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SYSTEMATIC REVIEW OF ANTI-RHEUMATIC MEDICINAL PLANTS

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ABSTRACT

Rheumatoid arthritis is an immune mediated inflammatory disease (IMID) of the joints, characterized by destruction of bones and joints. Genetic, hormonal, environmental and nutritional, and socio-economic, age and sex, ethnicity, smoking, infections are some risk factors of rheumatoid arthritis. The treatments which are available including steroidal and non-steroidal allopathic therapies cannot cure or prevent the disease and having severe side effects. These treatments can only provide temporary relief by suppressing and reducing the pain in the joints. Traditional medicines are prevalent in the treatment of rheumatoid arthritis due to severe side effect of allopathic medicines in many countries. Many native medicinal plant of India have effective properties on rheumatoid arthritis. In this review, medicinal plants of Indian ethno botanical resources on RA were reported. In this review study, a search was done for articles by the keywords rheumatoid arthritis, medicinal plants “anti-inflammatory”, “plant”, “herb”, and “herbal medicine”. A search on the databases, such as PubMed, Research Gate, Science Direct, and Google Scholar, Scopus, and a number of other databases was performed to collect authentic information. 27 herbs from different parts of India are traditionally used for the treatment of rheumatoid arthritis. Medicinal herbs, such as *Hemidesmus indicus*, *Calotropis gigantean*, *Curcuma. longa*, *Costus speciosus*, *Oxalis corniculata* etc. are of the native medicinal plants of India, which are effective on the treatment of rheumatoid arthritis.

Keyword: Medicinal plants, Rheumatoid arthritis, India

INTRODUCTION

Rheumatoid arthritis is an autoimmune inflammatory disease affecting around 1-3% of the world population. In India, more than 20% of population suffers from any type of arthritis [1]. The word Arthritis means inflammation of the joint (“artho” means the joint and “it is” meaning inflammation of the joint) [2-4]. 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. It is a multifunctional immune disorder with a known cause. Some factors which may influence RA are a genetic factor, age, hormones, environmental factors, smoking etc. The exact pathophysiology of RA is still unknown but release of certain free radicals such as nitrous oxide and superoxide radicals generated as by-products of cellular metabolism [5-6]. The release of such free radicals may induce the production of interleukins (IL) and tumor necrosis factor (TNF- α) from T-cells, which ultimately influence the production of growth factors, cytokines and adhesive molecules on immune cells as such factors may cause tissue destruction and inflammation. Pathological changes in RA are hyperplasia of synovial membrane, infiltration of inflammatory cells and neovascularization, which results into cartilage erosion and articular destruction [7].

Symptoms

Symptoms of RA include joint pain, swelling, stiffness in joints, sleeplessness, fatigue, loss of weight and having flu kind of symptoms. Abnormal antibodies IgG have been found in the blood of a person suffering from rheumatoid arthritis [8, 9]. They react to antigens leading to the formation of antigen-antibody complex that leads to inflammation and pain of the synovial membrane. 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.

Treatment

Treatment of rheumatoid arthritis patients is to eliminate symptoms, slow disease progression, and optimize quality of life. Certain goals must be considered before starting the treatment of rheumatoid arthritis such as relief of analgesia,

reduction of inflammation, protection of articular structure, maintenance of function, and control of systemic involvement [10-11]. Currently, strategies have changed from traditionally used non-steroidal anti-inflammatory drugs (NSAIDs) [12] or disease modifying antirheumatic drugs (DMARDs) to novel biological agents, like TNF monoclonal antibody to treat rheumatoid arthritis. Clinically, the treatment of rheumatoid arthritis includes five strategies. The primary approach is the use of NSAIDs followed by mild doses of glucocorticoids to minimize the signs of inflammation as well as progression of disease. In chronic patients, the use of DMARDs such as methotrexate, sulfasalazine, gold salts or D-pencillamine can be included in the treatment. In certain cases, TNF- α neutralizing agents like infliximab, etanercept etc; IL-1 neutralizing agents like anakinra and the drugs, which interfere with T-cell activation such as abatacept can also be included in treatment of chronic cases. Finally, immunosuppressive and cytotoxic drugs such as cyclosporine, azathioprine, and cyclophosphamide are used for the treatment of chronic patients. The above mentioned drugs reduce the inflammation and joint destruction but their long-term risks are still unknown. Shortness of breath, nausea, infections and allergic reactions have also been noticed as the short-term

side effects. However, long-term risks of drugs includes gastrointestinal ulcers, cardiovascular complications, hematologic toxicity, nephrotoxicity, pulmonary toxicity, myelosuppression, hepatic fibrosis, stomatitis, cirrhosis, diarrhea, immune reactions, and local injection-site reactions [13-15].

Herbal therapy for the treatment of arthritis

Ayurveda is one of the forms of alternative treatment of medicine. Herbal medicines are used for the treatment of various diseases from long times and it is not an exaggeration to say that the use of the herbal medicines is as old as mankind [16-18]. Herbal drugs are synthesized from the therapeutic experience of generation of practicing physicians of ancient system of medicine for more than hundreds of years [19]. Nowadays, researcher are much interested in medicinal agents that are derived from plants because allopathic drugs are having severe side effects [20-22]. Nature has blessed us with enormous wealth of herbal plants, which are widely distributed all over the world as a source of therapeutic agents for the prevention and cure of various diseases. According to WHO, around 80 % population of world uses herbal medicines for their primary health care needs. Herbal medicines will act as parcels of human society to combat disease from the dawn of civilization. The

medicinally important parts of these herbal plants are chemical constituents that produce a desired physiological action on the body. India is having a long history of use of herbal medicines in the officially alternative systems of health such as Ayurveda, Unani, Sidha, Homeopathy, and Naturopathy. More than 2500 plants species are currently used as herbal medicaments in India [23-24]. These herbal medicines are used either directly as folk medication or indirectly in the preparation of recent pharmaceuticals from last 3000 years. Thus, from the knowledge of traditional plants, one might be able to discover new effective and cheaper drugs. In this review article we have tried to compile some potent ayurvedic plants which have shown potency for the treatment of RA without any possible side effects [25]. The future treatment of RA should provide more effective relief. Medicinal herbs have been traditionally a resource for the treatment of many diseases. Treatment of inflammatory diseases, such as rheumatoid arthritis is practiced based on traditional medicine in many countries. Rheumatoid arthritis risk factors include genetic, hormonal, environmental and nutritional, and socio-economic factors, age and sex, ethnicity, smoking, infections, etc. Rheumatoid arthritis is associated with pain. 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 [26].

METHODOLOGY

In this review study, a search was done for articles by the keywords rheumatoid arthritis, medicinal plants “anti-inflammatory”, “plant”, “herb”, and “herbal medicine” and medicinal plants. A search on the databases, such as PubMed, ScienceDirect, Research gate, Scopus, Google Scholar and a number of other databases was performed. In this review, bibliographic investigation was carried out during Jan 2021-Oct 2021, by referring various text books and certain review papers and research papers, consulting globally accepted databases from last some decades. The data were gathered from various databases and the information is compiled by reviewing more than 200 research and review articles. The botanical correct names and families were mentioned after verification from published literature and databases. The method of selecting the data for this review article includes those plants: (i) Which are native to India (ii) used in traditional systems and in various polyherbal preparations, (iii) with reported anti-arthritic activity. Plants/their parts/extracts used traditionally in acute

rheumatic attacks, chronic analgesia, and chronic rheumatism have been considered as anti-arthritic agents. Further, detailed information on research status of 27 plant species has been explained.

RESULTS

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. 26 herbs from different parts of India are traditionally used for the treatment of rheumatoid arthritis. The medicinal plants like *Hemidesmus indicus*, *Calotropis gigantean*, *C. longa*, *Costus speciosus*, *Oxalis corniculata* Linn etc. are of the most effective native herbs of India on rheumatoid arthritis. Other medicinal plants of different parts of India, which are effective on rheumatoid arthritis, along with their additional information, are marked in **Table 1**.

Hemidesmus indicus is widely used in Indian medicine systems and also an official drug in Indian Pharmacopoeia. It is slender, laticiferous, twining, sometimes prostrate or semi-erect shrub. It is employed in nutritional disorder, syphilis, chronic rheumatism, gravel and other urinary disease and skin infection. The protective effects of hydroalcoholic and its

fractions from roots of *Hemidesmus indicus* on arthritis in *in-vitro* models of rodents were investigated [27]. Preliminary phytochemical analysis and thin-layer chromatography were performed to analyze constituents of hydroalcoholic extract and its three fractions namely ethyl acetate fraction, chloroform fraction and residual fraction of root of *Hemidesmus indicus*. Arthritis rats models were established by Complete Freund's Adjuvant. The parameters including paw edema, body weight, arthritic index, erythrocyte sedimentation rate, serum rheumatoid factor, serum C-reactive protein, serum nitrite level, and histopathology of synovial joints were observed. Methotrexate was taken as positive control. Hydroalcoholic extract and its ethyl acetate fraction of *Hemidesmus indicus* showed significantly higher anti-arthritic activity than chloroform and residual fraction. The present study suggests that *Hemidesmus indicus* has protective activity against arthritis and the activity might be attributed to presence of terpenoid in hydroalcoholic extract, as well as in ethyl acetate fraction. *Calotropis gigantea* Linn (Asclepiadaceae) commonly known as "Arka" in Sanskrit and "Mudar" in English has been claimed in traditional literature to be valuable against a wide variety of diseases. The shrub is distributed throughout India in dry

waste places. Indian medicinal plants describe the use of this plant in the treatment of number of ailments including anorexia, asthma, cold and cough. Roasted leaves application is useful in painful joints or swellings. Petroleum ether (40-60°), ethyl acetate, ethanol and aqueous extract of *Calotropis gigantea* leaves were tested for various preliminary phytoconstituents and were screened for anti-arthritic activities using Freund's adjuvant arthritis in albino rats [28]. The extracts were administered orally for 21 days and the mean changes in diameter of paw were noted at regular intervals. The changes in body weight were recorded daily. On 22nd day, at the end of study, blood was collected and haemoglobin content, total WBC count, differential WBC count, ESR and RBC were also estimated. The *Calotropis gigantea* leaves extracts reduced the hind paw oedema. In biochemical study, *Calotropis gigantea* extracts showed increase in haemoglobin content as compared to adjuvant positive control group. The increased WBC count was significantly suppressed by extracts. The significant increase of ESR in adjuvant control was also restored back to normal by the extracts.

Turmeric, scientifically known as *Curcuma longa*, belongs to the ginger family Zingiberaceae. It is extensively used as culinary spice, food preservative, colorant,

cosmetic and medicine. The "Golden spice" is also known as "Indian saffron" because of its saffron like colorant property. Turmeric despite of its spicing use, has a very long history of therapeutic use dating nearly 4000 years. *C. longa* has a long spectrum of bioprotective functions like anti-oxidant, anticarcinogenic, anti-mutagenic, anti-coagulant, anti diabetic, anti-fertility, anti-bacterial, anti-fungal and anti-inflammatory activities. The effects of polar extract of *C. longa* (PCL) against monosodium iodoacetate (MIA) induced osteoarthritis in rat and to compare with curcuminoids, which are contemporarily believed to be the only active phytochemicals of *C. longa* for relieving pain in osteoarthritis was investigated [29]. Degenerate Osteoarthritis in rats was induced by intra-articular injection of monosodium iodoacetate (MIA) in right knee. PCL or curcuminoids or tramadol was administered orally as single dose on the 5th day post MIA injection to rats. Weight bearing capacity and percentage inhibition of nociception of PCL treated groups were determined and compared with curcuminoids and tramadol (reference drug). In addition, gene expression levels of type II collagen and matrix metalloproteinases (MMP) in joint cartilage was measured by Reverse transcription polymerase chain reaction. PCL significantly decreased the difference in

weight distribution between left and right limb in a dose dependent manner. Anti-arthritis activity of PCL is evident from significant up regulation of type II collagen gene (COL2A1) and down regulation of MMP-3 and MMP-7.

Costus speciosus Koen. (Keu, Crape ginger), an Indian ornamental plant, has long been medicinally used in traditional systems of medicine. This plant of *Costaceae* (*Zingiberaceae*) family is commonly known as keukand (Hindi) and variegated Crepe Ginger (English). It is an erect, succulent, perennial herb, up to 2.7 meters in height, arising from a horizontal rhizome, found in tropical region of India and also cultivated for ornament. The rhizomes and roots are ascribed to be bitter, astringent, acrid, cooling, aphrodisiac, purgative, anthelmintic, depurative, febrifuge, expectorant, tonic which improves digestion, clears toxins and is a stimulant herb. An alkaloid ext. from *Costus speciosus* rhizomes is known to display papaverine like smooth muscle relaxant and antispasmodic activities. The plant possesses purgative, anti-inflammatory and anti-arthritis effect, anti-fungal activities and is used in gout rheumatism and bronchial asthma. The anti-arthritis activity of the methanolic extract of the aerial parts of *Costus speciosus* (CS) was evaluated in experimental animal models [30]. The

powdered drug was subjected to successive solvent extraction, with solvents in increasing order of polarity to obtain the methanolic extract of the aerial parts of the plant. CS was evaluated for anti-arthritis action by Freund's adjuvant induced arthritis test in adult Albino rats (150-200 gm). Rats were injected 0.1 ml of complete Freund's adjuvant into the planter region of the left hind paw. Statistical analysis was performed using One way analysis of variance (ANOVA) followed by Bonferonni test. $P < 0.05$ was considered statistically significant. The methanolic extract of CS in doses of 400 and 800 mg/kg showed 75.50% and 68.33% protection against increase in paw edema, respectively. CS showed dose-dependent action in all the experimental models. The present study indicated that CS has significant anti-arthritis properties.

Gentiana kurroo Royle is a plant which belongs to the family *Gentianaceae*. It is a critically endangered (CR) medicinal plant species, endemic to the north-western Himalayas. The drug (rootstock) of this plant is administered in fevers and urinary complaints and also used as a bitter tonic, antiperiodic, expectorant, antibilious, astringent, stomachic, antihelminthic, blood purifier, and carminative. The anti-inflammatory potential of different extracts obtained from *Gentiana kurroo* and their ability to reduce the arthritis symptoms

under in vivo conditions were studied [31]. Rat carrageenin paw edema was used as a model of acute inflammation and mycobacterium induced adjuvant arthritis as a model of chronic inflammation. The different extracts tested in acute inflammation showed anti-inflammatory effect with maximum potential shown by the methanolic extract. The methanolic extract was further analysed for the change in activity with the variation of dose. The results obtained were significant with the control and the standard groups. In the arthritic model, the methanolic extract showed decrease in the paw volume of arthritic animals and also in the arthritic symptoms. Again the results obtained were found to be significantly dose dependent. From the results obtained, it can be concluded that this extract may serve as a source of drug against the rheumatoid arthritis

Glycyrrhiza glabra (family Fabaceae), commonly known as licorice, is an herbaceous perennial that has been used as a flavoring agent in foods and medicinal remedies for thousands of years. Licorice root has been widely used around the world to treat cough since ancient times. It contains several active compounds including glycyrrhizin, glycyrrhetic acid, flavonoids, isoflavonoids, and chalcones. Glycyrrhizin and glycyrrhetic acid are considered to be the main active

components and are potent inhibitors of cortisol metabolism, due to their steroid-like structures. *Boswellia serrata* (Salai/Salai guggul) (Family: Burseraceae; Genus: *Boswellia*) is a moderate to large sized branching tree that grows in dry mountainous regions of India. The family of Burseraceae is represented in the plant kingdom with 17 genera and 600 species wide-spread in all tropical regions. Ayurveda describe the antirheumatic (antiarthritis) activity of gugguls-the gum-resins of trees. In addition to its beneficial use for arthritis, this gummy resin is also mentioned in traditional Ayurvedic and Unani texts as an effective remedy for diarrhoea, dysentery, ringworm, boils, fevers (antipyretic), skin and blood diseases, cardiovascular diseases, mouth sores, bad throat, bronchitis, asthma, cough, vaginal discharges, hair-loss, jaundice, hemorrhoids, syphilitic diseases, irregular menses and stimulation of liver. In a study, *Glycyrrhiza glabra* and *Boswellia serrata* extracts were combined to study the synergistic property for potent anti-arthritic activity [32]. The methanolic extract of *Glycyrrhiza glabra* was administered orally at a dose of 150 mg/kg and n-hexane extract of *Boswellia serrata* was administered 50mg/kg body weight for 21 days to the experimental animals after the induction of adjuvant arthritis. Further the combined formulation containing both

Glycyrrhiza glabra and *Boswellia serrata* 100mg/kg was administered in separate group. Different biochemical estimations were carried out like paw edema volume, lysosomal enzyme activity such as ACP, membrane bound enzymes like SGPT, SGOT and ALP, Total WBC count, different in vitro parameters like Proteinase inhibitory action and inhibition of Protein denaturation for the evaluation of anti-arthritis property. The anti-arthritis activity of *Glycyrrhiza glabra* and *Boswellia serrata* were assessed by significant reduction of paw edema volume and its capacity to stabilize lysosomal enzyme activity such as ACP significantly ($P < 0.01$). Furthermore the combined formulation containing both *Glycyrrhiza glabra* and *Boswellia serrata* at proportion (1:1) showed significant synergistic action. As a better synergistic activity was observed in combined formulation, it may be tried for therapeutic use clinically.

Camellia sinensis is an evergreen shrub, produces leaves that are used to prepare a popular beverage known as tea. The beverage is prepared by using variously processed leaves of the plant *Camellia sinensis*. The composition of tea also depends largely upon the climatic region in which it is grown, season, cultural practices of brewing. Hibiscus is also known to reduce inflammation within the body and thus, has a protective effect in maintenance

of health. Chamomile has been used for centuries in many different cultures in the form of teas as a mild, relaxing sleep aid, treatment for fevers, colds, stomach ailments, and as an anti-inflammatory, to name only a few therapeutic uses. *In-vitro* and *ex-vivo* studies on the anti-oxidant, anti-inflammatory and anti-arthritis properties of tea extracts such as *Camellia sinensis*, *Hibiscus rosa sinensis*, *Zingiber officinale*, *Matricaria chamomilla* were studied [33]. *Ex-vivo* tests for evaluating antioxidant property of samples using liver tissue by LPO assay was performed. In addition, tests such as inhibition of protein denaturation and RBC membrane stabilization were performed to determine anti-inflammatory effect of the sample. Collagen denaturation assay using chicken collagen to check anti-arthritis properties of samples were performed. All the tests showed positive results with the samples, which implied that the samples were potent in their anti-oxidant, anti-inflammatory and anti-arthritis activities. Thus, the use of natural sources to prevent disorders has become a more feasible option as there are no adverse effects. Reduction of inflammation can be brought about by daily consumption of green tea in turn reducing the cartilage destruction which is further responsible for decreasing the joint pain. Several studies have shown that the presence of large amount of collagen in the

cartilage renders the cartilaginous properties such as flexibility, elasticity, rigidity and helps in easy movement of hands and legs. Heat induced protein denaturation would cause the collagen to lose its optimum functionality structure leading to cartilage destruction. Inhibition of collagen denaturation was observed by the tea extracts proving that the extracts chosen have anti-arthritis property and maximum percentage inhibition was exhibited by green tea.

Oxalis corniculata (Linn.) is a subtropical plant belonging to Oxalidaceae family. It is commonly known as the creeping wood sorrel. It is a delicate, procumbent herb with palmately three foliolate leaves. It is a plant native of India which grows in damp shady places, plantations, roadside, lawns etc. Traditionally this plant is used as antiseptic, anti-inflammatory, anti-diabetic, digestive, antibacterial, diuretic, hepatopathic and cardiopathic agent. It also cures diarrhea, dysentery, skin diseases etc. Antioxidant, anti-arthritis and hypoglycemic activity of *Oxalis corniculata* Linn. leaf extracts were evaluated [34]. The dried leaves of *Oxalis corniculata* Linn. (Family:Acanthaceae) were extracted using pet ether (non-polar), ethyl acetate (mid-polar) and ethanol (highly polar). All three extracts were subjected to qualitative phytochemical screening to identify the phytoconstituents

present. The *in-vitro* anti-arthritis activity of the extracts was carried out by egg albumin denaturation method, where diclofenac was taken as standard. Ethanol extract exhibited potent antiarthritic activity by significantly ($p < 0.05$) inhibiting the denaturation of egg albumin at 50, 100 and 200 $\mu\text{g/mL}$ concentrations. Anti-diabetic effect was examined by α -amylase and α -glucosidase inhibitory activity, taking Acarbose as standard. Ethanol extract inhibited both the enzymes substantially ($p < 0.05$) at 50, 100 and 200 $\mu\text{g/mL}$ concentrations, unveiling potential anti-diabetic activity.

Withania somnifera (Solanaceae) is commonly known as Ashwagandha or Indian ginseng. It is a reputed herb used in Ayurvedic and indigenous medicine for over 3000 years. The pharmacological activities of *W. somnifera* like anti-inflammatory, antitumor, antibacterial, antioxidant, anticonvulsive and immunosuppressive properties have been studied. Anti-inflammatory effect of *Withania somnifera* root on collagen-induced arthritis in rats was studied [35]. The study focused on the effect of *W. somnifera* root powder on the behavioral and radiological changes in collagen-induced arthritic rats. The rats were randomly divided into five groups: normal control, arthritic control, arthritic rats treated with *W. somnifera* root powder (at

dose levels 600 and 800mg/kg) and arthritic rats treated with methotrexate (at dose level 0.3mg/kg). The treatment with *W. somnifera* (daily) and methotrexate (weekly) was initiated from the 20th day post collagen immunization and continued up until the 45th day. Arthritis was assessed macroscopically by measuring paw thickness, ankle size and body weight. Arthritic pain was assessed by toe-spread and total print length of the affected paw. Functional recovery due to the oral treatment of *W. somnifera* and methotrexate was assessed by sciatic functional index and rota rod activity. Administration of *W. somnifera* root powder (600mg/kg) to the arthritic rats significantly decreased the severity of arthritis by effectively suppressing the symptoms of arthritis and improving the functional recovery of motor activity and radiological score. *W. somnifera* root has a protective effect against collagen-induced arthritis (CIA) in rats. The results suggested that *W. somnifera* root powder acts as an anti-inflammatory and antioxidant agent in decreasing the arthritic effects in collagen-induced arthritic rats.

Lawsonia inermis Linn belonging to family Lythraceae commonly known as Henna/Mehandi in India. It is a much branched glabrous shrub or small tree, cultivated for its leaves although stem bark, roots, flowers and seeds have also been

used in traditional medicine. The plant is reported to contain carbohydrates, proteins, flavonoids, tannins and phenolic compounds, alkaloids, terpenoids, quinones, coumarins, xanthenes and fatty acids. The plant has been reported to have analgesic, hypoglycemic, hepatoprotective, immunostimulant, anti-inflammatory, antibacterial, antimicrobial, antifungal, antiviral, antiparasitic, antitrypanosomal, antidermatophytic, antioxidant, antifertility, tuberculostatic and anticancer properties. The scientific validation of the ethnopharmacological claim about *Lawsonia inermis* and its anti-arthritic property was evaluated [36]. In the present study, antiarthritic activity of hydroalcoholic extract of *Lawsonia inermis* was 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 results of the current investigation concluded that hydroalcoholic extract of *Lawsonia inermis* possess a

significant anti-arthritic activity against adjuvant induced arthritis and formaldehyde induced arthritis model and justifying its therapeutic role in arthritic condition. The observed antiarthritic activity may be due to the presence of phytoconstituents such as alkaloid and flavonoids.

Cedrus deodara (Roxb.), belonging to the family Pinaceae (Hindi-Marathi Deodar; Sanskrit-Devadaru; English-Cedar) is graceful, ornamental evergreen tree growing extensively on the slopes of the Himalayas. *C. Deodar* forests are common from Kashmir, especially Krishnaganga, Kishtwar and Jhelum to Garhwal. The wood of *C. deodara* has been used since ancient days in Ayurvedic medical practice for the treatment of inflammations and rheumatoid arthritis. *Cedrus deodar* in external applications in the ayurvedic system of medicine and a preliminary phytochemical study of the same to help deduce the possible active ingredients was evaluated [37]. The petroleum ether, chloroform, alcoholic extracts of the heart wood of *Cedrus deodar* were prepared by Soxhlet extractor and examined for its external anti arthritic activity in rats using the freunds adjuvant method. The results of the phytochemical study revealed the presence of alkaloids, flavonoids, glycosides, phenolic compounds, saponins and proteins. Application of all the three

extracts exhibited significant inhibition of CFA (Complete Freund's Adjuvant) induced rat paw edema when compared with the arthritic control group. These findings seem to justify the use of the plant in traditional Indian medicine in the treatment of inflammation, including arthritic conditions.

From various studies, it was observed that many of the plants belonging to the genus *Ocimum* possess anti-inflammatory properties, and that's why it is regarded as a good candidate for the treatment of rheumatoid arthritis. Folklorically, the plant *Ocimum gratissimum* L. was used for treating various inflammatory disorders like allergic dermatitis, mild swellings etc. Antiarthritic potential of *Ocimum gratissimum* L. in collagen induced arthritic Sprague-Dawley rats was evaluated [38]. Steroids and triterpenoids present in *O. gratissimum* L. may be the constituents responsible for the anti-arthritic activity. The mechanism behind the activity may be by decreasing the expression of pro-inflammatory cytokines such as TNF and also the suppression of COX enzymes, which results in the reduction of joint inflammation and destruction. The present study showed promising anti-inflammatory as well as anti-arthritic activity. The results showed that there is need to further explore the activities in molecular level to understand the mechanism behind action.

Piper longum L. (Piperaceae), popularly known in India as Pippali, is used as traditional medicine in Asia, especially in Indian medicine and in Pacific islands. Various *Piper* species, widely distributed in the tropical and subtropical regions of the world, have been used as a spice and also as a folk medicine. *Piper longum* is reported as good remedy for treating gonorrhoea, menstrual pain, tuberculosis, respiratory tract infections, chronic gut related pain. Other reported beneficial effects of *P. longum* include analgesic and diuretic effects, relaxation of muscle tension, and alleviation of anxiety. The extract of crude drug of *P. longum* is frequently used as anti-inflammatory and insecticidal agents. Aqueous extract of the fruits of the plant *Piper longum* was studied for their anti rheumatoid activity in Freund's Adjuvant Induced Arthritis [39]. Rats with the dose of 200 and 400 mg/kg p. o. The administration of extract reported significant reduction in paw swelling on 4th, 8th, 14th and 21st day after sub-plantar administration of Complete Freund's adjuvant. The paw swelling was measured as a volume displacement using digital Plethysmometer. Furthermore, these results supported by radiographic analysis of affected knees of rats. From the results observed in the present investigation, it may be concluded that the aqueous extract of *P. longum* possesses potentially useful

anti-arthritis activity in Complete Freund's Adjuvant model.

Terminalia chebula Retzius (Family: Combretaceae) is a widely growing evergreen tree in India and Southeast Asia. The fruit of *T. chebula* has been used extensively as an astringent, anti-tussive, anti-diarrhoeal, and anti-bleeding agent. *T. chebula* has been shown anti-oxidant and cytoprotective activities in rat primary hepatocytes, liver, and kidney, and protective effects against drug-induced gastric, intestinal, hepatic, and renal damages. The fruit of *Terminalia chebula* Retzius has been used as a panacea in India and Southeast Asia but its biological activities have not been fully elucidated. Anti-arthritis and analgesic effect of NDI10218, a standardized ethanol extract of *Terminalia chebula*, on collagen-induced arthritis and acetic acid-induced writhing model was studied [40]. Arthritis was induced in DBA/1J mice by immunizing bovine type II collagen and mice were treated with NDI10218 daily for 5 weeks after the onset of the disease. NDI10218 reduced the arthritis index and blocked the synovial hyperplasia in a dose-dependent manner. The serum levels of pro-inflammatory cytokines TNF- α , IL-6, and IL-1 β were significantly reduced in mice treated with NDI10218. Production of the inflammatory IL-17, but not immunosuppressive IL-10, was also

inhibited in splenocytes isolated from NDI10218-treated arthritis mice. Administration of NDI10218 markedly decreased the number of T cell subpopulations in the regional lymph nodes of the arthritis mice. Finally, NDI10218 reduced the number of abdominal contractions in acetic acid-induced writhing model, suggesting an analgesic effect of this extract. Taken together, these results suggest that NDI10218 can be a new therapeutic candidate for the treatment of rheumatoid arthritis.

Caesalpinia pulcherrima is a medicinal plant belonging to the family *Caesalpinaceae*. It is an ornamental plant due to its variety of flowers, which appear yellow, pink, off-white, and red with yellow margins. Phytochemical studies showed the presence of pulcherrimin, terpenoids, sitosterol, flavonoids like quercetin and myricetin, carotenoids, glycosides, steroids, and phenols. It is popular in Indian indigenous system of medicine like Siddha, Unani, Homoeopathy and Ayurveda. In traditional system of medicine, this plant has been used for anti-inflammatory, bronchitis, abortifacient, and malarial infection. Anti-arthritic activity of ethanolic extract of *Caesalpinia pulcherrima* (ECP) in adjuvant arthritic (AA) rat model induced by Freund's complete adjuvant (FCA) was evaluated [41]. Thirty healthy albino rats were

selected and randomly divided into five groups. Arthritis was induced by Freund's complete adjuvant (FCA) and then treated with ethanolic extract of *Caesalpinia pulcherrima* for 28 days. The various parameters like paw volume, haematological parameters (RBC, WBC, Hb and ESR), and radiological studies were assessed. In FCA induced arthritic rats, there was significant increase in rat paw volume whereas both doses of ECP treated groups showed strong significant reduction in paw volume. The altered haematological parameters in the arthritic rats were significantly recovered to near normal by the treatment with ECP at the dose of 200 and 400 mg/kg. Further radiological studies revealed the anti-arthritic activity of ECP by preventing cartilage and bone destruction of the arthritic joints of AA rats. ECP has shown anti-arthritic activity with a significant decrease in paw volume and it could significantly normalize the haematological abnormalities in adjuvant induced arthritic rats. Further radiological studies confirmed the anti-arthritic activity of ECP.

Merremia tridentata (L.) Hall. f. (Fam. Convolvulaceae) commonly known as "Mudiarkunthal" or "Savulikodi" or "Thrippan Pullu" in Tamil and "Prasarini" in Sanskrit is reported to possess a number of medicinal values. It is a thick climbing herb with woody rootstock spreading on the

walls and on the grounds. It grows in all plain districts of Tamilnadu, Western peninsula and Bengal. The plant is considered bitter, astringent, tonic and used in the treatment of rheumatism, piles, swellings and urinary disorders. The various extracts of *Merremia tridentata* for its anti-inflammatory and anti-arthritic activities in male albino rats were evaluated [42]. The anti-inflammatory activity was carried out using carrageenan-induced rat paw oedema model and the anti-arthritic activity was carried out using complete Freund's adjuvant induced arthritis model. Indomethacin (10 mg/kg bw) was used as a standard drug. The ethanol extract of *M. tridentata* exhibited significant dose dependent activity in acute inflammation and the doses of 100 mg/kg bw and 200 mg/kg bw produced 38.3% and 42.8% inhibition respectively after 3 hrs as compared with that of the standard drug which showed 48.5% inhibition. In arthritis model, the doses of 100 mg/kg bw and 200 mg/kg bw of the ethanol extract produced 49.0% and 51.7% inhibition respectively after 19 days when compared with that of the standard drug (55.5%). Both doses of the ethanol extract of *M. tridentata* exhibit significant anti-inflammatory and anti-arthritic activities.

Cyathocline purpurea (Buch-Ham ex D. Don.) Kuntze. Fam. Asteraceae is a rare existence Indian medicinal plant found in

moist habitats such as along watercourses and in rice fields throughout most of peninsular and northern India at an elevation of 1300 m. *C. purpurea* is reported to have antimicrobial, anthelmintic, hypotensive and stomach relieving properties. *C. purpurea* is used to treat inflammations and pulmonary tuberculosis and also sesquiterpene lactones like santa-marine, 9-acetoxycostunolide and 9-acetoxyparthenolide isolated from *C. purpurea* exhibited significant anticancer activities *in-vitro*. Anti-arthritic activity of methanolic extract of *Cyathocline purpurea* (MECP) in Freund's complete adjuvant (FCA)-induced arthritis in rats was evaluated [43]. The MECP was prepared and subjected to acute oral toxicity in mice and tested against FCA induced arthritis in rats. Arthritis assessment was done by measuring – paw volume, joint diameter, pain threshold, thermal hyperalgesia, mechanical nociceptive threshold and body weight. Haematological, serum, biochemical and *in vivo* anti-oxidant parameters were measured on the last day of the study. Histopathological and radiological analyses of ankle joints were also done. MECP was administered at the dose of 100, 200 and 400 mg/kg body weight. MECP dose dependently showed anti-arthritic activity which was evident with decrease in paw volume, joint

diameter and increase in pain threshold, paw withdrawal latency, mechanical nociceptive threshold and body weight when compared to arthritic control group. MECP (400 and 200 mg/kg) exhibits significant ($P < 0.001$ and $P < 0.01$, respectively) anti-arthritic activity by increasing levels of RBC, Hb and by decreasing levels of WBC, platelets and also serum C-reactive protein (CRP) and Rheumatoid factor (RF). The anti-arthritic activity was also confirmed with the altered biochemical parameters (AST, ALT, ALP and total protein level) and antioxidant parameters (SOD, MDA and GSH). MECP (400 and 200 mg/kg) and diclofenac (10 mg/kg) also inhibited joint destruction (histopathological and radiological analysis). *C. purpurea* may be a potential preventive or therapeutic candidate for the treatment of inflammation and arthritis.

Colchicum luteum (CL) has been traditionally used in the Unani system of medicine as a chief ingredient of many polyherbal formulations for the treatment of joint pain and rheumatoid arthritis (RA). It is an annual herb that is widely distributed in the Western Himalayas (China, India, Pakistan and Afghanistan) at an altitude of 600–2700 m. Its corms and seeds are used by practitioners of traditional medicine for the treatment of gout, rheumatism and diseases of liver and spleen. Antiarthritic activity of CL

hydroalcoholic extract (CLHE) in formaldehyde and complete Freund's adjuvant (CFA) induced arthritis was evaluated [44]. Arthritis was induced by administration of either formaldehyde (2% v/v) or CFA into the sub plantar surface of the hind paw of the animal. Joint swelling was measured on days 8, 9 and 10 in formaldehyde induced arthritis and days 3, 7, 14 and 21 in CFA induced arthritis. In order to evaluate the effect of CLHE on disease progression, serum TNF level and synovial expression of proinflammatory mediators (TNF-R1, IL-6 and IL-1) was determined in CFA induced arthritis. CLHE produced a significant and dose dependent inhibition of joint swelling during the entire duration of the study in both, formaldehyde and CFA induced arthritis. Serum TNF level was also reduced significantly in a dose dependent manner in all the CLHE treated groups. The expression of proinflammatory mediators (TNF-R1, IL-6 and IL-1) was also found to be less in the CLHE treated group as compared to control.

Cassia fistula linn from Fabacea family is a flowering plant used in Telangana Batukamma festival and can also be considered as an herbal medicine for the treatment of various diseases. The plant is commonly found in the greater part of India like Bengal, Bihar, Orissa, Tamilnadu, Karnataka, Andra pradesh and Kerala.

Cassia fistula linn is known as Golden shower has therapeutic importance in healthcare since ancient times. In Ayurvedic medicine the golden shower tree is known as Aragvadha meaning “disease killer” but there are not much scientific data regarding the usage of the plant. The ethanolic extract of *Cassia fistula linn* leaf (EECFL) was studied for *in-vitro* antiarthritic activity by bovine serum protein denaturation method [45]. The activity of ethanolic extract of CFL was compared with standard anti-inflammatory drug Diclofenec. It showed 18.3%, 29.7%, 44.4%, 69.2%, 81.5%, 93.1% inhibition of denaturation @ 100, 200, 400, 600, 800, 1000 mcg/ml of bovin serum whereas, standard diclofenac @ 100, 200, 400, 600, 800, 1000 mcg/ml showed 16.8%, 27.4%, 51.2%, 63.4%, 70.6%, 89.9% inhibition of denaturation of bovin serum. It was found that ethanolic extract of *Cassia fistula linn* leaves was more potent in inhibition of egg albumin denaturation than diclofenac. Finally, from results it can be concluded that *Cassia fistula linn* a traditional plant of Telangana posses good *In-vitro* antiarthritic activity. By further extensive research, we can explore the medicinal value of *Cassia fistula linn* leaf.

Herbal medicines have been used to treat various diseases such as arthritis, but the scientific profiles are not well understood. The inhibitory effects on various

inflammatory markers of the most commonly used herbal medicines to treat arthritis, boswellia (*Boswellia sapindales*), licorice (*Glycyrrhiza glabra*), guggul (*Commiphora wightii*), and neem (*Azadirachta indica*) In a study, mouse myoblast C2C12 cells were exposed to lipopolysaccharide (LPS) to elicit inflammatory response [46]. Tumor necrosis factor-alpha (TNF- α) and monocyte chemotactic protein-1 (MCP-1), which are cytokines activated during an inflammatory response, were determined. The optimal non-toxic concentration was determined by exposing different concentrations of drugs (from 0.01 to 10 mg/mL). Cell death measurement revealed that the drug concentrations lower than 0.05 mg/mL were non-toxic concentrations for each drug, and these doses were used for the main experiments. It was found that neem and licorice showed robust anti-inflammatory responses compared with ibuprofen. However, boswellia and guggul did not demonstrate significant anti-inflammatory responses. It was concluded that neem and licorice are more effective than ibuprofen in suppressing LPS-induced inflammation in C2C12 cells.

Ficus benghalensis Linn (Family-Moraceae) is commonly known as Banyan tree or vata or vada tree in ayurveda. *Ficus benghalensis* is a remarkable tree from India that sends down its branches and

great number of shoots, which take root and become new trunks. This tree is considered to be sacred in many places in India. Traditionally all parts of the plant are astringent, acrid, sweet, refrigerant, anodyne, vulnerary, depurative, anti-inflammatory, ophthalmic, styptic, antiarthritic, diaphoretic, antidiarrhoeal, antiemetic and tonic. Anti-arthritic activity of ethanol and aqueous extract of root of *Ficus benghalensis* on Freund's adjuvant induced arthritis in rats was evaluated [47]. 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 assess 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. Our findings showed a significant anti-arthritic activity of *Ficus benghalensis* root extracts against FCA induced arthritis in rats.

Vimang is the brand name of an aqueous extract of selected varieties of the mango (*Mangifera indica* L. Anacardiaceae) stem bark extract (MSBE) containing a definite mixture of polyphenols, triterpenes, phytosterols, fatty acids and microelements. This active pharmaceutical ingredient is used to produce Vimang tablets (300mg), which are registered as a phytodrug by the Cuban health regulatory agencies. MSBE showed antioxidant, antiinflammatory, analgesic, and immunomodulatory properties with selective prevention of inflammation-related gene expression by means of TNF α -induced NF- κ B translocation inhibition. The safety

of *Mangifera indica* extract (Vimang tablets, 300 mg) combined with methotrexate (MTX) on reducing disease activity in rheumatoid arthritis (RA) was evaluated [48]. 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. Other adverse effects were not reported.

Momordica Charantia (Cucurbitaceae) plant has huge traditional importance. The fruit has a distinct warty looking exterior and oblong shape, hallow in cross section, with relatively a thin layer of flush surrounding a central seed cavity with large flat seeds and pith, appear white in unripe fruits, and red on ripening. It is used in diabetes, antipyretic, anthelmintic, appetizer, cures biliousness, kapha, blood diseases, anemia, urinary discharges, and ulcer, as a carminative, aphrodisiac and astringent to the bowels also used in rheumatism. Antiarthritic potential of aqueous and ethanolic fruit extracts of *Momordica charantia* was evaluated using different screening models [49]. Fruit powder was successively extracted with ethanol (95%) and water using soxhlet extraction and subjected to phytochemical screening to identify different phytoconstituents. Ld50 studies for both (ethanolic and aqueous) extracts were conducted up to the dose level of 2 g/kg by following OECD up and down method of guidelines No. 425. Antiarthritic activity was performed using formaldehyde, Freund's adjuvant-induced arthritis in rats, and Collagen-induced arthritis model in mice. Statistical analysis was performed using one-way analysis of variance followed by Dunnett's t-test. $P < 0.05$ was considered statistically significant. Preliminary phytochemical studies revealed

the presence of saponins, sterols, mucilage, glycosides, alkaloids, steroidal saponins in both the ethanolic and aqueous extracts of *M. charantia*. No mortality was observed with aqueous and ethanolic extracts up to the maximum dose level of 2 g/kg. In Formaldehyde induced arthritis model the percentage reduction in paw volume was 30.69% and 42.81% for aqueous extract whereas for ethanolic extract it was 25.23% and 39.5%. In Freund's adjuvant model, the percentage of reduction in paw volume was 56.1% and 66.51% for ethanolic extract and 52.6% and 63.83% for aqueous extract, respectively. In collagen-induced arthritis models, the arthritis index was found 6.02 and 3.68 for ethanolic extract at medium and high dosage. The arthritis index of aqueous extract was found 5.66 and 4.03 at medium and high dosage. From the present experimental findings of both pharmacological and biochemical parameters observed from the current investigation, it is concluded that at the doses of 200 and 400 mg/kg aqueous extract of *M. charantia* possesses potentially useful anti-arthritic activity since it gives a positive result in controlling inflammation in adjuvant-induced arthritic and collagen-induced arthritis model in rats and mice.

Glycosmis pentaphylla is a flowering plant in the citrus family (Rutaceae) known commonly as orange berry and gin berry.

Juice of its leaves is used in fever, liver complaints and as a vermifuge, while leaves are considered good antidote for eczema and other skin troubles. *Glycosmis pentaphylla* has also been found to have antioxidant, galactagogue, immune stimulant, larvicidal, antipyretic, and hepatoprotective properties. In folk medicine, the bark of *Glycosmis pentaphylla* is used for the treatment of diabetes and gonorrhea. It is well evident that the roots are useful in the treatment of arthritis. The roots of *Glycosmis pentaphylla* DC (Rutaceae) for its anti-arthritic potential was evaluated [50]. To evaluate the anti-arthritic efficacy, the chloroform, ethyl acetate and ethanol extracts of roots of *Glycosmis pentaphylla* were taken and screened by bovin serum albumin denaturation method. A preliminary phytochemical screening revealed the presence of active phytochemicals such as alkaloid, glycosides, terpenoids, flavonoids tannins and phenolic compounds in the different extracts. The results indicated that all the extracts tested, have shown positive response, with the ethanol extract exhibiting maximum efficacy of 46.46%, when compared with standard drug, diclofenac sodium with 51.92 % inhibition at 10 µg/ml. The effect of different extracts were in the order of ethanol > ethyl acetate > chloroform. The study concludes that

further investigational studies are required to identify the phytoconstituent responsible for the activity and to elucidate the exact mechanism of anti-arthritic activity in *Glycosmis pentaphylla*.

Gossypium herbaceum commonly known as cotton plant cultivated world over and mainly used by the textile industries. Other parts of this plant including leaves can also be explored for their best utilization. Hence, Antiarthritic efficacy of cotton plant leaf extract against an inflammatory condition i.e rheumatoid arthritis was evaluated [51]. Freund's complete adjuvant (FCA) induced arthritis model was selected for this study. All the rats received treatments of plant extract from 10th day of the induction of arthritis and continued up to 28 days of the study. Once in every 7 days, the arthritic assessments i.e. paw volume, body weight and paw erythema were assessed. Arthritic rats showed severe paw swelling, erythema, reduced body weight, abnormal changes in haematological, biochemical and antioxidant parameters ($p < 0.05$) compared with normal control. Studies showed that treatment with MEGH (200mg/kg) was effective in reversing the symptoms and restore the normalcy by restoring the elevated parameters. Over all the plant proved useful in treating Rheumatoid Arthritis in rodents and further studies in this direction are necessary to understand

its mechanism.

Cuscuta reflexa Roxb. (Cuscutaceae) has been used traditionally for treating sore knees and kidney problems, but its efficacy has not been scientifically examined in treating arthritis and nephrotoxicity. Antiarthritic and nephroprotective potential of the aqueous methanolic extract of *Cuscuta reflexa* (AMECR) was evaluated [52]. Antiarthritic activity of *Cuscuta reflexa* in formaldehyde and turpentine oil induced rat arthritis models was appraised at 200, 400 and 600mg/kg doses and *in-vitro* protein denaturation (bovine serum albumin, egg albumin) inhibition was studied at 25–800 lg/mL concentration. The nephroprotective effect involved gentamicin-induced nephrotoxicity in rats at 200, 400 and 600mg/kg doses. Plant extract at 600mg/kg significantly reduced paw oedema and joint swelling with maximal inhibition of 71.22% at the 6th hour for turpentine oil and 76.74% on 10th day for formaldehyde. Likewise, *in vitro* results corroborated significant concentration-dependent increase in percentage protection at 800 lg/mL against both bovine serum albumin (89.30%) and egg albumin (93.51%) denaturation. Similarly, 600mg/kg dose showed maximum nephroprotection by reducing serum urea (41.400 ± 0.510 mg/dL), uric acid (0.740 ± 0.032 mg/dL), blood urea nitrogen (18.370 ± 0.328), creatinine (3.267

± 0.076) and minimizing kidney weight gain (0.586 ± 0.005) and histopathological alterations on 8th day. Furthermore, phytochemical and HPLC analysis revealed the presence of important

phytoconstituents. These results suggest that AMECR provides protection against arthritis and nephrotoxicity that might be due to the existence of phytoconstituents, thus supporting folkloric claim.

Table 1: Indian native medicinal plants for treating rheumatoid arthritis presented in their Indian names, scientific names, and family names, together with their parts used and areas where they are found

Raw	Scientific name	Family name	Indian name	Therapeutic use	Ref.
1	<i>Hemidesmus indicus</i>	Asclepiadaceae	Anantmul	Arthritis, diuretic, tonic	27
2	<i>Calotropis gigantea</i>	Asclepiadaceae	Arka	Arthritis, Painful joints, swellings	28
3	<i>Curcuma longa</i>	Zingiberaceae	Haldi	Arthritis, anti-septic, anti-inflammatory, anti-oxidant	29
4	<i>Costus speciosus</i>	Zingiberaceae	Keukand	Arthritis, inflammation	30
5	<i>Gentiana kurroo</i>	Gentianaceae	Chireta	Arthritis, antiperiodic, expectorant, anti-inflammatory	31
6	<i>Glycyrrhiza glabra</i>	Fabaceae	Mulathi	Rheumatism, Diarrhea,	32
7	<i>Matricaria chamomilla</i>	Asteraceae	Babona	Arthritis, anti-inflammatory	33
8	<i>Oxalis corniculata</i>	Oxalidaceae	Teen pattia	antiseptic, anti-inflammatory, anti-diabetic	34
9	<i>Withania somnifera</i>	Solanaceae	Ashwagandha	Arthritis, anti-inflammatory, antitumor	35
10	<i>Lawsonia inermis</i>	Lythraceae c	Henna	Arthritis, immunostimulant, anti-inflammatory, antibacterial	36
11	<i>Cedrus deodara</i>	Pinaceae	Deodar	Arthritis, Inflammation	37
12	<i>Ocimum gratissimum</i>	Lamiaceae	Ram tulsi	Arthritis, Conjunctivitis, skin infection	38
13	<i>Piper longum</i>	Piperaceae	Pippali	Arthritis, anti-inflammatory, analgesic, diuretic	39
14	<i>Terminalia chebula</i>	Combretaceae	Harad	Arthritis, anti-tussive, anti-diarrheal	40
15	<i>Caesalpinia pulcherrima</i>	Caesalpinaceae	Guleteru	Arthritis, anti-inflammatory, bronchitis	41
16	<i>Merremia tridentata</i>	Convolvulaceae	Gandhali	rheumatism, piles, swellings	42
17	<i>Cyathocline purpurea</i>	Asteraceae	Gangotra	Arthritis, anthelmintic, hypotensive	43
18	<i>Colchicum luteum</i>	Liliaceae	Suranjan	Rheumatism, gout	44
19	<i>Cassia fistula</i>	Fabacea	Amaltas	Rheumatism, antioxidant, analgesic, anti-inflammatory,	45
20	<i>Azadirachta indica</i>	Meliaceae	Neem	Arthritis, Anti fungal, Insect repellent	46
21	<i>Ficus benghalensis</i>	Moraceae	Vada	Arthritis, anti-inflammatory, ophthalmic, styptic	47
22	<i>Mangifera indica</i>	Anacardiaceae	Aam	arthritis, anti-inflammatory, analgesic	48
23	<i>Momordica charantia</i>	Cucurbitaceae	Karela	Rheumatism, carminativ, aphrodisiac,	49
24	<i>Glycosmis pentaphylla</i>	Rutaceae	Ashvashakhot	Arthritis, Antipyretic,	50
25	<i>Gossypium herbaceum</i>	Malvaceae	Kapas	Arthritis, Diarrhea, headaches,	51
26	<i>Cuscuta reflexa</i>	Cuscutaceae	Amarbel	Arthritis, nephrotoxicity	52

DISCUSSION

In this review, our attempt was to compile some potent research works of plants which have shown antiarthritic activities. Rheumatoid arthritis is associated with inflammation and pain and the presented plants have anti-inflammatory activities. Medicinal plants are considered safer than synthetic drugs. Hence, they have attracted people as well as researchers to investigate their pharmacological and therapeutic activities.

CONCLUSION

Arthritis is one of the major diseases, which affected a big population in the world. Due to hectic modern life style, where individual don't get time for proper exercise and balanced diet, it is prevalent even among younger generation. Allopathic treatment like NSAIDs, steroids etc are available to relieve pain and inflammation associated with the disease but with severe side effects. Many plants have shown potent anti-arthritis activity and many researchers have worked on these plants. Our efforts were to compile all the articles together so that this review article can be used as guidance for further research and a safe and effective medicine can be prepared.

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