Rheumatoid arthritis and herbal drugs: A review

Jyoti B. Wadekar*, Ramesh L. Sawant, Unnati B. Patel

ABSTRACT

Rheumatoid Arthritis (RA) is a chronic autoimmune disease of unknown etiology that affects 0.5% of the population and can result in disability owing to joint destruction, characterized by joint synovial inflammation and progressive cartilage and bone destruction resulting in gradual immobility. The greatest disadvantage in the presently available potent synthetic drugs lies in their toxicity and reappearance of symptoms after discontinuation. With limitations of existing drug molecules herbal drugs are gaining interest among RA patients. Medicinal plants are plants containing inherent active ingredients used to cure disease or relieve symptoms of arthritis. The aim of this review is to update information on RA including causes, epidemiology, prevalence, symptoms and diagnosis, classification, medications, toxicities of allopathic anti-rheumatic drugs and importance of herbal drugs for the management of RA. The present review also focuses on the medicinal plants that interact with the mediators of inflammation and are used in the treatment of rheumatoid arthritis (RA).

Keywords: Rheumatoid Arthritis, causes, medications, classification, medicinal plants.

INTRODUCTION

Arthritis, generally inflammation of joints, is one of the oldest known diseases occurring almost in all age groups. In India, more than about 20% of total population is suffering from arthritis [3]. Rheumatoid Arthritis (RA) is a chronic autoimmune disease of unknown etiology, characterized by joint synovial inflammation and progressive cartilage and bone destruction resulting in gradual immobility [2].

It was first found in early Native American population several thousand years ago but might have appeared in Europe after 17th century [9]. Pro-inflammatory cytokines such as tumor necrosis factor-α (TNF-α), interleukin (IL)-1β, and IL-6 are important mediators of the disease perpetuation [4]. The arthritis usually begins in the small joints of the hands and the feet, spreading later to the larger joints, the inflamed joint lining or synovial extends and then erodes the articular cartilage and bone, causing joint deformity and progressive physical disability. Extra-articular features include nodules, pericarditis, pulmonary fibrosis, peripheral neuropathy and amyloidosis [5].

Causes

Arthritis involves the breakdown of cartilage. Cartilage normally protects a joint, allowing it to move smoothly [8]. The process produces an inflammatory response of the synovial (sinusitis) secondary to hyperplasia of synovial cells, excess synovial fluid, and the development of panes in the synovial. The pathology of the disease process often leads to the destruction of articular cartilage and alkalosis of the joints. Rheumatoid arthritis can also produce diffuse inflammation in the lungs, pericardium, pleura, and sclera, and also nodular lesions, most common in subcutaneous tissue. Although the cause of rheumatoid arthritis is unknown, autoimmunity plays a pivotal role in both its chronicity and progression, and RA is considered a systemic autoimmune disease.

Epidemiology

About 1% of the world's population is afflicted by rheumatoid arthritis, women three times more often than men [7]. Arthritis represents one of the most prevalent chronic health problems and is a leading cause of disability. Arthritis affected 43 million U.S. adults in 2002 and by the year 2020, this number is expected to reach 60 million [8]. It is up to three times more common in smokers than non-smokers, particularly in men, heavy smokers, and those who are rheumatoid factor positive. A study in 2010 found that those who drank modest amounts of alcohol regularly were four times less likely to get rheumatoid arthritis than those who never drank [9].

Prevalence of RA

RA is strongly associated with the inherited tissue type Major histocompatibility complex
(MHC) antigen HLA-DR4 (most specifically DRB01 and 0404)—hence family history is an important risk factor. The risk of first developing the disease appears to be greatest for women between 40 and 50 years of age, and for men somewhat later. [10]. The incidence and prevalence of RA generally rises with increasing age until about age 70, then declines [11-13]. Around twice as many women as men are affected. The prevalence of RA is generally lower in developing countries, with few or no cases found in some African surveys [14]. The prevalence in native American groups can be considerably higher [15-17].

Figure 1: Comparison of normal joint and joint affected by rheumatoid arthritis

Symptoms and diagnosis

The pervasive nature of arthritis symptoms and their effect on physical, social and occupational activities can be discouraging, resulting in psychological sequelae such as anxiety, depression and helplessness [18]. RA can be hard to detect because it may begin with subtle symptoms, such as achy joints or a little stiffness. The stiffness seen in active RA is most often worst in the morning. It may last one to two hours (or even the whole day). Stiffness for a long time in the morning is a clue that one may have RA, since few other arthritic diseases behave this way [19].

Other signs and symptoms that can occur in RA include:

- Joint pain and swelling; reduced ability to move the joint; redness of the skin around a joint; warmth around a joint; loss of energy and appetite; low fevers; dry eyes and mouth from a related health problem; Sjogren's syndrome Firm lumps, called rheumatoid nodules, which grow beneath the skin in places such as the elbow and hands.

Methods to detect RA include clinical assessment, imaging and laboratory tests. Clinical assessment and opinion is considered the ‘gold standard’ [20]. Diagnosis of RA depends on the symptoms and some blood tests can also help to confirm RA. Telltale signs include:

- Anemia (a low red blood cell count); rheumatoid factor (an antibody, or blood protein, found in about 80% of patients with RA in time, but in as few as 30% at the start of arthritis); antibodies to cyclic citrullinated peptides (pieces of proteins), or anti-CCP for short (found in 60–70% of patients with RA); Elevated erythrocyte sedimentation rate (a blood test that, in most patients with RA, confirms the amount of inflammation in the joints).

X-rays can help in detecting RA, but may not show anything abnormal in early arthritis. Even so, these first X-rays may be useful later to show if the disease is progressing. Often, MRI and ultrasound scanning are done to help judge the severity of RA. There is no single test that confirms an RA diagnosis for most patients with this disease.

Medications

Medications may be prescribed along with lifestyle changes. All medications have risks, some more than others [21-22].

Table 1: Medications available for treatment of rheumatoid arthritis

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over The Counter</td>
<td>Acetaminophen (Tylenol), Aspirin, ibuprofen, or naproxen</td>
</tr>
<tr>
<td>Nonsteroidal anti-inflammatory drugs (NSAIDs)</td>
<td>Paracetamol, ibuprofen, naproxen, meloxicam, etodolac, nabumetone, sulindac, tolfentin, choline magnesium salicylate, diclofenac, diflusinal, indomethacin, ketoprofen, oxaprozin, and piroxicam.</td>
</tr>
<tr>
<td>Biological agents</td>
<td>Tumor necrosis factor alpha (TNFα) blockers -etanercept (Enbrel), infliximab (Remicade), adalimumab (Humira), certolizumab pegol (Cimzia), golimumab (Simponi) Monoclonal antibodies against B cells – rituximab (Rituxan)</td>
</tr>
</tbody>
</table>

Generally, over-the-counter medications are recommended first:

- Acetaminophen (Tylenol) is usually tried first. It is advisable not to take more than the recommended dose or do not take the drug along with a lot of alcohol. Doing so may damage liver.
- Aspirin, ibuprofen, or naproxen are nonsteroidal anti-inflammatory drugs (NSAIDs) that can relieve arthritis pain. However, they have many potential risks, especially if used for a long time. Potential side effects include heart attack, stroke, stomach ulcers, bleeding from the digestive tract, and kidney damage.

Surgery and other treatments

In some cases, surgery may be done if other treatments have not worked. This may include:

- Arthroplasty to rebuild the joint
- Joint replacement, such as a total knee joint replacement
Classification criteria for RA were first proposed by the American Rheumatism Association (ARA) in 1958 [23]. The 1958 ARA criteria were revised in 1987 by the American College of Rheumatology (ACR) [24].

Table 2: The 1987 revised ARA/ACR criteria for the classification of rheumatoid arthritis*

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Short title</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Morning stiffness</td>
<td>Morning stiffness in and around the joints, lasting at least 1 hour before maximal improvement. At least 3 joints.</td>
</tr>
<tr>
<td>2.</td>
<td>Arthritis of 3 or more joint areas</td>
<td>Areas simultaneously have had soft tissue swelling or fluid (not bony overgrowth alone) observed by a physician. The 14 possible areas are right or left PIP, MCP, wrist, elbow, knee, ankle, and MTP joints.</td>
</tr>
<tr>
<td>3.</td>
<td>Arthritis of hand Joints</td>
<td>At least 1 area swollen (as defined above) in a wrist, MCP or PIP joint.</td>
</tr>
<tr>
<td>4.</td>
<td>Symmetric Arthritis</td>
<td>Simultaneous involvement of the same joint areas [as defined in (2)] on both sides of the body (bilateral involvement of PIPs, MCPs, or MTPs is acceptable without absolute symmetry).</td>
</tr>
<tr>
<td>5.</td>
<td>Rheumatoid Nodules</td>
<td>Subcutaneous nodules, over bony prominences, or extensor in juxtaarticular regions, observed by a physician.</td>
</tr>
<tr>
<td>6.</td>
<td>Serum rheumatoid factor</td>
<td>Demonstration of abnormal amounts of serum rheumatoid factor or any method for which the result has been positive in &lt;5% of normal control subjects.</td>
</tr>
<tr>
<td>7.</td>
<td>Radiographic Changes</td>
<td>Radiographic changes typical of rheumatoid arthritis on posteroanterior hand and wrist radiographs, which must include erosions or unequivocal bony decalcification localized in or most marked adjacent to the involved joints (osteoarthritis changes alone do not qualify).</td>
</tr>
</tbody>
</table>

*For classification purposes, a patient shall be said to have rheumatoid arthritis if he/she has satisfied at least four of these seven criteria. Criteria 1 through 4 must have been present for at least 6 weeks. Patients with two clinical diagnoses are not excluded.

Need for herbal drugs for the management of RA:

Conventional treatments for rheumatoid arthritis (RA) present a number of problems, in terms of both safety and efficacy [25]. Owing to side effects of synthetic drugs as shown in table 2, many patients look for complementary and alternative medicine (CAM) options in coping with this debilitating disease.

Table 3: Showing toxicities of allopathic anti-rheumatic drugs [26]

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Drug</th>
<th>Toxicities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Methotrexate (DMARD’s)</td>
<td>Stomatitis, rash, alopecia, infrequent myelosuppression, hepatotoxicity, rare but potentially life-threatening pulmonary toxicity</td>
</tr>
<tr>
<td>2.</td>
<td>Oral Gold Salts</td>
<td>Diarrhoea</td>
</tr>
<tr>
<td>3.</td>
<td>Injectable Gold Salts</td>
<td>Stomatitis, myelosuppression, rash, thrombocytopenia</td>
</tr>
<tr>
<td>4.</td>
<td>Cyclosporine</td>
<td>Renal impairment, hypertension, gingival overgrowth</td>
</tr>
<tr>
<td>5.</td>
<td>D-penicillamine</td>
<td>Rash, stomatitis, dysgeusia, proteinuria, myelosuppression</td>
</tr>
<tr>
<td>6.</td>
<td>Nonsteroidal AntiInflammatory Drugs</td>
<td>Gastrointestinal symptoms (indigestion, ulceration, hemorrhage, stomatitis); renal abnormalities; pulmonary neurological abnormalities; abnormalities; dermatologic abnormalities; hematologic abnormalities; hepatic abnormalities; displacement of protein-bound drugs; possible systemic complications</td>
</tr>
</tbody>
</table>

Research has indicated that people suffering from chronic pain, as in RA, and those dissatisfied with current treatment are very likely to seek alternative treatments, and an estimated 60–90% of persons with arthritis use CAM. With the growing interest in herbal therapies among persons with rheumatoid arthritis, there exists a need for investigation into their safety and efficacy [27].

The management of rheumatoid arthritis is a multidisciplinary approach in order to lessen the pain, reduction of inflammation and restoration of joints function. In practical terms suppression of inflammation is the target intensive therapy. Herbal medicines have become popular for the treatment of rheumatoid arthritis worldwide recently [28].

Herbal medicinal drugs that interact with the mediators of inflammation are used in the treatment of rheumatoid arthritis (RA) which are shown in below listed table:
Table 3: List of plant species and their families, constituents/isolated compounds, therapeutic uses and parts used in pain-inflammatory disorders including rheumatoid arthritis

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Biological Source</th>
<th>Part Used</th>
<th>Active Ingredient</th>
<th>Therapeutic Uses</th>
<th>Extract</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>Annona montana.</em> (Annonaceae)</td>
<td>Leaves, seeds, bark, roots</td>
<td>Cyclomontanins A-D (1- 4), annonuricatin C (5), and (+)-corytuberine</td>
<td>Anti-rheumatic, antihelminthic, anticonvulsant, antidepressant, antimicrobial, antineoplastic, antiparasitic, antispasmodic, antiviral, astringent, cardiodepressant, cytostatic, cytotoxic, febrifuge, hypotensive, insecticide, nervous, pectoral, sedative, stomachic, vasodilator, vermifuge</td>
<td>Methanol</td>
<td>[29]</td>
</tr>
<tr>
<td>2.</td>
<td><em>Abrus precatorius.</em> (Fabaceae/ Leguminosae)</td>
<td>Fresh leaves</td>
<td>Triterpenoids (abrusosides A-D)</td>
<td>Colds, cough, convulsion, fever, rhematism, conjunctivitis and ulcers by traditional healers</td>
<td>Methanol</td>
<td>[30-31]</td>
</tr>
<tr>
<td>3.</td>
<td><em>Aristolochia bracteolata.</em> (Aristolochiaceae)</td>
<td>Whole plant</td>
<td>Ceryl alcohol, β-sitosterol, aristolochic acid, diglucoside (AG-7) and β-sisysterl Arabinoside</td>
<td>Anthelminthic, fever, purgative and painful joints.</td>
<td>Petroleum ether, chloroform and Methanol</td>
<td>[32]</td>
</tr>
<tr>
<td>4.</td>
<td><em>Alpinia conchigera.</em> Griff. (Zingiberaceae)</td>
<td>Rhizomes</td>
<td>Galangoflavonoid, 1'S-1'-acetoxychavicol acetate, 1'-acetoxychavicol acetate (galangal acetate), β-sitosterol diglucoside (AG-7) and β-sisysterl Arabinoside</td>
<td>Analgesic and anti-inflammatory</td>
<td>Ethanol</td>
<td>[33-34]</td>
</tr>
<tr>
<td>5.</td>
<td><em>Alchornea cordifolia.</em> (Euphorbiaceae)</td>
<td>Leaf</td>
<td>Tannins, phenolic acids: gallic acid, ellagic acid, protocatechic acid, flavonoids: quercetin, hyperin and guaijaverin and an alkaloid: triisopentenyguanidine</td>
<td>Anti-inflammatory: chancre, yaws wounds, cicatrisation, ulcers, caries, toothache, gum inflammation and conjunctivitis</td>
<td>Aqueous decoction and methanol extract</td>
<td>[35]</td>
</tr>
<tr>
<td>6.</td>
<td><em>Asparagus racemosus.</em> (Liliaceae)</td>
<td>Roots, leaves, flowers and fruits</td>
<td>Steroidal glycosides including shatavarins I-IV, diosgenin and various sterols, alkaloid asparagamine A, flavonoids: quercitin, rutin and hyperoside, an isoflavone, and a mucilage</td>
<td>Ulcerogenesis, antioxidant, treatment of thirst, fainting, dyspnoea, and gout</td>
<td>Methanol</td>
<td>[36]</td>
</tr>
<tr>
<td>7.</td>
<td><em>Anacardium occidentale.</em> (Anacardiceae)</td>
<td>Leaves</td>
<td>Myricetin, quercetin, kaempferol, apigenin and glycosides</td>
<td>Diarrhoea, diabetes, swelling, skin diseases, mouth ulcers, anti-inflammatory</td>
<td>Ethanol extract and its petroleum ether, solvent ether, ethyl acetate, butanol and butanone fraction</td>
<td>[37]</td>
</tr>
<tr>
<td>8.</td>
<td><em>Azadirachta indica.</em> (Meliaceae)</td>
<td>Leaf</td>
<td>Alkaloids, flavonoids, triterpenoids, phenolic compounds, carotenoids and sterols and ketones</td>
<td>Anti-inflammatory, antipterygic, antimalarial, antitumour, antiulcer, antidiabetic, antifertility</td>
<td>Hydro-alcoholic extract, ethyl acetate and n-butanol fractions</td>
<td>[38-39]</td>
</tr>
<tr>
<td>9.</td>
<td><em>Allium cepa.</em> (Liliaceae)</td>
<td>Bulbs</td>
<td>Organic sulfur compounds, including trans-S-(1-propenyl) cysteine sulfoxide, S-S-aryl-cysteine sulfoxide, S-propylcysteine sulfoxide and cycloallin; flavonoids; phenolic acids; sterols including cholesterol, stigma sterol, β-sitosterol; saponins; sugars and a trace of volatile oil composed mainly of sulfur compounds, including dipropyl disulfide, fructans</td>
<td>Antimicrobial, anti-inflammatory</td>
<td>Petroleum ether, methanol and aqueous extracts</td>
<td>[40-42]</td>
</tr>
<tr>
<td>10.</td>
<td><em>Antrodia cinnamomea.</em> (Fomitopsidaceae)</td>
<td>Fruiting bodies</td>
<td>Antrocamphin A, ergostane-type triterpenoids and polyacytelenes</td>
<td>Cancer, inflammatory disorders and antioxidant</td>
<td>Methanol extract</td>
<td>[43-44]</td>
</tr>
<tr>
<td>11.</td>
<td><em>Butea frondosa.</em> (Fabaceae)</td>
<td>Roots and leaves</td>
<td>Flavonoids, glucosides and lectins</td>
<td>Anti-inflammatory</td>
<td>Aqueous extract</td>
<td>[45-46]</td>
</tr>
<tr>
<td>No.</td>
<td>Species</td>
<td>Part(s)</td>
<td>Active Constituents</td>
<td>Medicinal Uses</td>
<td>Solvents</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------------------------</td>
<td>-------------</td>
<td>------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
<td>---------------------------------------</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Barringtonia racemosa (Lecythidaceae)</td>
<td>Fruits, leaves</td>
<td>Diterpenes and triterpenes, lycopene, bartogenin acid, gastrostagiolum, gastrostagiol</td>
<td>Anti-inflammatory, anti-tumor, anti-nociceptive, α-glucosidase inhibitory, anti-bacterial and anti-fungal</td>
<td>Hexane, ethanol and methanol, ethyl acetate</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Boswellia serrata Roxb. (Burseraceae)</td>
<td>Oleogum resin</td>
<td>Resin which is pentacyclic triterpenoid in nature in which boswellic acids (β-boswellic acid, acetyl-β-boswellic acid, keto-β-boswellic acid and acetyl-11-keto-β-boswellic acid)</td>
<td>Cancer, inflammation, arthritis, asthma, psoriasis, colitis and hyperlipidemia</td>
<td>Petroleum ether</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Borassus flabellifer L. (Arecaaceae)</td>
<td>Male flowers (inflorescences)</td>
<td>Alkaloids, terpenoids, spirostane-type steroid saponins and phenolic compounds</td>
<td>Anti-inflammatory, anti-laprotic, diuretic, antiphlogistic, stomachic, sedative, laxative, aphrodisiac, immunosuppressant</td>
<td>Ethanol</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Aegle marmelos (Rutaceae)</td>
<td>Roots, leaves and fruits</td>
<td>Glycoside, alkaloids, coumarins, fatty acid and sterols, tannins, skimmianine, essential oil (mainly carophyllene, cineole, citral, eugenol), steroids and or triterpenoids, including lupol, β-sitosterol and α-amyrin, flavonoids (mainly rutin) and coumarins, including aegeline, marmesin and umbelliferone</td>
<td>Vata diseases, insomnia, seizures, and hysteria, for diarrhoea, dysentery, colitis, loss of appetite and abdominal dull pain, anti-inflammatory</td>
<td>Aqueous extract and alcoholic extract</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Commiphora mukul (Burseraceae)</td>
<td>Stem</td>
<td>Guggulsterones (E- and Z-stereoisomers) and gugulipid</td>
<td>Arthritis, obesity, and other disorders</td>
<td>Ethyl acetate</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Calluna vulgaris (Ericaceae)</td>
<td>Aerial parts</td>
<td>Kaempferol-3-O-β-D-galactoside, a common flavonol derivative</td>
<td>Anti-inflammatory and antinoiceptive, antiarthritic, diuretic, astringent and treatment of urinary infections</td>
<td>Ethanol, chloroform, ethyl acetate, n-butanol and water, methanol</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Cistus laurifolius (Cistaceae)</td>
<td>Leaves</td>
<td>Favonoids; 3-O-methylquercetin (1), 3,7-O-dimethylquercetin (2) and 3,7-O-dimethylkaempferol</td>
<td>Inflammatory ailments including rheumatism and renal inflammations</td>
<td>Ethanol</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>Cardioesperum helicacabum (Sapindaceae)</td>
<td>Leaves</td>
<td>Saponins, alkaloids, (+)-pinitol, apigenin, luteolin and chrysoeriol</td>
<td>Anti-inflammatory activity</td>
<td>Alcoholic</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Cyperus rotundus (Cyperaceae)</td>
<td>Tubers</td>
<td>β-sitosterol, 1,8-cineole, 4-alpha,5-alpha-oxidoudeis-11-en-3-alpha-ol, alkaloids, alpha-cyperone, alpha-rutinol, beta-cyperone, beta-pinene, beta-rutinol, beta-selene, calcium, camphene, copaene, cyperene, cypereon, cyperol, cyperocene corotundone D-copadiene, D-epoxyguaeni, D-fructose, D-glucose, flavonoids, gamma-cymene, isopolyrol, isokobusone, kobusone, limonene, linoleic-acid, magnesium, mangesnese, mustakone, myristic-acid, oleancolic-acid, oleancolic-acid-3-o-neohesperidoside, oleic-acid, P-cyhnol, patchoulenone, pectin, polyphenols, rothunedone, rotundone, selinatiene, stearic acid, sudeonol, sugetrol</td>
<td>Anti-inflammatory, cervical cancer, liver, menstrual disorders, menstrual pain, as a digestive stimulant and for memory</td>
<td>Methanol</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>Cleome rutidosperma (Capparidaceae)</td>
<td>Aerial parts</td>
<td>Alkaloids, steroids, flavonoids</td>
<td>Stimulant, antiscorbutic, antihelmintic, vesicant, rubifacient, carminative, antiplasmodial, analgesic, locomotor, anticomicrobial, diuretic, laxative</td>
<td>90% Methanol, ethanol, petroleum ether, diethyl ether and ethyl acetate</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>Callophyllum inophyllum (Chusiaceae)</td>
<td>Nuts</td>
<td>Xanthone dehydrocologua-nadine, callophlin-B</td>
<td>Anti-inflammatory</td>
<td>Methanol</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>Ficus religiosa (Moraceae)</td>
<td>Leaves, stem</td>
<td>Sterols, glycosides, tannins and amino acids</td>
<td>Laxative, diarrhoea, asthma, cough, earache, toothache</td>
<td>Methanol, Aqueous</td>
<td></td>
</tr>
</tbody>
</table>
24. *Justicia gendarussa* (Acanthaceae)  
- **Leaves**  
- Sterols and flavonoids  
- Migraine, gastric problems, haematuria and memory enhancing activity  
- Ethanol (95%)  

25. *Moringa oleifera* (Moringaceae)  
- **Flowers, leaves**  
- Nitrile glycosides, miazirin, niazirin, sterol components – stigmasterol, campisterol  
- Anti-arthritis  
- Ethanol (95%)  

26. *Nyctanthes arbor-tristis* (Oleaceae)  
- **Leaves, stems**  
- Nycanthoside, polysaccharides, iridoid glycosides, hentri-acontane, benzoic acid, glycosides  
- Sciatica, arthritis and anti-inflammatory  
- Ethanol (95%)  

27. *Premna serratifolia* (Verbenaceae)  
- **Wood**  
- Iridoid glycosides, alkaloids, phenolic compounds and flavonoids  
- Cardiovascular diseases, skin diseases, inflammatory diseases, arthritis, gonorrhoea, rheumatism, anorexia and jaundice.  
- 90% Ethanol  

28. *Pistacia khinjuk* (Anacardiaceae)  
- **Leaf**  
- Flavonoid; galloylated compounds, gallic acid, methyl gallate, quercetin-3-O-β-(4)C(1)-galactopyranoside (hyperin), myricetin-3-O-β-l(1)C(4)-rhamnopyranoside (myricitrin), 1,6-digalloyl-β-d-glucose, 1,4-digalloyl-β-d-glucopyranoside, and 2,3-di-O-galloyl-β-l(1)C(4)-glucopyranose (nilocitin)  
- Anti-inflammatory  
- Aqueous methanol  

- **Leaves, bark or fruit**  
- Flavonoids, kaempferol, ellagic acid and gallic acid; vitamin C and other antioxidants like emblicanin A, emblicanin B, punigluconin, pedunculagin  
- Hypercholesterolemic, rheumatoid arthritis and osteoporosis  
- Water  

30. *Rosa multiflora* Thunb. (Rosaceae)  
- **Hips**  
- Fatty acid, mainly including dodecanoic acid (8.72%), hexadecanoic acid (9.24%), pentadecanoic acid (1.58%), linoleic acid (26.04%), oleic acid (22.58%) and octadecanoic acid (6.3%)  
- Dietary and medicinal purposes like cold, flu, inflammation, osteoarthritis, rheumatoid arthritis and chronic pain  
- Ethanol, petroleum ether, ethyl acetate  

31. *Vitex negundo* (Verbenaceae)  
- **Roots, bark, leaves, flowers**  
- C-glycoside, casticin, essential oil, vitamin c, benzoic acid, flavone  
- Antiseptic, ophthalmic, anti-gonorrhoeic, depurative, anti-inflammatory  
- Ethanol, water  

32. *Vernonia anthelmintica* (Asteraceae)  
- **Seeds, dried leaves and roots**  
- Alkaloids, flavonoids, steroids, triterpenes and polyphenols  
- Anti-inflammatory, anti-arthritic  
- Ethanol (99.9%)
CONCLUSION

A large number of number of plants described in this review clearly demonstrated the importance of herbal plants in treatment of rheumatoid arthritis and also to consider one of good source for a new drug or a lead to make a new drug.

REFERENCES


HOW TO CITE THIS ARTICLE