



ISSN 2250-0774

Advance Research in Pharmaceuticals and Biologicals

(A Peer Reviewed International Journal for Pharmaceutical and Allied Research)



USA CODEN: ARPBGZ

TREATING RHEUMATOID ARTHRITIS WITH MEDICINAL HERBS - AN UP-TO-DATE COMPILATION OF HERBAL DRUGS USED FOR TREATING THE DISEASE

*G. N. Bader and A. Prince

Department of Pharmaceutical Sciences, University of Kashmir, Srinagar Kashmir-190006

Received on 02/05/2014

Revised on 04/05/2014

Accepted on 10/05/2014

ABSTRACT:

Rheumatoid arthritis (RA) is an autoimmune disease which results in a chronic, systemic inflammatory disorder that affects many tissues and organs, but principally attacks flexible (synovial) joints. It can be a disabling and painful condition, which may lead to substantial loss of functioning and mobility if not adequately treated. Although a number of synthetic drugs are being used as standard treatment for rheumatoid arthritis but they have adverse effects that can compromise the therapeutic treatment. Unfortunately, there is still no effective treatment for rheumatoid arthritis. Modern medicine only treats the symptoms of this disease. There are many herbal remedies that help in reducing the pain in arthritic patients, and some of them have a long history of use. This article is a compilation of various herbal preparations used worldwide for this crippling disease and their scientific status with regard to their utility as antirheumatic drugs.

Keywords: Rheumatoid arthritis, Analgesics, Anti-inflammatory drugs, Arthritic patients.

***Corresponding Author:**

Dr. G. N. Bader

Assistant Professor

Department of Pharmaceutical Sciences,
University of Kashmir, Srinagar, Kashmir-190006

Email: gbader2007@gmail.com

Mob: 9419055344

INTRODUCTION

Rheumatoid arthritis (RA) is an inflammatory disease that exerts its greatest impact on joints of the body that are lined with synovium (a specialized tissue responsible for maintaining the nutrition and lubrication of the joint). The distribution of joints (synovial joints) affected is characteristic. It typically affects the small joints of the hands and the feet, and usually both sides are equally affected in a symmetrical pattern, irrespective of the fact that any synovial joint can be affected. In patients with established and aggressive disease, most joints are affected over the period of time. The initial trigger for RA is unknown. There is evidence to suggest abnormalities in components of the immune system that lead to the body developing abnormal immune and inflammatory reactions, particularly in joints. These changes may precede the symptomatic onset of RA by many years. Whatever sets the pathology in motion the result is a large increase in blood flow to the joint (giving heat and

sometimes redness), proliferation of the synovial membrane with an increase in synovial fluid (swelling), and pain (due to stretching of pain receptors in the soft tissues around, and the bone on either side of the joint). These features result in rapid loss of muscle around an affected joint and this along with pain and swelling lead to loss of joint function¹. Following is a list of some herbal remedies used worldwide to treat this disease and status of their scientific claim.

1. ***Polygonum glabrum***: Effective anti-inflammatory activity of this plant was demonstrated by hot water decoction and ethanol extract of its stem against acute carrageenan-induced paw oedema, exudate and granuloma formation in the granuloma pouch test, acute and delayed reactions in formaldehyde arthritis, and acute primary and delayed secondary reactions in adjuvant-induced polyarthritis in albino rats. The acute toxicity in albino mice and 1-month studies on sub acute toxicity in rats

- suggested a good margin of safety. The extract was more effective parenterally than orally².
2. **Polygonum viviparum:** Studies were carried out to investigate the effects of *Polygonum viviparum* methanol extract (PVM) on acute and chronic inflammation. The results of the study revealed a significant reduction of paw inflammation both in acute and chronic inflammatory models at the dose level of 250mg/kg. In acute inflammation the inhibition was 18 to 34% whereas the reduction of the chronic inflammation ranged up to 44%. It also inhibited the elevated levels of biochemical (SGPT) and hematological parameters (ESR and TLC) in arthritic animals. PVM also showed significant inhibition of the exudate volume and total count of pleural fluid³.
 3. **Chirayita (*Swertia Chirayita*):** It is commonly used for chronic fever, anaemia and asthma. Swerchirin, swertianone and swertianin are the active components responsible for the anti-inflammatory activity. Chirayita is reported to reduce the elevated levels of IL-1 β , TNF- α and IL-6 (Pro-inflammatory cytokines) in experimental arthritis as well as in asthmatic conditions⁴.
 4. **Eugenol and Ginger oil:** A study was carried out to examine the effect of eugenol and ginger oil on severe chronic adjuvant arthritis in rats. Eugenol (33 mg/kg) and ginger oil (33 mg/kg), given orally for 26 days, caused a significant suppression of both paw and joint swelling. These findings suggest that eugenol and ginger oil have potent antiinflammatory and/or antirheumatic properties⁵.
 5. **Turmeric (*Curcuma longa*):** Its active constituent curcumin is an active anti-inflammatory component. The rhizome and the root of curcuma are used in medicinal and food preparations. Curcumin, the main active component of this herb exhibits antioxidant properties. Significant improvement in morning stiffness, walking time and joint swelling have been observed as anti-arthritic effects after regular curcuma consumption by RA patients⁶.
 6. **Saffron (*Crocus sativus Iridaceae*):** Saffron stigma possesses anti-inflammatory action due to presence of crocetin and carotenoids. Aqueous and ethanolic extracts of saffron petals exhibit radical scavenging as well as anti-inflammatory effects in xylene and formalin induced inflammation⁷.
 7. **Harshingar (*Nyctanthes arbor tristis* Linn. NAT):** It has been used widely as a decoction for the treatment of arthritis and sciatica in ayurvedic system of medicine since centuries. Arbostrisoides, nyctanthic acid, and crocetin are the main active principals of NAT. Water soluble ethanolic extract of NAT leaves have been reported to reduce significantly the levels of inflammatory cytokines (IL-1, TNF- α) in experimental arthritis⁸.
 8. **Abutilon indicum:** This sweet herb has been reported to have anti-inflammatory as well as analgesic activity both in-vitro as well as in-vivo. A study was carried out to find anti-arthritic activity in-vitro. Aqueous herbal extract (100mcg/ml and 250 mcg/ml) was used and results were compared with acetyl salicylic acid (250 mcg/ml.). The herbal extract showed dose dependent activity which was found to be better than that of acetyl salicylic acid⁹.
 9. **Barleria lupulina (acanthaceae):** Traditionally used in the treatment of rheumatoid arthritis, a study was designed to investigate the anti-arthritic potential of its leaves and its role in immune modulation. Its methanol extract (MEBL) (300mg/kg and 600mg/kg) showed statistically significant inhibition ($P < 0.05$ and $P < 0.001$) of the edema formation and Myeloperoxidase (MPO) during experimental period and activities of antioxidants were restored significantly. MEBL extracts significantly increased the Hemoglobin (Hb) level, serum albumin, total protein, calcium and phosphorus levels and reverted back the levels of WBC count and erythrocyte sedimentation rate (ESR) ($P < 0.05$ and $P < 0.01$). Histopathological studies of ankle joints also supported this finding. Immunomodulatory study revealed an increase in the blood leukocyte count, weight of spleen, splenic leukocyte count and increase in paw volume on delayed type hypersensitivity footpad thickness suggesting an uplift of immune status¹⁰.
 10. **Tinospora cordifolia** Willd (Menispermaceae): Antiarthritic activity of ethanol extract of *Tinospora cordifolia* was studied. Results suggested that oral dosage of 150 mg/kg body weight exhibited anti-arthritic activity in Freund's adjuvant arthritic rats. In collagen induced arthritic rats, the dosage of 100 mg/kg body weight showed significant anti-arthritic activity¹¹.
 11. **Aegle marmelos:** Therapeutic efficacy of this plant in treating Rheumatoid Arthritis (RA) was studied by using collagen-induced arthritis (CIA) animal model. CIA rats were treated orally with daily different doses of methanolic extract of *A. marmelos* (MAM). The results showed that treatment with MAM markedly reduced paw swelling and arthritic index even in the established CIA. Radiologic and

histopathologic changes in the arthritic joints were also significantly reduced in the MAM-treated versus vehicle-treated rats. Moreover, Rheumatoid factor was significantly reduced in MAM treated group as compared to disease control group¹².

12. ***Randia dumetorum***: A study was undertaken to determine efficacy of madecassoside (MA) against collagen-induced arthritis (CIA) in female rats. CIA rats were treated daily with oral administration of different doses of methanolic extract of *Randia dumetorum* (RD) beginning on the day after the onset of arthritis (day 21st of the therapeutic treatment) until day 45. The results showed that treatment with RD markedly reduced paw swelling and arthritic index even in the established CIA. Radiologic and histopathological changes in the arthritic joints were also significantly reduced in the RD-treated versus vehicle-treated rats. Moreover, Rheumatoid factor was significantly reduced in RD treated group as compared to disease control group¹³.
13. ***Trachyspermum ammi***: A study was aimed to investigate the possible antioxidant potential of *Trachyspermum ammi* on collagen induced arthritis (CIA) in Wistar rats. 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 plant extract brought significant changes in all the parameters studied as compared with CIA rats. 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 rats¹⁴.
14. ***Polygonum bistorta***: The aqueous and ethanolic extracts of *Polygonum bistorta* L. (*Polygonaceae*), *Guaiacum officinale* L. (*Zygophyllaceae*) and *Hamamelis virginiana* L. (*Hamamelidaceae*) were screened for anti-inflammatory activity at dose levels of 100 and 200 mg kg⁻¹, p.o. in wistar rats. Extracts of *P. bistorta* significantly suppressed both the maximal oedema response and the total oedema response (monitored as area under the time course curve). *H. virginiana* was inactive and *G. officinale* was only active at 200 mg kg⁻¹. At 200 mg kg⁻¹ administered before the induction of adjuvant arthritis, *P. bistorta* significantly inhibited both the acute and

chronic phases of the adjuvant-induced rat paw swelling, while *G. officinale* and *H. virginiana* were only active against the chronic phase. Further studies on *P. bistorta* (100–800 mg kg⁻¹) revealed a dose-dependent inhibition of the carrageenan-induced rat paw oedema over the dose range 100–400mgkg⁻¹, the E₅₀ value being approximately 158.5mgkg⁻¹. The extract (200mgkg⁻¹) administered after the onset of the inflammatory responses reversed the course of both the carrageenan and adjuvant-induced rat paw swelling. The results confirmed that the extracts of *P. bistorta*, *G. officinale* and *H. virginiana* contain anti-inflammatory substances¹⁵.

15. ***Polygonum cuspidatum*** (PC): Despite recent evidence that PC has anti-oxidant, anti-tumor, and anti-inflammatory effects, its analgesic and anti-inflammatory effects have not been elucidated yet *in vivo*. Thus, a study was carried out to assess analgesic and anti-inflammatory effects of ethyl acetate extract of PC (EAPC) *in vivo*. Hot plate test and tail-flick tests revealed that EAPC at 200 mg/kg exerts analgesic effect (p < 0.05). In contrast, EAPC did not show significant analgesic effect in acetic acid-induced writhing test. In serotonin-induced paw edema model, EAPC suppressed swelling inflammatory response within 12 min after serotonin injection, at both 100- and 200-mg/kg dose (p < 0.05). Consistently, in FCA-induced adjuvant arthritis model, FCA at 200 mg/kg significantly suppressed FCA-induced joint swelling within 3 days (p < 0.05), whereas FCA at 100 mg/kg showed the similar result within 5 days (p < 0.05). Furthermore, EAPC effectively inhibited positive responses of C-reactive protein and rheumatoid factor compared to untreated control. Taken together these findings suggest that EAPC can be a potent candidate for rheumatoid arthritis treatment¹⁶.
16. ***Polygonum hydropiper*** L (*Polygonaceae*): A study aimed at exploring the anti-inflammatory effects of 99% methanol extract (Ph-ME) of this plant revealed a dose-dependent suppression of nitric oxide (NO) release, tumour necrosis factor (TNF)- α , and prostaglandin (PGE₂) in RAW264. 7 cells and peritoneal macrophages stimulated by lipopolysaccharides (LPS). Ph-ME inhibited mRNA expression of pro-inflammatory genes such as inducible NO synthase (iNOS), cyclooxygenase (COX)-2, and TNF- α by suppressing the activation of nuclear factor (NF)- κ B, activator protein (AP-1), and cAMP responsive element binding protein

(CREB), and simultaneously inhibited its upstream inflammatory signalling cascades, including cascades involving Syk, Src, and IRAK1. Consistent with these findings, the extract strongly suppressed the kinase activities of Src and Syk. Based on HPLC analysis, quercetin, which inhibits NO and PGE₂ activities, was found as one of the active ingredients in Ph-ME¹⁷.

17. ***Tripterygium wilfordii*** Hook F (TWH): An alcohol extract of this plant known as T2 has been suggested to be effective in the treatment of rheumatoid arthritis (RA). T2 at 0.1–1 µg/ml inhibited antigen- and mitogen-stimulated proliferation of T cells and B cells, interleukin-2 (IL-2) production by T cells, and immunoglobulin production by B cells. T2 did not affect IL-2 receptor expression by T cells, IL-1 production by monocytes, or the capacity of monocytes to present antigen. Inhibition could not be accounted for by nonspecific toxicity. This result supports the conclusion that T2 exerts a powerful suppressive effect on human immune responses. This action might account for its therapeutic effectiveness in RA¹⁸.
18. ***Gentiana macrophylla***: Acute treatment of rheumatoid rats with an extract from the roots of *Gentiana macrophylla* (*Gentianaceae*) produced a significant inhibitory effect on rheumatoid arthritis (RA). When rats were administered with this extract orally (100 mg/kg body weight) the prostaglandin E₂ (PGE₂) levels in the inflammatory tissues, sole thickness, and ankle circumferences of feet were significantly decreased. The anti-inflammatory activity observed in *Gentiana macrophylla* was comparable to that observed in prednisone. These observations suggest its use in rheumatoid arthritis¹⁹.
19. ***Bryophyllum pinnatum***: A study was undertaken to investigate the anti-inflammatory property of the aqueous extract of *Bryophyllum pinnatum* leaf (BPE, 25–800 mg/kg p.o. or i.p.). It significantly inhibited fresh egg albumin-induced acute inflammation in rats ($P < 0.05$ – 0.001). The different flavonoids, polyphenols, triterpenoids and other chemical constituents of the herb are speculated to account for the observed anti-inflammatory property of the plant²⁰.
20. ***Alstonia boonei*, *Rauwolfia vomitoria* root barks and *Elaeis guineensis* nuts**: A boiling water extract from a mixture of these herbal drugs without pericarp was tested for its antiinflammatory activity by measuring over a period of 17 days the changes in rat ankle diameter caused by subplantar injection of complete Freund's adjuvant. The extract fed in drinking water ad libitum reduced ankle adjuvant swelling by an average of 16% for the period of + 4 to + 17 days and improved weight gain²¹.
21. ***Sclerocarya birrea*** (*Anacardiaceae*): A study was undertaken to investigate the anti-inflammatory property of the aqueous extract of plant's stem-bark in experimental models of pain and inflammation. The plant extract (25–800 mg/kg p. o.) produced a dose- and time-related, sustained and significant reduction ($p < 0.05$ – 0.001) in the fresh egg albumin-induced acute inflammation of the rat hind paw oedema. However, the anti-inflammatory effect of the plant's extract was found to be approximately 10–15 times less than that of diclofenac. This experimental finding lends pharmacological support to the suggested folkloric use of the plant's stem-bark in the management and/or control of pain, inflammatory conditions in some communities of South Africa²².
22. ***Strychnos potatorum*** Linn (*Loganiaceae*): To investigate the folkloric use of the seeds a study was carried out to see 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. In FCA induced arthritic rats, there was significant increase in rat paw volume and decrease in body weight, whereas SPP and SPE treated groups showed significant reduction in paw volume and normal gain in body weight. The altered haematological parameters (Hb, RBC, WBC and ESR) and biochemical parameters (blood urea, serum creatinine, total proteins and acute phase proteins) in the arthritic rats were significantly brought back to near normal by the SPP and SPE treatment at the dose of 200 mg/kg/p.o in both developing and developed phases of arthritis. Further the histopathological and radiological studies revealed the antiarthritic activity of SPP and SPE by indicating fewer abnormalities in these groups when compared to the arthritic control group²³.
23. ***Aeschynanthus bracteatus***: Chemical examination of the EtOAc extract from the aerial parts of *Aeschynanthus bracteatus* led to isolation of four phenylethanol glycosides, aeschynanthosides A–D (1–4), and 55 known constituents, including 8 phenylethanoids, 23 phenols, 5 lignans, 7 flavonoids, 9 terpenoids, and 4 others. The isolates were also tested for inhibitory activities against

- LPS-induced NO production in RAW 264.7 macrophages. Aeschynanthosides A-D and naringenin, within the concentration range tested (50–100 µg/ml) showed very weak dose-dependent effects with the inhibition rate of 24.2%, 35.4%, 66.0%, and 9.5%, 40.1%, 65.0%, respectively, relative to positive controls²⁴.
24. ***Premna serratifolia***: In the indigenous system of medicine, wood of *Premna serratifolia* Linn is reported to be useful in the treatment of arthritis. Aimed at the scientific validation of the ethnopharmacological claim about its anti-arthritic property, a study was undertaken. Loss in body weight during arthritic condition was corrected on treatment with ethanol extract and standard drug, indomethacin. The ethanol extract at the dose of 300 mg/kg body weight inhibited the rat paw oedema by 68.32% which was comparable with standard drug indomethacin 74.87% after 21 days. The observed anti-arthritic activity may be due to the presence of phytoconstituents such as irridiod glycosides, alkaloids, phenolic compounds and flavonoids²⁵.
25. **Ginger** (*Zingiber officinalis*, *Zingiberaceae*): Five constituents of ginger have been identified as inhibitors of prostaglandins. Another constituent of ginger, gingerol inhibits lipopolysaccharide (LPS) induced inducible nitric oxide synthase (iNOS) expression and production of NO *in vitro*²⁶. According to a study, oral administration of ginger oil suppressed the induction of adjuvant induced inflammation²⁷.
26. **Pineapple**: Bromelain, an extract of pineapple stem, has been reported to possess anti-inflammatory property. Active components of bromelain are peroxidase, acid phosphatase, several protease inhibitors. When bromelain was tried with RA patients, 72% of total patients reported reduced swelling and pain²⁸.
27. **Karvi** (*Strobilanthes callosus*, *Acanthaceae*): Lupeol and 19 α -H Lupeol isolated from the roots of this plant have demonstrated the anti-inflammatory as well as anti-rheumatic activity in carrageenan induced oedema²⁹.
28. ***Trewia polycarpa*** Benth (*Euphorbiaceae*) roots: These are used in Indian Ayurvedic medicine for the treatment of rheumatism, arthritis and gastritis³⁰. Two Indian species *viz.* *Trewia nudiflora* Linn. and *Trewia polycarpa* Benth are common. No toxicity has been observed after oral administration of alcoholic extract at different doses to wistar rats, also superoxide dismutase, glutathione peroxidase activities were found to be elevated thus indicating the free radical scavenging property³¹.
29. **Madimadi**: It is a Korean folklore medicine; a kind of fermented alcohol prepared from water extracts of herbal medicines. It has also been used for the treatment of RA since long time by the natives of the Korea. Madimadi had inhibitory effects on pro-inflammatory cytokine and dose dependently inhibited TNF- α , IL-1 β and IL-8 production in RA patients. Madimadi also downregulates the TNF- α and IL-1 β ³².
30. ***Shiraiia bambusicola***: The active component of *Shiraiia bambusicola*, Shiraiachrome. A significantly inhibits the proliferation, migration, and angiogenesis by blocking growth factor-stimulated autophosphorylation of receptor tyrosine kinases in diseased synovium³⁵.
31. **Qin Jiao** (*Gentiana macrophylla*, *Gentianaceae*): It has been reported that roots of *Gentiana* have anti-inflammatory effect in RA patients, which is quite comparable to Prednisone, a conventional drug used to treat RA³⁶.
32. ***Eucommia Ulmoides***, (*Eucommiaceae*): Due to its antioxidant and anti-inflammatory properties, this deciduous tree has been used for thousands of years in modern medicine and traditional Chinese medicine to treat different ailments. Commonly for arthritis, osteoporosis, and hypertension. In addition, it is often recommended for giving the bones additional strength and to help prevent osteoporosis³⁷.
33. **Dong Quai** (*Radix Angelica Sinensis*): With its anti-inflammatory and anti-spasmodic properties, it has shown good effects on people with arthritic conditions. It contains properties that, in tests, have displayed activities that may lead to the reduction of pain, improved blood flow and stimulation as well as relaxation of uterine muscles. It is widely used to treat a variety of female complaints, from lack of sleep mainly due to hormonal changes to hot flashes³⁸.
34. **Chinese Foxglove** (*Radix Rehmannia Glutinosa*): It is one of the 50 fundamental herbs used in traditional Chinese medicine. This medicinal herb stimulates the proliferation and activities of osteoblasts, while inhibiting the generation and resorptive activities of osteoclasts. It has shown preventive effects on osteoporotic bone loss induced by an ovariectomy³⁹.
35. **Gou Ji** (*Rhizoma Cibotij*): This bitter, sweet and warm herb has been used in traditional Chinese medicine to relieve rheumatic conditions. It is

known to strengthen the knees and lower back. Most often used in combination with other liver-kidney tonics and waist-knees strengthening herbs, such as Du Zhong. It counters the stiffness of spine and difficulty in bending and stretching due to pathogenic wind, cold and dampness⁴⁰.

36. ***Asystasia dalzelliana***: Anti-arthritis activity of ethanolic extract of *Asystasia dalzelliana* leaves was evaluated by Freund's adjuvant induced arthritis model in rats. Paw edema, changes in organ weight, serum parameters (SGOT, SGPT and ALP) were estimated. The results concluded that extract at dose of 800mg/kg possess a significant anti-arthritis activity than the lower doses of 200mg/kg and 400mg/kg⁴¹.
37. ***Ficus bengalensis***: The analgesic, anti rheumatic and ant-oxidant activity of the methanolic extract of the bark of *Ficus bengalensis* (MFB) was studied at doses of 100, 200 and 300 mg/kg (i.p). The extract produced marked inhibitory effect on edema especially on secondary immunological arthritis and caused graded inhibition of both phases of Formalin- induced pain⁴².
38. ***Glycyrrhiza glabra***: The methanolic extract of *Glycyrrhiza glabra* was administered orally at a dose of 150mg/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. The combined formulation at proportion (1:1) showed significant synergistic action [43].
39. ***Hybanthus enneaspermus***: The effect of alcoholic and aqueous extracts of the whole plant of *Hybanthus enneaspermus* Muell (*Violaceae*) on Freund's adjuvant induced arthritis was evaluated. Both the extracts significantly decreased the paw thickness at the end of 30 days treatment. The alcoholic extract showed more pronounced effect (59.4%) as compared to aqueous extract (57.4%). Results support the folklore use of this plant against the inflammatory conditions like arthritis [44].
40. ***Justicia gendarussa*** Burm F: The anti-arthritis potential of the alcoholic extract of this plant was evaluated using the Freund's adjuvant-induced and

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- collagen-induced arthritic rat models. The rats were treated with the ethanolic extract of *J. gendarussa* and with standard aspirin. The ethanolic extract of *J. gendarussa* showed significant anti-arthritis activity that was statistically similar to that of aspirin [45].
41. ***Lawsonia innermis***: Antiarthritic activity of hydroalcoholic extract of *Lawsonia innermis* 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 was corrected on treatment with hydroalcoholic extract of *L.inermis* and Diclofenac. The results concluded that hydroalcoholic extract of *L.inermis* possesses a significant anti-arthritis activity against adjuvant induced arthritis and formaldehyde induced arthritis model [46].
42. ***Merremia emarginata* Burm.F**: Ethanolic extract of whole plant of *Merremia emarginata* (100, 200 and 400mg/kg p.o) was studied for its anti inflammatory activity using carrageenan induced rat paw edema animal model, anti arthritis activity using complete Freund's adjuvant model and analgesic activity at the same dose level using Hot plate model in mice. The results indicate that treatment of adjuvant induced arthritic rats with EME improves ESR, Hb value and also restores body weight [47].
43. ***Piper longum***: Aqueous extract of the fruits of the plant *Piper longum* was studied for its anti-rheumatoid activity in Freund's adjuvant induced arthritis in Rats with the dose of 200 and 400 mg/kg p. o. It was concluded that the aqueous extract of *P.longum* possesses potentially useful anti-arthritis activity in Complete Freund's Adjuvant model [48].
44. ***Pongamia pinnata***: The antiarthritic activity of different doses of *Pongamia pinnata* extract (100, 200 and 400mg/kg) in rats was evaluated on 7th and 14th day of treatment. The *Pongamia pinnata* extract at dose levels of 200 and 400mg/kg showed significant reduction in paw volume on 7th and 14th day of treatment and also significant effect in radiographic and histopathological analysis [49].

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