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A Promising Approach Towards Arthritis: Bacopa Monnieri

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Abstract

Joint inflammation, pain, and a progressive loss of function are the hallmarks of arthritis, a chronic and crippling condition that frequently results in disability and a lower quality of life. The need for safer options is highlighted by the fact that while current therapy approaches, such as NSAIDs, corticosteroids, and disease-modifying antirheumatic medications, give symptomatic relief, they are usually linked to serious adverse effects. In this regard, the wellknown Ayurvedic medicinal plant Bacopa monnieri, also known as Brahmi, has drawn interest due to its encouraging anti-arthritic properties. Bacopa monnieri has long been used as a cognitive enhancer, but it also has strong anti-inflammatory, antioxidant, analgesic, and immunomodulatory qualities that could help treat arthritis. The main bioactive components of Bacopa monnieri are phytochemicals, including alkaloids, flavonoids, triterpenoids, and bacosides. These substances mainly work by lowering prostaglandin synthesis and altering the inflammatory cascade by blocking the activity of the cyclooxygenase-2 (COX-2) enzyme. Bacopa has been shown in experimental models to reduce arthritic joint edema, stabilize cellular membranes, and inhibit the release of lysosomal enzymes. Additionally, because oxidative stress is a major factor in cartilage degradation and synovial inflammation, its antioxidant capability helps to reduce it. Bacopa's dual function in regulating oxidative pathways and pro-inflammatory mediators highlights its potential as a treatment for chronic inflammatory illnesses. Bacopa provides the benefits of reduced toxicity and less systemic adverse effects when compared to traditional allopathic medications. Bacopa has been used in Ayurvedic formulations, such as oils and decoctions, to help arthritis sufferers with pain, stiffness, and edema. Current studies also point to the possibility of using it in conjunction with conventional treatments in a synergistic way. Future developments in tailored delivery methods and nanoformulations could increase bioavailability. But even with its medicinal potential, further research is still needed to determine long-term safety, the best dosage, and widespread clinical efficacy. In summary, by fusing contemporary pharmacological research with age-old Ayurvedic knowledge, Bacopa monnieri shows promise as a natural remedy for the treatment of arthritis. It is positioned as a possible substitute or supplement to traditional therapies due to its capacity to minimize side effects, protect cartilage, and reduce inflammation. For its successful incorporation into arthritis treatment plans, standardized formulations and therapeutic guidelines must be established through future clinical trials and mechanistic investigations.

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INTRODUCTION

In almost all forms of arthritis, pain is the primary symptom. Joint pain, stiffness, and swelling are other symptoms. Rheumatoid arthritis, psoriatic

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arthritis, and ankylosing spondylitis are the three most prevalent forms of chronic inflammatory arthritis. An increase in fluid in the tissues around the joints causes swollen joints. Joint swelling is a typical symptom of several forms of arthritis. The cartilage that cushions the ends of the bones deteriorates with persistent arthritis.

In chronic arthritic diseases, the synovial membrane swells and becomes oedematous, which can result in "cold" effusions. When synovial fluid output is reduced, articular cartilage loses its lubricating properties and nutrients [1].

The capsule experiences low-grade chronic inflammatory alterations along with fibrous degradation. Fibrous degeneration occurs in ligaments. The muscles undergo atrophy, which prevents the patient from using the joint. Movement is further limited as a result of the pain.

Fibrous degradation and low-grade chronic inflammatory alterations occur in the capsule. Ligaments undergo degeneration of fibrous tissue. Muscles suffer from atrophy, making the patient unable to use the joint. Movement is further limited due to the presence of pain.

A patient with arthritis may exhibit the following symptoms. One or more joints may be affected by pain and soreness on either one or both sides. Pain usually increases gradually and intermittently, with a very delayed commencement. The synovial membrane is under stress in weight-bearing joints, which causes pain. Later, the contact of the bone surfaces, which are rich in nerve endings, causes pain. Resting helps with the pain at first, but later on, pain alarms throughout sleep.

Usually, the accumulation of synovial fluid causes the joint to expand. Compared to other types of arthritis, rheumatoid arthritis is more likely to cause synovitis. Additionally, many osteoarthritic joints have it. Joint pain or tenderness, swelling, and hard lumps called nodules are all symptoms of synovitis. When associated with rheumatoid arthritis, swelling is a better indicator than tenderness. The perennial creeping herb Bacopa monnieri is indigenous to the marshes of eastern and southern India [2] (Table 1).

Table 1. Types of arthritis.

Type of arthritis	Cause / mechanism	Common symptoms	Commonly affected joints
Osteoarthritis (OA)	Degeneration of joint cartilage	Joint pain, stiffness (especially after rest)	Knees, hips, spine, hands
Rheumatoid Arthritis	Morning stiffness, swelling	Sudden severe pain, redness, swelling	Small joints of hands, wrists, feet
Gouty Arthritis (Gout)	Sudden severe pain, redness, swelling	Fingers, toes, spine	Big toe (most common), ankle, knee
Psoriatic Arthritis	Joint pain, stiffness, swelling	Joint pain, stiffness, swelling	Fingers, toes, spine
Ankylosing Spondylitis (JIA)	Autoimmune inflammation of spine	Acute pain, redness, fever	Bamboo spine on X-ray, variable course
Infectious (Septic) Arthritis (JIA)	Joint pain, swelling, fever, rash	Knee pain, redness, fever	Can’t see, can’t pee, can’t climb a tree
Reactive Arthritis (Reiter’s Syndrome)	Follows infection (GI or urinary tract)	Joint pain, eye inflammation, urethritis	Can’t see, can’t pee, can’t climb a tree

Osteoarthritis

Around the world, osteoarthritis is the most prevalent type of arthritis. Primary osteoarthritis and secondary osteoarthritis are the two types into which it falls. Although osteoarthritis is clinically quite varied and can manifest as anything from an asymptomatic accidental discovery to a debilitating and permanently disabling ailment, it often manifests as joint discomfort and loss of function. The origin, presentation, assessment, and treatment of osteoarthritis are reviewed in this exercise, along with the function of the interprofessional team in assessing, diagnosing, and treating the condition.

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Complications

The following are some of the issues that osteoarthritis can cause:

- Pain Drops
- Inability to walk
- Misalignment of the joints
- Reduced joint mobility due to radiculopathies [3].

Rheumatoid Arthritis

Inflammatory arthritis and extra-articular involvement are hallmarks of rheumatoid arthritis (RA), a systemic autoimmune illness. It is a chronic inflammatory disease that mostly affects synovial joints and is frequently brought on by the interplay of genes and environmental factors, such as tobacco. If treatment is not received, it usually begins in tiny peripheral joints, is symmetrical, and then spreads to proximal joints. Over time, joint inflammation causes bone erosion and cartilage loss, which ultimately results in joint degeneration. Early-stage RA is defined as having symptoms for less than six months, while established-stage RA is described as having symptoms for more than six months.

Complications

Radiographic damage, increasing deformity, and functional incapacity are the outcomes of chronic joint inflammation. Felty syndrome and anaemia of chronic illness are well-established side effects of seropositive RA. Up to 10% of individuals with pulmonary illness and RA may have the secondary type of Sjögren syndrome, which is linked to RA. Other problems, such as Felty's syndrome and inflammatory eye disease, are infrequent to rare. Although rheumatoid vasculitis is uncommon, it can cause serious problems if it does occur. Clinical manifestations vary from severe systemic involvement mimicking polyarteritis nodosa to localized digital involvement. [4].

Psoriatic Arthritis

About 20% of people with psoriasis also have psoriatic arthritis, which is a chronic inflammatory arthritis that is closely related to psoriatic arthritis. Potentially serious morbidity and a reduced quality of life are hallmarks of this aggressive illness.

Complications

Psoriatic arthritis, which was once thought to be a benign condition, is now seen as a crippling condition that needs focused therapy along with regular monitoring and follow-up care. Although it is possible to get total symptom relief, the majority of patients still have chronic inflammatory illness. An ophthalmologist will be needed to evaluate and treat patients with uveitis. Comorbid conditions such as metabolic syndrome, obesity, diabetes mellitus, hyperlipidemia, hypertension, and cardiovascular disease are more common in psoriatic arthritis patients.

Gout Arthritis

One of the most prevalent causes of chronic inflammatory arthritis is gout, which is defined by the accumulation of crystals of monosodium urate (MSU) monohydrate in the tissues. Even before the common period, gout was identified. As a result, it is possibly the most well-understood and treatable rheumatic illness. In addition to reviewing the assessment and treatment of gout, this exercise emphasizes how interprofessional team members work together to deliver coordinated care and improve patient outcomes.

Complications

- *Problems with the Skeletal System:* Bone loss, OA, Tophi joint deformity.
- *Urological complications:* Nephropathy caused by urea.
- *Eye Problems with Nephrolithiasis:* Scleritis, Uveitis, and Conjunctivitis.

Systemic Lupus Erythematosus

Systemic autoimmune illness that affects several systems, systemic lupus erythematosus (SLE) is linked to a high rate of morbidity and death. The loss of immunological tolerance against self-antigens

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is influenced by genetic, immunological, endocrine, and environmental variables. This results in the development of pathogenic autoantibodies, which harm tissue in a variety of ways. The assessment and treatment of systemic lupus erythematosus are reviewed in this exercise, which also emphasizes the importance of the interprofessional team in the treatment of patients with this illness [5].

Complications

- Kidney failure may result from lupus nephritis.
- *Heart:* Higher risk of hypertension, myocarditis, pericarditis, and heart disease. • Lungs: pulmonary hypertension, pneumonia, and pleuritis (inflammation of the lung lining).
- *Brain and Nervous System:* headaches, neuropathy, memory loss, seizures, and strokes.
- *Blood and Vascular:* Vasculitis, anaemia, and blood clots.
- Immunosuppressants and compromised immune systems can lead to infections.
- Avascular necrosis, osteoporosis, and arthritis affect the bones and joints. • Preterm birth, hypertension, and miscarriage are examples of pregnancy complications.

Juvenile Arthritis

Diverse category of chronic arthritis, juvenile idiopathic arthritis (JIA) is the most prevalent chronic rheumatological illness in children. With unique symptoms, genetic predispositions, pathophysiology, test results, disease progression, and prognosis, there are seven distinct subtypes of JIA. This exercise examines how JIA is assessed and managed, as well as how the medical staff assesses and treats people with this illness.

Complications

- Joint contracture and leg length disparity are the most frequent side effects of JIA. Because of the unchecked activation and multiplication of T cells and macrophages, macrophage activation syndrome is a very frightening consequence. It is uncertain how often this condition is in JIA patients; however, some research suggests that up to 10% of cases have it.
- Growth retardation, poor bone mineral density for chronological age, severe hip involvement requiring a hip prosthesis, and amyloidosis are other significant problems.

Reactive Arthritis

Inflammatory arthritis, known as reactive arthritis (ReA) appears days to weeks following a genitourinary or gastrointestinal infection. The traditional trifecta of conjunctivitis, urethritis, and arthritis is another name for it. The majority of patients, nonetheless, do not exhibit the traditional trio at first. It was once known as "Reiter syndrome, " after Hans Reiter, who was the first to describe this condition. An abnormal immunological reaction to a gastrointestinal or genitourinary infection brought on by salmonella, shigella, campylobacter, or chlamydia is thought to be the etiology of the illness. This exercise illustrates the function of the interprofessional team in addressing this condition and explains its etiology, pathophysiology, and presentation [6].

Complications

- Arthritis that flares up again (15 to 50%)
- Sacroiliitis or chronic arthritis
- 30 to 50% of patients with ankylosing spondylitis also have HLA-B27 positivity.
- The urethral stricture
- Necrosis of the aortic roots
- Cataracts
- Edema of the cystoid macular.

Infectious Arthritis

Infectious arthritis, also known as septic arthritis. Inflammation of the joints due to an infectious cause, such as a bacterial, fungal, mycobacterial, viral, or other infection, is known as septic arthritis.

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Although polyarticular septic arthritis affecting more or smaller joints can occasionally occur, it is often monoarticular. The assessment and management of septic arthritis are described in this exercise, along with the function of the interprofessional team in enhancing patient care.

Complications

- Severe bone and cartilage degradation resulting in joint damage and deformity.
- Cronic arthritis causes stiffness and discomfort in the joints.
- *Sepsis:* When an infection enters the bloodstream, it can cause potentially fatal consequences.
- The infection spreads to neighbouring bones in osteomyelitis.
- *Joint Function Loss:* Long-term impairment and decreased mobility.
- *Recurrent Infections:* People with weakened immune systems are more susceptible to joint4Ðfections in the future [7].

Ankylosing Spondylitis

persistent inflammatory condition affecting the axial spine is called ankylosing spondylitis (as). The most prevalent symptoms of this condition are growing spinal stiffness and persistent back discomfort. Characteristics include the involvement of the spine, fingers, entheses, peripheral joints, and sacroiliac joints. Ankylosing spondylitis is frequently linked to peripheral arthritis, enthesitis, dactylitis, buttock and hip discomfort, postural problems, and impaired spine movement. The assessment and treatment of ankylosing spondylitis are reviewed in this exercise, which also emphasizes the importance of the interprofessional team in assessing and enhancing patient care.

Complications

- *Spinal Fusion & Stiffness:* A hunched posture is caused by decreased flexibility.
- *Fractures:* A brittle spine makes fractures more likely, particularly to occur in the neck.
- *Reduced Lung Function:* Inflammation can cause the rib cage to tighten, which makes it harder to breathe.
- *Heart Disease:* A higher chance of developing heart disease and problems with the aortic valve.
- Eye inflammation, also known as uveitis, results in discomfort, redness, and issues with vision.
- *Neurological Problems:* Pain or paralysis may result from nerve compression brought on by spinal injury.
- *Osteoporosis:* Fractures are more likely when bones are weak.
- Inflammatory bowel disease (IBD) is more common in those with stomach problems [8].

TREATMENT OF ARTHRITIS

Arthritis cannot be permanently treated. However, arthritis is treated using both nonpharmacological and pharmacological methods. Compared to other chronic illnesses, arthritis pain is relatively common and can make a patient's life extremely difficult. The resulting pain can be either neuropathic, which results from damage to the nerves, or nociceptive, which results from damage to the tissue. The most prevalent type of arthritis in people is osteoarthritis [9].

An Allopathic Approach to Arthritis Treatment: (Figure 1).

Rheumatoid Arthritis

It is imperative to treat RA as soon as possible because failure to do so may result in bone erosion NSAIDs, or nonsteroidal anti-inflammatory drugs Monotherapy with methotrexate. Combining disease-modifying anti-rheumatic medications (DMARDs) is known as combination therapy. Both synthetic and biologic DMARDs are possible. The two types of synthetic DMARDs are targeted (tofacitinib) and conventional (methotrexate, sulfasalazine, leflunomide, hydroxychloroquine, and corticosteroids) and Targeted (tofacitinib).

Tumor necrosis factor antagonists (adalimumab, golimumab, certolizumab pegol, infliximab, and etanercept) a•f-e biologic DMARDs [10].

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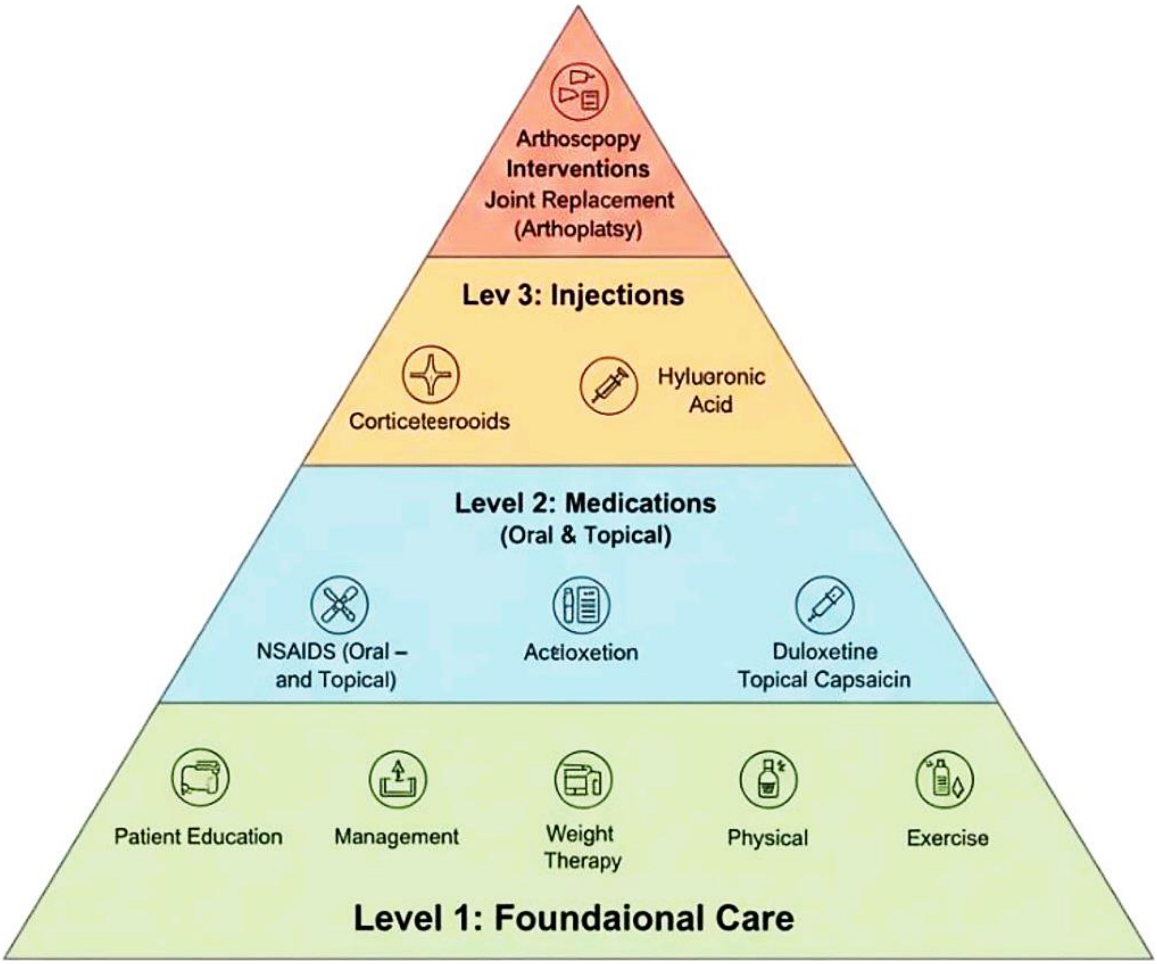

Figure 1. Allopathic treatment for osteoarthritis.

Osteoarthritis

- *Simple analgesia:* Nonsteroidal anti-inflammatory medications (NSAIDs) and paracetamol are both used to alleviate symptoms.
- *Topical treatment:* topical NSAIDS, topical capsaicin, chondroitin sulphate and glucosamine;
- Intra-articular therapy
- Opioid analgesia

All of these are typical methods of treating osteoarthritis. Figure 2 illustrates a step-by-step method for treating osteoarthritis.

Figure 2. Brahmi plant.

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CTLA-4-Ig fusion protein (abatacept), anti-CD20 monoclonal antibody (rituximab), IL-6 receptor antagonist (tocilizumab), aÐd antagonist (anakinra) [11].

Gouty Arthritis

NSAIDs, colchicine, corticosteroids, cortisone IA/IM, and interlukin-l antagonist work for acute gout; xanthine oxidase inhibitors (allopurinol, febuxostat), uricosuric agents (probenecid), selective inhibitors of the URATl transporter (lesinurad), and uricase (pegloticase) work for chronic gout.

NSAIDs are frequently used for arthritis, although they have numerous adverse effects on various bodily systems.

NSAIDs can cause problems with the upper gastrointestinal tract (GI), cardiovascular hazards (heart failure, myocardial infarction, etc.), and renal problems (edema, weight gain, sodium retention, hypertension, acute renal failure, papillary necrosis, etc.).

Asthma/allergic, hepatic (high transaminases), Anxiety (disorientation, light-headedness) [12].

Psoriatic Arthritis

Although systemic retinoids, fumaric acid esters, and phototherapy can be useful first-line treatments for psoriasis, they do not alleviate its symptoms. The first-line therapy for mild PSA is non-steroidal anti- inflammatory medications (NSAIDs), which may alleviate joint pain. NSAIDs may exacerbate skin lesions, hence, they are not advised for the treatment of psoriasis. The lack of clinical trial evidence and the fact that systemic corticosteroid regimens are linked to flare-ups of psoriasis during or after tapering make them unsuitable for treating psoriasis.

- Methotrexate
- Sulfasalazine [13].

Systemic Lupus Erythematosus

Treatments for lupus that control your symptoms will be recommended by your doctor. The objective is to reduce organ damage and the degree to which lupus interferes with daily living. To help them avoid flare-ups and minimize the intensity of their symptoms during one, the majority of lupus patients require a combination of drugs. You may require:

- *Hydroxychloroquine:* A disease-modifying antirheumatic medication (DMARD) called hydroxychloroquine can reduce lupus symptoms and decrease their progression. NSAIDs: Over-the-counter (OTC) NSAIDs decrease inflammation and alleviate discomfort. The optimal kind of NSAID for you and how frequently to take it will be determined by your doctor. Consult your physician before using NSAIDs for longer than ten days in a row.
- *Corticosteroids:* Prescription drugs called corticosteroids lower inflammation. One corticosteroid that doctors frequently use to treat lupus is prednisone. Your doctor may give oral medications or administer a corticosteroid injection directly into a joint.
- *Immunosuppressants:* Immunosuppressants are drugs that inhibit and reduce the activity of your immune system. They can aid in avoiding and tissue damage [14].

Juvenile Arthritis

Controlling pain, maintaining range of motion (ROM), muscular strength, and function, managing systemic problems, and promoting normal growth, nutrition, and physical and mental development are the goals of treating juvenile rheumatic arthritis (JRA). Therefore, rather than progress, the overall goal of treatment is remission. Other extra-articular problems (such as uveitis, serositis, growth retardation, and osteopenia) should be taken into account even though the primary emphasis of medical therapy for JRA is on the arthritis. Treatment for this illness should generally be community-based, family-centered, and well-coordinated.

- *NSAIDs:* Naproxen, Ibuprofen, Tolmetin, Indomethacin, etc.
- Methotrexate
- Glucocorticoids drugs, etc. [15]

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Reactive Arthritis

Reactive arthritis has no known cure, hence, the goal of treatment is to lessen its symptoms. Physicians customize care based on each patient's symptoms. One or more of the following may be used by your physician:

Drugs

- *Prescription or over-the-counter pain and anti-inflammatory drugs:* These can aid in lowering joint discomfort and swelling.
- *Corticosteroids:* These are often injected into the afflicted joint, but if more than one joint is damaged, your doctor may also prescribe them orally or intravenously. Since they are strong medications, physicians usually recommend the lowest dosage to have the intended effect. For symptoms related to your skin or eyes, you could require corticosteroid creams or drops.
- *DMARDs, or disease-modifying anti-rheumatic medications:* These medications help prevent inflammation in the joints and other tissues by broadly suppressing the immune system. They are often only used by doctors when corticosteroids and anti-inflammatory drugs have failed.
- *Antibiotics:* Antibiotics may be prescribed

Physical Therapy

Joint function can be improved and discomfort can be reduced with physical therapy. Techniques for enhancing joint flexibility and supporting and strengthening the muscles surround-iBg a joint can be taught by a physical therapist [16].

Infectious Arthritis

Antimicrobial medication and joint fluid drainage (arthroscopy, arthrotomy, or daily needle aspiration) are the two main treatments for septic arthritis. As soon as joint aspiration is finished and cultures are acquired, empiric intravenous antibiotic treatment should begin.

Septic Arthritis Is Treated Using the Following Methods

- *Surgery:* In the majority of cases, intravenous (IV) antibiotics and surgical debridement—the removal of inflammatory tissue—are required.
- *Antibiotics:* Antibiotics must be used to treat all instances of septic arthritis. Antibiotics can be administered by your doctor either intravenously or as pills.
- *Joint fluid drainage:* Using a tiny needle, your healthcare professional may aspirate (drain) fluid from your joint. As you recuperate, they might need to repeat this.
- *Physical treatment:* In order to strengthen the muscles surrounding your joint and restore joint function, you will probably require physical therapy.
- *Artificial joint removal:* If you develop septic arthritis in a prosthetic joint, you will probably need to have the joint removed and replaced with a joint spacer, which is a device composed of antibiotic cement. Your doctor will replace your prosthetic joint after a few months [17].
    - *Ankylosing Spondylitis:* In addition to preventing or delaying problems including spinal deformity, the therapy aims to alleviate pain and stiffness. Treatment for ankylosing spondylitis is most effective before the condition results in permanent damage.
    - *Drugs:* The medications that medical professionals most frequently prescribe to treat axial spondyloarthritis and nonradiographic axial spondyloarthritis are nonsteroidal antiinflammatory drugs (NSAIDs), such as naproxen sodium (Aleve) and ibuprofen (Advil, Motrin 1B, and others). Although these medications help reduce stiffness, discomfort, and inflammation, they may also result in gastrointestinal bleeding.

Therapy

- Physical therapy is a crucial component of treatment and offers several advantages, such as reduced pain and increased strength and flexibility. For you, a physical therapist can create customized workouts. You might be instructed in the following to maintain proper posture.

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- Stretching and range-of-motion exercises.
- Workouts to strengthen the muscles in the back and abdomen.
- Appropriate postures for walking and sleeping [18].

Ayurvedic Treatment over Allopathic

The greatest ayurvedic treatment for osteoarthritis is provided by Ayurveda, along with a number of natural solutions that can help control symptoms and enhance joint function. Common herbs used to treat arthritis and joint pain include ashwagandha, triphala, rasna, guggulu, brahmi, turmeric, and shalaki. Rheumatoid arthritis treatment using Ayurveda:

One of the Ayurvedic Treatments for Rheumatism Is Dosha Balancing

- Preventing the production of Aama at various levels; raising the Agni (metabolic and digestive fires).
- Encourages Aama digestion and excretion.
- Aids in repairing the weakened digestive mucosa and improving absorption.

The Most Effective Ayurvedic Treatments for Arthritis

The finest treatment for arthritis can be found in Ayurveda, which combines the palliative treatment known as Shamana with the purifying therapy known as Shodhana. Reducing joint pain, swelling, and inflammation as well as improving metabolic abnormalities,+re the primary goals of Ayurvedic treatment for arthritis [19].

Research Approach for Herbal Products

Other methods for the production of natural drugs are complementary to the path of reverse pharmacology, which emerged from observational therapies.

The range of plant uses in medicine can often be daunting to someone unfamiliar with the field. Nonetheless, the research plan options provide compelling incentives for the development of novel pharmacophores for interdisciplinary studies and a development network. Two other ways that novel pharmacophores might add to the arsenal of herbal therapeutic and preventive medicines are the creation of new pharmacological targets and the potential for combinatorial chemistry on the novel pharmacophores [20].

LIST OF AYURVEDIC DRUGS WITH EXPLANATION

Herbal Remedies for Arthritis

- *Guggulu:* Herbs from Ayurveda are frequently used to treat arthritis because they improve joint health, balance doshas, and reduce inflammation. Among the most often utilized plants and mixtures are: Commiphora mukul, or guggulu: One of the most potent antiinflammatory herbs in Ayurveda is guggulu. It is a crucial treatment for rheumatoid arthritis and osteoarthritis since it lessens joint pain and swelling. Certain formulations, such as Yograj Guggulu and Mahayograj Guggulu, are used to treat the symptoms of arthritis. Guggul's Ushna (hot) potency aids in lowering Ama. Due to its ability to balance Vata, guggul also helps reduce joint discomfort and swelling, which are indications of rheumatoid arthritis. It relieves pain, lumbago, cracking, cold or dry joints, inflammati9Ð, deformation, numbness in rheumatoid arthritis, sciatica, carpal tunnel syndrome, repetitive strain injury, multiple sclerosis, spasms, neuralgia, tingling sensations, tremors, painful periods, and pains. One of the greatest dietary supplements for Ayurvedic pain management [21].
- *Ashwagandha:* Withania somnifera, often known as ashwagandha, is an adaptogenic plant that strengthens muscles, eases stress, and benefits joints. It helps individuals with osteoarthritis move more freely and balance their Vata. It is commonly acknowledged that stress plays a significant role in the aetiology of inflammatory rheumatic diseases. Anti-inflammatory, antitumor, antistress, antioxidant, immunomodulatory, hematopoietic, and restorative qualities are all displayed by Withania somnifera, also known as ashwagandha14,15. Ashwagandha powder has been beneficial for RA patients. lessen inflammation by blocking inflammatory indicators such reactive oxygen species, nitric oxide, and cytokines (such as TNF-a and IL-6) [22].

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- *Shallaki:* Shallaki slows down cartilage degradation and possesses potent anti-inflammatory qualities. Because it increases joint mobility and lessens discomfort, it is very helpful in controlling osteoarthritis. Chemicals found in Boswellia serrata may boost the body's immunological response and reduce edema. With its potent anti- inflammatory qualities, Shallaki is a blessing for those with long-term bone conditions including osteoarthritis, osteopenia, osteomyelitis, etc. In India, the hilly states of Gujarat, Bihar, Orissa, Assam, Rajasthan, Andhra Pradesh, Telangana, and Madhya Pradesh are dotted with Shallaki trees [23].
- *Turmeric:* Curcumin, which is found in turmeric (Curcuma longa), has strong anti-inflammatory and antioxidant qualities. It helps reduce inflammation in the joints, making it beneficial in treating rheumatoid arthritis. To increase its effectiveness, turmeric is frequently used in conjunction with other plants. The extracted curcumin extract (CE) possesses antiinflammatory characteristics similar to that of non-steroidal anti-inflammatories. It has been demonstrated that CE influences NF kappa Beta activity, which in turn impacts the signalling of proinflammatory cytokines such interleukins, phospholipase A2, 5-lipoxygenase enzyme, and cox-2 [24].
- *Brahmi:* By modification, Brahmi (Bacopa monneri) can release proinflammatory mediators. The extract of bacosides and triterpenoids is beneficial in treating a variety of inflammatory diseases. Brahmi, which has anti- inflammatory and pain-relieving properties, works by specifically blocking the cyclo-oxygenase-2 enzyme, which lowers the production of prostaglandins. By inhibiting prostaglandin production and preventing lysosomal membrane rupture, Jain et al. showed that CDRI-08 (KeenMind) could successfully control the inflammatory reaction generated in an experiment [25].
- *Nirgundi:* The plant niggundi is widely known for lowering joint inflammation, discomfort, and swelling. It is frequently used as a paste or oil to relieve the symptoms of arthritis. The analgesic properties of nirgundi aid in the relief of a number of symptoms, such as musculoskeletal discomfort, menstrual cramps, and headaches. When eombined with bioactive components like alkaloids and flavonoids, it has anti-inflammatory qualities [26].

Brahmi

Brahmi (Figure 2) is employed in Siddha literature for a variety of purposes that aid in increasing mental capacity. It is referred to as Brahmi in Tamil. Triterpenoid saponins called bacosides, which include jujubogenin or pseudo- jujubogenin moieties as aglycone units, are the phytochemicals in Bacopa monnieri that have been well described.

Bacopa was utilized to prevent and lessen the inflammatory changes brought on by prostaglandins and arachidonic acid in several preclinical investigations. Bacopa may help reduce arthritis-related swelling. The leaves of bacopa have anti-arthritic qualities. When administered to synovitis-indæed edematous arthritic joints, swelling would go away right away [27].

Botanical Composition

Numerous active substances, including bacosides, alkaloids, flavonoids, and saponins, are found in brahmi. These bioactive substances are thought to play a part in the herb's capacity to improve general wellbeing, reduce stress, and enhance cognitive function. The most significant active ingredient in bacopa, is essential for enhancing brain and memory performance [28].

The Plant

Brahmi is a tiny creeping perennial with many branches and tiny, rectangular, somewhat thick leaves that are positioned on the stem opposite one another. Little flowers with four to five petals are either white or light purple. Wetlands, shallow water, and muddy shorelines are all suitable habitats for its natural growth. It is a common aquarium plant because of its capacity to thrive in water, yet it can also tolerate somewhat brackish conditions. The distinctive feature of Brahmi is that, although being an aquatic plant, it can be grown in pots, a garden, or even in full sun as long as it has enough water [29].

It is possible to use the entire plant medicinally. It has a cooling energy (Virya), a sweet aftermeal impact (Vipaka), and a bitter and sweet flavor (Rasa). All three Doshas and all Dhatus (tissues), particularly the nerve, blood, and plasma, return to normal. Numerous Srotas (systems), including the circulatory, digestive, neurological, excretory, muscular, and reproductive systems, are impacted.

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Chemical Constituents

The characteristic chemical makeup of Bacopa monniera is characterized by the presence of substances such as bacosides, which are dammarane-type triterpenoid saponins with jujubogenin or pseudo-jujubogenin moieties as its aglycone units. The structural similarity has led to the elucidation of 12 analogs from the Bacoside family. Bacopasides I—XII, a distinct family of saponins, have recently been discovered to constitute a significant component of the herbal extract. The alkaloids brahmine, herpestine, and nicotine have also been categorized as chemical elements of Bacopa monniera, into hersaponin, apigenin, D-mannitol, monnierasides 1—111, plantainoside B, and cucurbitacin. The most researched and powerful component of bacopa is bacoside A (Figure 3), which is made up of bacoside A3, bacopasaponin C, bacopaside Il, and bacopaside X [30].

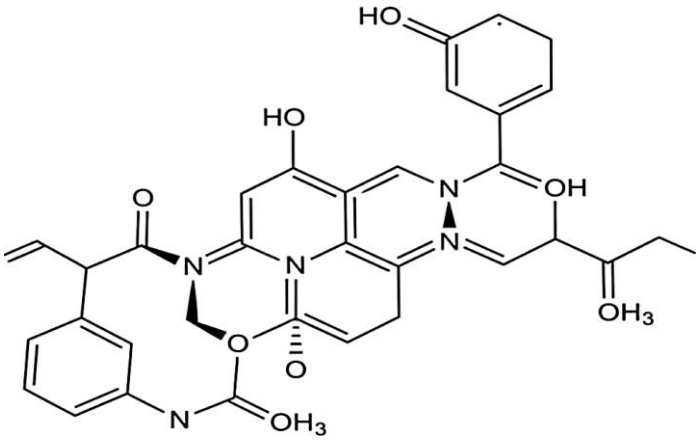

Figure 3. Structure of bacoside A.

A combination of chemical substances called bacosides that were separated from Bacopa monnieri is called bacoside A. The saponins bacoside A3, bacopaside Il, bacopasaponin C, and the jujubogenin isomer of bacopasaponin C are among its main components. The mixture's possible neuroprotective propeHies have been investigated in animal models and in vitro tests [31].

Major

The primary components of bacoside A include brahmine, herpestine, alkaloids, and major saponins. Known to humans as betulic acid, bacoside A, and bacoside B. It has been possible to isolate D-mannitol, stigmastanol, - sitosterol, and stigma sterol. Two of the three sugars produced by the acid hydrolysis of Bacoside A were glucose and arabinose. When bacoside B is hydrolyzed, glucose and arabinose are produced.

Other Substances Include

betulinic acid, wogonin, o Luteolin, luteolin-7-glucoside, stigmasterol, stigmastanol, ßsitosterol, D-mannitol, and Bacoside B, Bacoside Al, Bacoside A3, Bacogenin Al, Bacogenin A2, Bacogenin A3, Bacogenin A4, Bacopa Saponin-C, Bacopasides I and Il, Bacopasides Ill-V, Bacobitacins A-D, Monnieraside I, Monnieraside Ill, Monnieri, and Plantioside B [32].

Ethanopharmacology

In addition to being considered to sharpen the intellect, it is chilly, bitter, and astringent. Asthma, hoarseness, dermatitis, anemia, diabetes, heart problems, insanity, and epilepsy are among the many conditions it is used to treat. The entire plant is used medicinally; for example, children can be given leaf juice to relieve rheumatism with leaf paste, cough problems with leaf decoction, and bronchitis and diarrhea.

Furthermore, it has been observed that it is a safe cardiac tonic that helps patients with anxiety neurosis when mixed with sugar, ginger juice, and extracts from the bark of the Moringa oleifera plant. It was said to be-a potent blood vessel dilatation and antioxidant.

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Mechanism of Action

Brahmi, which has anti-inflammatory and pain-relieving properties, lowers prostaglandin production by specifically inhibiting the cyclooxygenase-2 enzyme. By inhibiting prostaglandin production and avoiding lysosomal membrane rupture, could successfully control the inflammatory reaction generated . Additionally, there were no stomach issues after taking an anti-inflammatory dosage of Brahmi. Using whole plant ethanol extract of CDRI-08 at 250 and 500 mg/kg, the writhing caused by acetic acid in mice was decreased (Rao et al., 2000). Mathur et al. investigated the anti-inflammatory properties of various CDRI-08 extracts in rat hindpaw edema brought on by carrageenan. According to, supplements containing Brahmi methanolic and aqueous extract (100 mg/kg) were shown to considerably decrease inflammation, whilst petroleum ether and hexane extracts had no effect. Additionally, methanolic extract (100, 200, and 300 gg) was found to help stabilize membranes more than diclofenac sodium [33].

Numerous pharmacological effects of Bacopa monnieri include bronchodilator, cardiotonic, anti-inflammatory, anticonvulsant, antioxidant, and protection against peptic ulcers.

PHARMACOLOGICAL EFFECTS

Absorption

- *Bioactive substances:* The therapeutic properties of Bacopa monnieri are attributed to the presence of bioactive molecules such as bacosides, bacopasides, and bacopasaponins.
- *Oral bioavailability:* Bacopa monnieri's bioactive components have a comparatively poor oral bioavailability, ranging between 5% and 20%. This might be the result of things like inadequate absorption, low solubility, or breakdown by intestinal enzymes.

Distribution

- *Systemic circulation:* Following absorption, Bacopa monnieri's bioactive components go into the systemic circulation, where they can be dispersed to different tissues, including arthritic joints.
- *Tissue distribution:* Research indicates that the bioactive substances in Bacopa monnieri may build up in organs such as the kidneys, liver, and brain. It is unclear, though, how they are distributed in the joint tissues that are most impacted by arthritis.

Metabolism

- *Metabolic pathways:* Glucuronidation and sulfation pathways are the main metabolic changes that Bacopa monnieri's bioactive substances go through in the liver.
- *Metabolite activity:* Some of the bioactive chemicals in Bacopa monnieri may still have antiinflammatory and antioxidant properties in their metabolites, which might help explain the herb's medicinal benefits.

Excretion

- *Renal excretion:* Within 24 hours, a sizable amount of the metabolites of the bioactive components in Bacopa monnieri are removed in the urine. These metabolites are mostly cleared via the kidneys.
- *Excretion in the feces:* A lesser percentage of the metabolites may be eliminated in the feces

KEY AYURVEDIC HEALTH BENEFITS OF BRAHMI

Improves Physical Well-Being

- Brahmi promotes physical health in addition to mental well-being. The herb's potent antioxidant qualities shield the body from oxidative stress, which can cause chronic diseases and early aging. Additionally, Brahmi fortifies the immune system, fostering general health and energy.
- *Enhanced Immunity:* By thwarting dangerous infections and strengthening the body's defenses, brahmi can strengthen the immune system.
- *Detoxification:* Brahmi is well-known for its ability to rid the body of accumulated toxins, which improves organ function and circulation.
- *Anti-Inflammatory Effects:* By lowering the symptoms of long-term inflammatory diseases like arthritis, brahmi's anti-inflammatory qualities enhance joint flexibility and health.

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- Promotes Cognitive Function and Brain Health.
- Lessens Anxiety and Stress.
- Improves Concentration and Memory.
- Promotes the Health of Skin and Hair.
- Pharmacological Activity of Brahmi and its effect is given in Table 2.

Table 2. Pharmacological activity of brahmi and its effect.

S.N.	Pharmacological activity of brahmi	Effects
1.	Anti-Asthmatic activity	According to reports, B. monnieri extract has tracheal muscle relaxant qualities. Additionally, it aids in bronchodilation. The antagonism of carbachol-induced effects on inspiratory and expiratory stress may be a reflection of this plant's bronchodilator activity.
2.	Anti-allergy activity	According to reports, B. monnieri leaves may be used to treat allergy problems since their methanolic extract has a strong mast cell stabilizer.
3.	Anti-cancer activity	The ethanolic extract of the B. monnieri plant contains bacosides A and B, which have antitumor properties. This plan's cucurbitacin component has been shown to have potent antitumorigenic and anti-proliferative properties.
4.	Anticonvulsive activity	B. monnieri's crude water extract has been shown in several scientific investigations to regulate epilepsy. A sedative is produced by the plant extract. It is well recognized that drugs that increase the neurotransmitter GABA have calming, pain- relieving, and anticonvulsant properties.
5.	Antidepressant activity	The primary use of Bacopa monneri is as a brain stabilizer. This plant's methanolic extract has antidepressant qualities.
6.	Anti-inflammatory activity	By modification, bacopa monneri can release proinflammatory mediators. The extract of bacosides and triterpenoids is beneficial in treating a variety of inflammatory diseases.
7.	Anti-nociceptive activity	By acting on PI -adrenergic, (12-adrenergic, and 51-1T receptors, among other routes, the plant's aqueous extract has pain-relieving properties.
8.	Antioxidant activity	The alcoholic and hexane components of B.monnieri have antioxidant qualities that prevent the lipid peroxidation impact. B. monnieri's antioxidant impact was demonstrated by various scientific investigations using other methods. Specifically, by preventing the activities of glutathione peroxidase (GPX), catalase (CAT), and superoxide dismutase (SOD). [83,841 The methanolic extract can restrict the superoxide anion concentration because of the lowered nitric oxide (NO which are employed in many disorders including AD, ischemia.
9.	Anti-Spasmodic Activity	Because BM plant extract blocks calcium influx through the membrane's voltage and receptorworked calcium channels, it has spasmolytic action in smooth muscles.
10.	Anxiolytic effect	Since this plant does not cause amnesia and has memory- enhancing qualities in addition to its anxiolytic effect, it is significantly more significant than lorazepam (LZP).
11.	Cardiovascular activity	The plant's ethanolic extract has cardiovascular qualities. By compressing the left ventricle, it keeps the blood flowing. Additionally, it has a protective impact on the aorta and aspiratory system.
12.	Gastroprotective activity	In cases of intestinal spasms, such as irritable bowel syndrome, it is quite beneficial.There have been reports of anti-ulcer qualities in the plant's juice and extracts. The mucosal membrane increases mucin production and decreases cell shedding as a result of the juice's gastroprotective impact.
13.	Hepatoprotective activity	The ethanolic extract of B. monnieri contains bacoside, which has been shown in the published research to have hepatoprotective action when tested against albino mice. An essential function of Bacoside A is to inhibit the rise in LPO and serum marker enzyme activity.
14.		Memory enhancer Alzheimer's disease and Schizophrenia

Therapeutic Value of Brahmi

The whole brahmi plant is used as a diuretic by making a decoction. The whole plant is used as a kidney tonic to cure rheumatism, hoarseness, scurvy, and beri-beri. It is also considered an

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antispasmodic, diuretic, and stimulant. Additionally, the whole plant is used as a treatment for diarrhea, an appetizer, and astomachic. In China, it is mostly used to treat gastrointestinal disorders including diarrhoea and colic. An alternate remedy for thread worms is a decoction made from brahmi plants. Brahmi vati is a useful treatment for mental disease, sadness, stress, mental exhaustion, poor memory, and psychotic disorders (Table 3).

Table 3. Therapeutic value of brahmi.

Disease	Treatment
Insomnia	Before going to bed, mix 100 mL of cow's milk with 3 g of brahmi powder. It relieves sleeplessness.
Memory Booster	Add 1/4 tsp black pepper, 1 tsp almonds, and 1 tsp dry brahmi. Pulverize each of the 3 g pills in water. Twice day, take each tablet with milk.
Acne	Add turmeric powder, lemon juice, and a few brahmi leaves. Make a paste, then dab it on the face.
Anxiety Long Term Headache	With water, grind 3 grams of brahmi and a pinch of black pepper. Give the patient the strained solution three or four times a day.
Crude Fiber & Hair Growth	When applied to the scalp, brahmi oil stimulates hair growth and has positive effects on the brain, neurological system, and psyche.

Side Effects: Although bacopa monnieri is usually regarded as safe, prolonged usage or excessive dosages may have negative consequences. The following are some possible adverse effects:

Common Side Effects

- *Digestive problems:* cramping in the stomach, diarrhoea, vomiting, and nausea.
- *Light-headedness and dizziness:* As a result of the brain receiving more blood.
- *Menstrual pain:* mild to moderate.
- *Fatigue:* A sense of exhaustion or sluggishness.
- *Dry mouth:* A decrease in salivation.

Rarely Occurring but Serious Side Effects

- *Allergic responses:* Infrequent instances of anaphylaxis and other allergic reactions.
- *Seizures:* People with a history of seizure disorders may experience seizures when taking high dosages.
- *Hypotension:* Bacopa monnieri may cause hypotension by lowering blood pressure.
- *Thyroid issues:* May exacerbate thyroid disorders or interfere with thyroid treatments.
- *Bleeding disorders:* May make those with bleeding disorders more likely to haemorrhage (Table 4).

Table 4. Marketed ayurvedic preparation.

S.N.	Ayurvedic formulation	Dosage
1.	Yograj Guggulu	Tablets
2.	Ortho Vedic Oil	Oil
3.	Rheumaspa	Capsule
4.	Ortho Urja	Soft Capsule
5.	Arthoright	Liquid
6.	Orthorun	Powder
7.	Brahmi Tailam	Oil
8.	Nirgundi Tel	Oil

FUTURE RESEARCH AVENUES

Many research organizations have looked into the medicinal benefits of Brahmi in great detail. The active ingredients in the herbal extract that are thought to be primarily responsible for the nootropic effects on humans are the bacosides. Brahmi (Bacopa monnieri) can be used topically to treat Arthritis. Ayurvedic Formulation such as Oil, Spray, Lotion, etc. will be very helpful to arthritis patients to come over it. There are many other ayurvedic formulation that helps to treat arthritis, but as brahmi show very

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less side effects, and good results against arthritis. As, Brahmi can replace diclofenac in future because diclofenac results severe side effects and brahmi also show same effect like diclofenac but with less side effect. So, Brahmi will be the promising ayurvedic formulation to treat arthritis in future.

Future research on Bacopa monnieri (Brahmi) for arthritis treatment should focus on elucidating its anti- inflammatory mechanisms, particularly its effects on cytokine modulation (TNF-Œ, IL-6) and key signaling pathways (NF-KB, MAPK). Studies should investigate its chondroprotective properties, assessing its role in inhibiting matrix metalloproteinases (MMPs) and promoting cartilage regeneration. Additionally, research should explore its antioxidant potential in reducing oxidative stress and mitochondrial dysfunction in joint tissues. Clinical trials are essential to determine its efficacy, optimal dosage, and long-term safety in arthritis patients. Furthermore, innovative drug delivery approaches, such as nanoformulations and targeted therapy, could enhance its bioavailability and therapeutic effects. The potential synergistic effects of Brahmi with conventional arthritis treatments and other herbal compounds should also be studied. Gut-joint axis research and pharmacogenomic studies could help personalize Brahmi-based therapies for arthritis management [34].

CONCLUSION

Bacopa monnieri is considered as the major traditional plant which is used to prepare various Ayurveda and Folk medicines. It shows huge potential in the anti-inflammatory effect, to treat arthritis, and other problems. Bacoside A is considered the most important phytochemical extracted from this plant which issued to prepare various therapeutic medicines. Brahmi is known to have anti-inflammatory, pain relief, mitigating, antimicrobial and antioxidant and memory-enhancing properties. As brahmi show anti-inflammatory and pain-relieving properties, lowers prostaglandin production by specifically inhibiting the cyclooxygenase-2 enzyme. By inhibiting prostaglandin production and avoiding lysosomal membrane rupture could successfully control the inflammatory reaction generated. It is thus concluded from the literature that Bacopa monnieri is a valuable medicinal herb that is being used in Ayurvedic traditional system for the treatment of arthritis.

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