88]
54	*Premna corymbosa*, *Premna serratifolia* Linn Verbenaceae, Munnai	Leaves	The disfunctioning of antioxidant enzymes has been implicated in several disorders including rheumatoid arthritis, reperfusion injury, cardio-vascular diseases, immune injury as well as diabetes mellitus. [92]
55	*Ricinus communis* Linn, Euphorbiaceae, Amanaku	Leaves	The seeds yield castor oil, which has been used to treat liver infections and to cure inflammation in Indian system of medicine. Free radical scavenging and anti-inflammatory activities of methanolic extract of *R. communis* roots have been studied in Wistar albino rats. [95]

56	*Rubia cordifolia* Linn, Rubiaceae, Manjitti	Roots	The Literature review revealed that antimicrobial, anticancer, Hypoglycaemic, Haemostatic, antipyretic, analgesic, antihelmintic, anti-inflammatory, In purifying blood, Diuretic, In liver complaints, In pains of joints, Uterine pains, In Rheumatoid arthritis property of Rubia cordifolia have been studied scientifically. [96]
57	*Ruta chalepensis* Linn, Rutaceae, Aruvadam	Oil	Orally, it is used as analgesic, antipyretic, anti-infl ammatory, in menstrual problems, antispasmodic, anthelmintic and abortifacient relief of rheumatic pain and mental disorders. [98]
58	*Sida cordifolia* Linn, Malvaceae, Kuruntotti	Roots and Leaves	The water extract of the whole plant is specially used in the treatment of rheumatism. [99]
59	*Solanum nigrum* Linn, Solanaceae, Kantankattiri	Whole Plant	S. nigrum has been extensively used traditionally to treat various ailments such as pain, inflammation and fever. [101]
60	*Spondias pinnata* Linn, Anacardiaceae, Mampulicci	Roots	The bark is aromatic, astringent and refrigerant and used in dysentery, diarrhea, vomiting and muscular rheumatism.[102]
61	*Stereospermum colais*, Bignoniaceae, Padiri	Leaves	The leaves are used to treat otalgia, odantalgia, rheumatalgia, malarial fever and wounds. [103]
62	*Tectona grandis* Linn, Verbenaceae, Tekku	Wood	In traditional medicine, a wood powder paste has been used against bilious headache and swellings. They are also used for treating inflammatory swelling. [104]
63	*Trachyspermum ammi*, Umbelliferae, Asamtavomam	Fruits	The plant has been used for centuries as a therapeutic agent for the treatment of inflammatory diseases and disorders of the digestive tract by the practitioners of the Ayurvedic and Unani systems of medicine.[105]
64	*Tribulus terrestris* Linn, Zygophyllaceae, Nerinci	Whole Plant	The ash of the whole plant is good for external application in rheumatic-arthritis. [107]
65	*Vatteria indica* Linn, Dipterocarpaceae, Painimaram	Oil	It is credited with tonic, carminative and expectorant properties and is used for the treatment of respiratory disorders like chronic bronchitis, throat troubles, tubercular gland, boils, piles, diarrhea and rheumatism and so on. [108]
66	*Vitex negundo* Linn, Verbenaceae, Nirkundi	Roots	They are useful in dispersing swellings of the joints from acute rheumatism. [109]
67	*Vitis vinifera* Linn, Vitaceae, Kotumuntiri	Stem	It is used in the treatment of colds and rheumatic ailments. [110] Results of another experiment indicated that intraperitoneal injection of GSE attenuated CIA (Collagen induced Arthritis) in mice and suggested that GSPE may be useful in the treatment of Rheumatoid Arthritis. [113]

The present work is collection of information regarding plants having potential in treatment of Rheumatoid Arthritis, used in the traditional Indian system of medicine. These plants are being used in the form of single herbs and combination drugs and poly herbal formulations.

***Alpinia galangal* Linn. Zingiberaceae:** In rats with adjuvant-induced arthritis, administration of galangin (5, 10, 20 mg/kg) and MEAO significantly ((P<0.001) suppressed the paw swelling, increased the paw withdrawal latency, and reduced the paw thickness. Diclofenac was taken as standard. Galangin (20mg/kg) and MEAO inhibited the increased level of serum lysosomal enzyme activity viz. aspartate aminotransferase (AST), alanine aminotransferase (ALT), and alkaline phophatase (ALP). Galangin, MEAO exhibited anti-arthritic activity by improving the altered haematological parameters.

Histopathological examination showed reduced cartilage destruction, influx of inflammatory cells, pannus formation, fibrin deposition, synovitis and chronic inflammation in galangin and MEAO treated arthritic rats. [3]

***Aquilaria agallocha* of family Thymelaeaceae:** The ethanolic extract of *Aquilaria agallocha* (EEAA) leaves and the *Aquilaria agallocha* oil (AAO) from Heart Wood were studied using in-Vitro BSA denaturation method and *in-vivo* Freund's adjuvant induced arthritic rat model. The inhibition of protein denaturation *in-vitro* model and paw volume, hematological parameters and radiology of hind legs were studied. In FA Arthritic model EEAA inhibited the increase in paw volume and maximum inhibition were 21.20% and 25.34% respectably on 21th day. The percentage of inhibition was found gradually increasing with the day of treatment.

Treated group with AAO inhibited the increase in paw volume and maximum inhibition were 19.78% and 27.88% respectably on 13th and 21th day respectably. Further the hematological and radiological studies also revealed the antiarthritic activity of EEAA and AAO. [8]

***Callicarpa macrophylla* Vahl, Verbenaceae:** The *in-vitro* anti-arthritic activity of ethanolic extract of *Callicarpa macrophylla* Flower was evaluated using inhibition of protein denaturation model and human red blood cell Membrane stabilization model. Diclofenac sodium was used as a standard drug. Results revealed that the ethanolic extract of Callicarpa macrophylla at different concentrations possessed significant anti-arthritic activity as compared to standard drug used as Diclofenac sodium. The results obtained in the present investigation Indicate that ethanolic extract of Callicarpa macrophylla flower showed anti-arthritic activity. [10]

***Cardiospermum halicacabum* Linn, Sapindaceae:** Anti-rheumatic effects and antioxidant properties of *C. halicacabum* leaves (EECH), were studied in wistar rats with CFA-induced arthritis, Arthritis was induced to the albino Wistar rats by CFA. Fifteen days after CFA induction, arthritic rats received EECH orally at the doses of 250 and 500 mg/kg daily for 20 days. Diclofenac sodium was used as reference standard. Ultrasonography and histology images of hind limb in EECH treated groups confirmed the complete cartilage regeneration. [14]

***Citrullus colocynthis* Linn Cucurbitaceae:** The study was to evaluate the effects of ethanol extract of Colocynth root on pro-inflammatory cytokine COX-2, INOS, IL-1β , TNF-α and NO, PGE2 on Inflammatory cells, similar osteoarthritis in chondrocyte cells and monocytes/macrophages and then treating them. Our observations indicated that ethanol extract of root Citrullus colocynthis can reduce expression levels of pro-inflammatory cytokines in inflamed cells caused by situation same osteoarthritis, and this plant can be used for the treatment of osteoarthritis in the future. [19]

***Commiphora myrrha* Nees, Burseraceae:** Several animal studies have demonstrated the effectiveness of guggulu extract in standard osteoarthritis (OA) models. The study conducted both animal and clinical investigations of guggulu for OA prior to this study. The goal of this study was to determine the effectiveness of guggulu for reduction of pain, stiffness, and other symptoms that arise from OA. [23]

***Commiphara wightii*, Burseraceae:** Guggul reduced the thickness of the joint swelling during the course of drug treatment, indicating that gum guggul has a beneficial role in experimental arthritis. Gum guggul appeared to be a relatively safe and effective supplement to reduce symptoms of osteoarthritis after 1 month treatment and significantly improve the WOMAC (Western Ontario and McMaster Osteoarthritis Index) total score and continued. [24]

***Cordia dichotoma* Forst Boraginaceae:** Transdermal films were prepared using natural polymer (fruit gum) of *C. dichotoma* with different percentage of plasticizer (glycerin 0.10, 0.20 and 0.25% w/v), preservatives (methyl paraben 0.1% w/v) and drug neomycin (0.2% w/v). The films were casted on glass plates under dried controlled condition. These films were evaluated by various parameters like thickness, tensile strength, water uptake, folding endurance, and skin irritation test. The films were screened for the anti-inflammatory activity using carrageenan-induced rat paw edema model. The data was analyzed using student *t*-test and level of significance was set at $P<0.001$. The results were compared with standard drug, diclofenac sodium. The percentage of inhibition of odema was considered as a mark of anti-inflammatory potential and it was found to be highest in 0.20% (w/v) glycerin treated animals which indicate significant anti-inflammatory activity of cordia dichotoma. [25]

***Coriandrum sativum*, Apiaceae:** The antiarthritic activity of CS seed hydroalcoholic extract (CSHE) was evaluated in adult Wistar rats by using two experimental models, viz. formaldehyde and Complete Freund's adjuvant (CFA) induced arthritis. The expression of pro-inflammatory cytokines (predominantly contributed by macrophages) was also evaluated. TNF- α level was estimated in serum by ELISA method. TNF-R1, IL-1 β and IL-6 expression in the synovium was analysed by immune histochemistry.

CSHE produced a dose dependent inhibition of joint swelling as compared to control animals in both, formaldehyde and CFA induced arthritis. [27]

***Euphorbia antiquorum* Linn, Euphorbiaceae:** The effect of the extracts was evaluated against acute inflammation using carrageenan induced rat paw edema and chronic inflammation using cotton pellet induced granuloma in rats and complete Freund's adjuvant (CFA) induced arthritis in rats. The results revealed that the triterpenoids present in both the extracts of EA might be responsible for anti-inflammatory and anti arthritic effects. [31]

***Ficus benghallensis*, Moraceae:** The anti-arthritic activity of ethanol and aqueous extract of root of *Ficus benghalensis* on Freund's adjuvant induced arthritis in rats was evaluated. The crude ethanol and aqueous root extract was administered orally at dose of 300mg/kg body weight for 28 days. Indomethacin at dose of 10mg/kg body weight was used as standard drug. The paw volume was measured on days 7, 14, 21 and 28. At the end of day 28th the animals were anaesthetized with anesthetic ether and blood was collected from retro-orbital route to all the groups of animals and various haematological parameters such as hemoglobin content, total WBC, RBC and erythrocyte sedimentation rate (ESR) were estimated. The body weight of the animals was measured by digital balance to access the course of the disease at the initial day before induction and the end of 28th day. The results indicate that at the dose of 300mg/kg b.w, both the extracts protect the rats against primary and secondary arthritic lesions, body weight changes and haematological perturbations induced by FCA. Daily treatment with crude extracts and standard drug effectively inhibits paw edema in rats. Both the extracts significantly ($p<0.01$) altered the parameters which were estimated, when compared to control group rats.

The observations showed that ethanol extract show highly inhibition of paw edema in rats. The ethanol extract inhibits rat paw edema by 63.64% than the aqueous extract 31.82% when compared to standard drug 62.34% on 28th day. At the end of study the ethanol extract show more pronounce effect then aqueous extract when compared to standard drug. The findings showed a significant anti-arthritic activity of Ficus benghalensis root extracts against FCA induced arthritis in rats. [32] The analgesic, anti rheumatic and ant-oxidant activity of the methanolic extract of the bark of

Ficus bengalensis (MFB) were studied at doses of 100, 200 and 300 mg/kg (i.p) using the 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 present study validates the traditional use, demonstrating that the methanolic extract of bark of Ficus bengalensis possesses dose –dependent anti-rheumatic activity in all the models with a possibility of acting through the central and peripherally mediated activities. [33]

***Heliotropium indicum* Linn, Boraginaceae:** The study was conducted on 196 patients (male: 65 and female: 131) aged ≥ 50 years old for genu varum deformities, normalized by the topical application of phytotherapeutic treatment protocol. To detect the normalization, anatomical measurements and biochemical parameters along with radiological images are being studied before (0 sitting) and after 42 sittings of the treatment. The present results clearly reveal that normalization of genu varum deformities are achieved by topical application of phytoconstituents (aqueous extracts) from acknowledged Indian medicinal plants (*Cissus quadrangularis, Heliotropium indicum*, Rosmarinus officinalis, Calotropis gigantea) with specialized treatment paradigm, within forty-two sittings. [39]

***Jatropha curcas* Linn. Euphorbiaceae:** The results revealed that the ethanolic extract of J. *curcas* leaves at doses of 150 mg/kg, 300 mg/kg and 600 mg/kg significantly reduced arthritis scores ($p<0.05$) compared to control group (CFA). The J. curcas leaf extract at doses of 150 and 300 mg/kg BW decreased mobility scores. Histopathology studies showed that the J. curcas extract reduced edema and cartilage destruction in arthritic joints. [49]

***Juglans regia* Linn, Juglandaceae:** Anti-inflammatory effects were studied using xylene induced ear edema and cotton pellet tests.

In xylene test, both extracts showed anti-inflammatory activity in some doses. The extracts showed anti-inflammatory activity against the chronic inflammation. *J. regia* leaves demonstrated antinociceptive effect through non-opioid receptors and anti-inflammatory effect against acute and chronic inflammation. The extracts of *J. regia* could be considered as a promising analgesic and anti-inflammatory agents against diseases such as rheumatoid arthritis. [52]

***Justicia gendarussa* Burn, Acanthaceae:** The anti-arthritic potential of the alcoholic extract of the plant *Justicia gendarussa* was evaluated using the Freund's adjuvant-induced and collagen-induced arthritic rat models. The rats were treated with the ethanolic extract of *Justicia gendarussa* and with standard aspirin. The ethanolic extract of *Justicia gendarussa* showed significant anti-arthritic activity that was statistically similar to that of aspirin. The results suggested that the alcoholic extract of *Justicia gendarussa* exhibits significant anti-arthritic potential. [53]

***Kaempferia galangal* Linn, Zingiberaceae:** This study evaluated the anti-inflammatory effect of *Kaempferia galanga* (KG) using an activity-guided approach. These extracts (2 g/kg each) were tested for their ability to inhibit carrageenan-induced rat paw edema. These results validate the anti-inflammatory activity of KG which may be exerted by the inhibition of cyclooxygenases 1 and 2. EPMC isolated from this plant may be the active anti-inflammatory agent. [55]

***Lantana camara* Linn, Verbenaceae:** The anti-arthritic activity of *Lantana camara* var Linn leaves extract was investigated on albino rats. In this abstraction, the acute non immunological model was followed. The arthritis was induced with turpentine. Ethanolic extract of Lantana camara showed significant ($P<0.05$) and dose dependent inhibitory effect against acute model of arthritis. In this study an ethanolic extract of Lantana camara showed better anti-arthritic activity than aspirin. [56]

***Lawsonia inermis* Linn, Lythraceae:** The anti-arthritic activity of hydroalcoholic extract of *Lawsonia inermis* is done by Freund's adjuvant induced arthritis model and formaldehyde induced arthritis model. Paw edema, paw diameter and loss in body weight during arthritis condition were corrected on treatment with hydroalcoholic extract of Lawsonia inermis and Diclofenac. Biochemical parameters such as hemoglobin and erythrocyte sedimentation rate were estimated. Serum parameters such as SGOT, SGPT, ALP, and Total protein were also estimated for assessing the anti-arthritic potential of hydroalcoholic extract of *Lawsonia inermis*. The hydroalcoholic extract of *Lawsonia inermis* possess a significant anti-arthritic activity against adjuvant induced arthritis and formaldehyde induced arthritis model. [59]

The anti-arthritic activity of ethanolic extract of *Lawsonia Inermis* Linn (EELI) was studied against Freund' s Complete Adjuvant (FCA) induced arthritis in rats. The parameters assessed were paw diameter, body weight changes, haematological parameters like (RBC, WBC, Hb, and ESR), biochemical parameters like (SGPT, SGOT, ALP, and TP), histopathology and radiology of hind legs. Diclofenac sodium drug was taken as standard. The ethanolic extract of Lawsonia Inermis is having good anti-arthritic activity, when compared to Diclofenac sodium. [60]

The Present study was designed to assess the antiarthritic potential of aqueous extract of *Lawsonia inermis*. L. The various concentrations of the extract were tested for antiarthritic potential by percentage inhibition of protein denaturation and membrane lysis method. [61]

***Mangifera indica* Linn, Anacardiaceae:** *Mangifera indica* extract (Vimang tablets, 300 mg) combined with methotrexate (MTX) on reducing disease activity in rheumatoid arthritis (RA). Twenty patients with active RA underwent a year of treatment with MTX (12.5 mg/week) associated to non-steroidal anti-inflammatory drugs (NSAIDs) and/or prednisone (5–10 mg/day) were randomly allocated to the experimental group ($n = 10$), that received the extract supplementation (900 mg/day) or preceding usual treatment ($n = 10$) during 180 days. RA activity was evaluated using the tender and swollen joint counts, erythrocyte sedimentation rate, disease activity score-28 (DAS 28), visual analogue scale (VAS) and health assessment questionnaire (HAQ). Treatment's efficacy was demonstrated with ACR criteria.

Only the patients of MTX-Vimang group revealed statistically significant improvement in DAS 28 parameters with respect baseline data but no differences were observed between groups. ACR improvements amounted 80% only in MTX-Vimang group at the 90 days ($p < 0.001$). In MTX-Vimang group, 100% of patients decreased NSAIDs administration ($p < 0.01$) and 70% of those eradicated gastrointestinal side effects ($p < 0.01$) ensuing of the preceding treatment.[65]

***Myxopyrum serratulum*, Oleaceae:** *In vitro* antiarthritic activity was carried out using protein Denaturation Method and in vitro Anti Inflammatory Activity was carried out Using HRBC Membrane Stabilization Method. The percentage stabilization of ethanolic extracts on HRBC Membrane stabilization was found 61.25% at 200µg/ml. The percentage inhibition of ethanolic extracts on Protein Denaturation method was found to be 67.51% at 200µg/ml. In vitro studies which was carried out by the above mentioned methods brings out the fact that the ethanolic extract possess better activity which was comparable to the standard drug Diclofenac Sodium.[68]

***Naravelia zeylanica* Linn Ranunculaceae:** The anti-arthritic activity was evaluated in Freud's adjuvant induced arthritis model in albino rats. The percentage increase in paw volume 7days and 21days after the drug administration were noted. It was noted that a moderate reduction in paw volume in the right and left paw of rats treated with chloroform extract (69.86 ± 3.39 &50.88 ± 2.51), ethanolic extract (66.99 ± 3.85 & 49.040 ± 2.87) and Prednisolone 10 mg/kg p.o. (63.82 ± 1.86 & 34.90 ± 3.00) treated animals when compared with control (147.94 ± 5.84 & 111.97 ± 8.45) group animals. Both the extracts (200mg/kg) were statistically significant (p<0.01). The activity may be due to the presence of flavanoids, triterpenoids and phenolic compounds in the both extracts. [70]

A comparative study of two varieties of *O. basilicum, Basilicum* and thyrsiflora was done for evaluation of anti-inflammatory and anti-arthritic activity. Carrageenan induced paw oedema for anti-inflammatory activity and Complete Freund's Adjuvent induced arthritis for anti-arthritic activity were the two animal models used for the investigation.

The present investigation suggests that O.basilicum var. basilicum (OSBB) at a dose of 50,100 & 200mg/kg p.o. exhibits decrease in carrageenan induced rat paw oedema. OSBB possess potent anti-arthritic and anti-inflammatory activity in a dose dependent manner. In case of arthritis there was significant inhibition at the dose of 100 & 200 mg/kg (p less than 0.01 and 0.001 respectively). *O. basilicum* var. thyrsiflora (OSBT: p less than 0.05) was unable to show activity at lower dose. Thus higher dose of OSBT may be required to exhibit the same pattern of anti-arthritic and anti-inflammatory activity in lab animals. The study was carried out to corroborate the traditional claims for anti-arthritic activity as well as quantification of three marker compounds ursolic acid, oleanolic acid and eugenol by HPTLC and HPLC and to check interspecies variation. [72]

***Oroxylum indicum* Linn, Bignoniaceae:** The relative percentage inhibition potential of paw volume in rats treated with various extracts of *Oroxylum indicum* was found to be ethyl acetate extract (67.69%) >chloroform extract (64.61%) >n-butanol extract (58.46%) respectively. The hematological parameters like RBC count, hemoglobin content showed significant increase while there was a significant decrease in total WBC count and ESR in all the groups of animals pretreated with root bark extracts. The biochemical parameters such as catalase, glutathione contents showed a significant increase while the lipid peroxide and Cathepsin-D content decreased significantly only in case of ethyl acetate pretreated rats when compared to others.[74]

Therefore, the anti-inflammatory and analgesic activities of Sonapatha (*Oroxylum indicum*) were studied in Swiss albino mice by different methods. The hot plate, acetic acid, and tail immersion tests were used to evaluate the analgesic activity whereas xylene-induced ear edema and formalin induced paw edema tests were used to study the anti-inflammatory activity of Sonapatha. The administration of mice with 250 and 300 mg/kg b.wt. of O. indicum reduced pain and inflammation indicating that Sonapatha possesses analgesic and anti-inflammatory activities. The maximum analgesic and anti-inflammatory activities were observed in mice receiving 300 mg/kg b.wt. of O. indicum ethanol extract.[75]

***Pandanus odoratissimus* Linn, Pandanaceae:** The anti-inflammatory activity was estimated by carrageenan-induced acute and formalin-induced chronic paw edema models in rats. The methanolic extract of *P. odoratissimus* was given in the doses of 25, 25, and 100mg/kg−1. The plant extract at the dose of 100mg kg−1 showed significant anti-inflammatory activity at 3 h observation where, it caused increase in inhibition of paw edema by carrageenan-induced acute (689) and the formalin-induced chronic (64.29) paw edema models with standard drug diclofenac sodium in rats.[76]

P. odoratissimus (kewda) has been used in rheumatic fever, rheumatism, and rheumatoid arthritis. The major components of the hydrodistilled kewda oil are 2-phenyl ethyl methyl ether terpene-4-ol, *α*-terpineol, 2-phenyl ethyl alcohol benzyl benzoate, and so forth. Both methanolic and hydroalcoholic extracts were tested in rodent models by carrageenan-induced paw edema, albumin induced plantar edema, acetic acid induced vascular permeability, and castor induced diarrhoea. In all these animal models both extracts have shown significant anti-inflammatory activity. [77]

After initial phytochemical screening of methanolic (MEPF) and aqueous extracts (AEPF) of the plant, the extracts were screened for possible acute anti-inflammatory properties in vivo models. Acute anti-inflammatory properties of both the extracts were tested in rodent models by carrageenan induced paw edema, albumin induced plantar edema, acetic acid induced vascular permeability and castor induced diarrhoea. In all these animal models MEPF and AEPF have shown significant anti-inflammatory activity.[78]

***P. fascicularis* Lam, Pandanaceae:** Analgesic activity of aqueous extract of *P. fascicularis* Lam. at doses (400 and 800 mg/kg) by using hot plate models, tail-flick method in rats and the writhing model of mouse and compared with the analgesic action of codeine and aspirin. *Pandanus* aqueous extract revealed significant analgesic activity by both central ($P < 0.001$) and peripheral ($P < 0.001$) mechanisms in this study, which is comparable to that of codeine and aspirin, and this favors the use of *Pandanus* aqueous extract in rheumatism and rheumatoid arthritis in traditional medicine. [79]

***Piper nigrum*, Piperaceae:** The *in vitro* anti-inflammatory activity of piperine was tested on interleukin 1β (IL1β)-stimulated fibroblast-like synoviocytes derived form patients with rheumatoid arthritis. The analgesic and antiarthritic activities of piperine were investigated on rat models of carrageenan-induced acute paw pain and arthritis. In rats, piperine significantly reduced nociceptive and arthritic symptoms at days 8 and 4, respectively. Histological staining showed that piperine significantly reduced the inflammatory area in the ankle joints. [82]

***Plumeria rubra* Linn, Aponacynaceae:** Inflammation has been reported to be the main pathological characteristic of rheumatism such as rheumatoid arthritis. On the other hand, pain is a common symptom of rheumatism and antinociceptive effects of successful painkillers are considered to be crucial in a variety of species and pain tests. [84-87]

***Pongamia pinnata* Linn, Fabaceae:** The anti-arthritic and anti-inflammatory activity of P. pinnata hydroalcoholic extract was done by Inhibition of protein denaturation and Human red blood cell membrane stabilization (HRBC) in vitro methods. [89, 90]

Comparative anti-arthritic activity of ethanolic extract of seeds of *Pongamia pinnata* (linn.) pierre (EEPP) and methanolic extract of rind of Punica granatum linn. (MEPG) by *in-vitro* techniques. Two in-vitro models i.e. inhibition of protein denaturation and Human red blood cell (HRBC) membrane stabilization were selected for the study. Diclofenac sodium was used as a standard drug. The results of both models exhibited that EEPP, MEPG and standard drug (diclofenac sodium) showed concentration dependent inhibition of protein (egg albumin) denaturation as well as stabilization towards HRBC membrane. [91]

***Premna corymbosa*, Linn Verbenaceae:** The anti-arthritic activity of PCEE in Complete Freund's Adjuvant (CFA)-induced arthritis in rats were conducted. The results indicated that the long-term treatment significantly ($p < .01$) suppressed the development of chronic arthritis induced by CFA. This study established the anti-arthritic activity of P. corymbosa leaves. [93]

***Premna serratifolia* Linn Verbenaceae:** Anti-arthritic activity of ethanol extract of *Premna serratifolia* Linn., wood is done by Freund's adjuvant induced arthritis model.[94]

***Rubia cordifolia* Linn, Rubiaceae:** Arthritis is induced in albino rats by injecting Freund's Complete Adjuvant and Bovine type II Collagen. Effectiveness of the plant extract is evaluated by comparing with that of a standard non-steroidal anti inflammatory drug Aspirin. Treatment is assessed by using various blood parameters and also by taking the change in paw volume. Ethanolic extract of rubia cordifolia showed significant anti arthritic activity which was statistically similar to aspirin. [97]

***Sida cardifolia* Linn, Malvaceae:** *Sida cardifolia L* is used in folk medicine for the treatment of inflammation. A 50% of ethanolic extract of Sida cardifolia. L tested on rats showed potent anti-antioxidant and anti-inflammatory activity when compared with standard drug deprenyl. [100]

***Stereospermum colais* Bignoniaceae:** Roots of SC and SS were extracted successively with various solvents such as Pet. Ether, chloroform, ethylacetate and ethanol. *In vitro* antiarthritic study was carried out by protein denaturation method using Bovine Serum Albumin. The results of *in vitro* antiarthritic activity showed that the various extracts of SC and SS has antiarthritic potential in a dose dependent manner when compared with diclofenac sodium. In both the species, the ethanol extract showed maximum activity on comparison with other extracts. The antiarthritic activity was maximum in SC compared to SS. [104]

***Trachyspermum ammi*, Apiaceae:**
Trachyspermum ammi extract (TAE) in a dose of 100 mg kg -1 was orally administered to rat once daily for 21 days after immunization. The estimation of levels of oxidant products and the activities of antioxidant enzymes were carried out in the joints. The induction of arthritis significantly increased the levels of oxidative stress markers like thiobarbituric acid reactive substances and inflammation markers like elastase. The level of non-enzymatic antioxidant, reduced glutathione (GSH) and the activities of enzymatic antioxidants like superoxide dismutase and catalase decreased. The study revealed that the treatment with TAE was effective in bringing significant changes on all the parameters studied as compared with CIA rat. Supplementation with *T.ammi* reversed the oxidative changes in all the parameters suggesting either termination of cellular infiltration or limiting the generation of oxidants following CIA in rats and might have potential value in the treatment of inflammatory disease.[107]

***Vitis vinifera* Linn, Vitaceae:** The anti arthritic activity of grape seed ethanolic extract invitro by protein denaturation method was evaluated. [113]

***Barleria prionitis* L. Acanthaceae:** *Barleria prionitis* L. leaves fraction were evaluated for anti-arthritic potential at two doses 125 and 250 mg/kg, against formaldehyde-induced acute non immunological and Freund's Complete Adjuvant-induced chronic immunological arthritis in rats. Dose dependent and significant inhibition of oedema was observed in both acute as well as chronic models. [114]

***Euphorbia tirucalli Linn* Euphorbiaceae:** The anti arthritic efficacy was evaluated for the triterpenoid fraction isolated from *Euphorbia tirucalli Linn* (TET) in collagen induced arthritis model (CIA). [115]

***Hemidesmus indicus* Apocynaceae:** The anti arthritic activity was evaluated on roots of *Hemidesmus indicus* in rats, arthritis rat models were established by CFA, *Hemidesmus indicus* has protective activity against arthritis and the activity might be attributed to the presence of triterpenoids. [116]

***Strychnos potatorum* Linn Loganiaceae:** The present study states the effect of the aqueous extract (SPE) and the whole seed powder (SPP) of *Strychnos potatorum* Linn seeds on the Freund's complete adjuvant (FCA) induced arthritic rat paw edema. [117]

***Tridax procumbens* Asteraceae:** To determine the anti-arthritic effect of whole plant ethanolic extract of *Tridax procumbens* (Asteraceae) in female Sprague Dawley (SD) rats using the Freund's Complete Adjuvant (FCA) model. [118]

Polyherbal formulation: The polyherbal formulation was formulated using the ethanol

extracts of the stem bark of *G. pentaphylla*, whole plant of *T. procumbens*, and leaves of *M. indica*. The polyherbal formulation contains the ethanol extracts of *G. pentaphylla*, *T. procumbens*, and *M. indica* in the ratio of 2:2:1. Arthritis was induced in female Wistar rats using Freund's complete adjuvant (FCA), and the antiarthritic effect of polyherbal formulation was studied at doses of 250 and 500 mg/kg. The effects were compared with those of indomethacin (10 mg/kg). Polyherbal formulation showed significant antiarthritic activity at 250 and 500 mg/kg, respectively, and this effect was comparable with that of indomethacin. [119]

This study was carried out to investigate the phytochemical constituents of *Myristica fragrance*, *Nigella sativa*, *Piper longum*, *Vitex negundo* and *Zingiber officinale*. 25 informants were selected for this study, suffering from rheumatoid arthritis and who used the plants and plant parts for treatments. [120] Muhammad Shaiful Alam Bhuiyan [120]

***Alangium salvifolium* Alangiaceae:** The acute toxicity and anti-arthritic activity of stem barks of *Alangium salvifolium* in rats by Fruends adjuant arthritis model. All the extracts (petroleum ether, Ethyl acetate, chloroform, and methanol) have exhibited significant anti-arthritic activity. [121]

CONCLUSION: Arthritis is one of the major diseases, in the world which affects many people. In the modern world the normal life style of people is that they do not have a balanced diet, no proper exercise, the modern life style is people always sit in front of laptops for long time, these are the main causes which leads to arthritis. So the younger generations are also affected by this disease. Hence there are different treatments available for arthritis like NSAIDs, Steroids, etc these treatments can relieve pain, and the disease can be controlled to a certain extent, with severe side effects. The quality control and standardization must be improved for traditional Indian system of medicine. As this is a review article, authors have extensively reviewed several articles which say about the potential application of plants. More that hundred articles have been used as reference, by reviewing this article researchers can use this article as guidance for further research.

This article also strengthens data regarding plants and it may help research for further advance research in the field of phytopharmacology. Thus, in light of modern science, combination drugs and herbal formulations should be prepared by using medicinal plant resources that could result in the development of satisfactory medicines to treat RA patients.

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