INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

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Review Paper

Targeting Arthritis Through Phytomedicine: Mechanistic Understanding and Clinical Evidence

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ARTICLE INFO

Published: 18 June 2026
Keywords:
Arthritis, chronic musculoskeletal conditions, joint inflammation, stiffness, swelling, and progressive disability, arthritis
DOI:
10.5281/zenodo.20748817

ABSTRACT

Arthritis is one of the most prevalent chronic musculoskeletal conditions, affecting millions worldwide and significantly reducing quality of life. Characterized by joint inflammation, stiffness, swelling, and progressive disability, arthritis primarily exists in two major forms: osteoarthritis (OA), a degenerative joint disease, and rheumatoid arthritis (RA), an autoimmune systemic disorder. Current management relies on synthetic drugs such as non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and disease-modifying antirheumatic drugs (DMARDs). While these agents provide symptomatic relief, their long-term use is often associated with gastrointestinal, renal, hepatic, and immunosuppressive complications. Consequently, there is a rising demand for safer and more sustainable alternatives. Phytomedicine, rooted in traditional medical systems such as Ayurveda, Siddha, and Traditional Chinese Medicine, has emerged as a promising complementary approach. Herbal drugs such as:Curcuma longa (curcumin), Boswelliaserrata (shallaki), Withaniasomnifera (ashwagandha),Tinospora cordifolia (guduchi), Commiphora mukul (guggul) possesses anti-inflammatory, antioxidant, and immunomodulatory properties. Modern drug delivery innovations, including phytosomes, nanoemulsions, emulgels, and nanocarriers, have further enhanced their therapeutic potential. This review provides a comprehensive overview of the mechanistic basis of arthritis, conventional therapies, limitations of synthetic drugs, rationale for herbal alternatives, clinical evidence, and future prospects for phytomedicine in arthritis management

INTRODUCTION

Arthritis is a broad term encompassing over 100 rheumatic diseases and conditions that affect

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

joints, surrounding tissues, and connective structures. It represents one of the leading causes of disability worldwide, with an estimated global prevalence of more than 350 million individuals. **Osteoarthritis (OA)** and rheumatoid arthritis (RA) are the most common and debilitating forms [1].

Osteoarthritis (OA): A degenerative joint disorder characterized by the progressive breakdown of articular cartilage, subchondral bone remodeling, and limited joint mobility. It is strongly associated with aging, obesity, and repetitive mechanical stress.

Rheumatoid arthritis (RA): A chronic autoimmune inflammatory disease leading to synovial membrane inflammation, pannus formation, cartilage erosion, and joint deformity. Unlike OA, RA is systemic and often accompanied by extra-articular manifestations such as cardiovascular and pulmonary complications [2].

The global burden of arthritis continues to rise due to increased life expectancy, sedentary lifestyles, and obesity prevalence. The World Health Organization (WHO) recognizes musculoskeletal conditions, including arthritis, as major contributors to disability-adjusted life years (DALYs). The limitations of conventional synthetic drugs, coupled with the long duration of arthritis treatment, have prompted growing interest in phytomedicine [3]. Herbal medicines not only offer symptomatic relief but also exert disease-modifying actions with minimal toxicity, making them attractive candidates for long-term management.

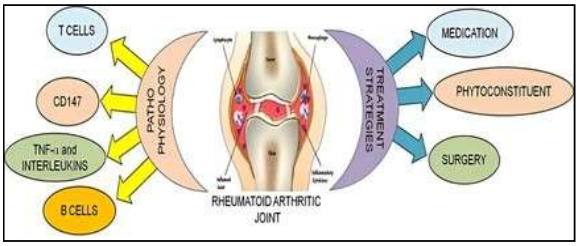


FIG. 1



FIG. 2

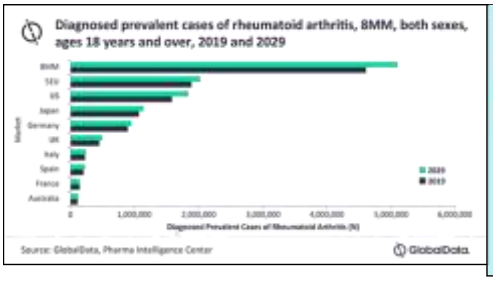


FIG. 3

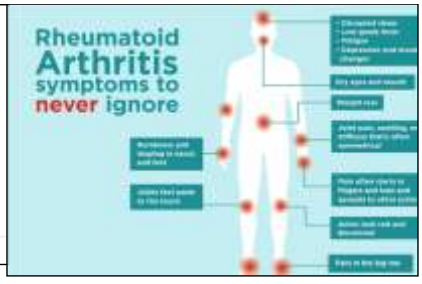


FIG. 4

Etiological factors:

Genetic predisposition: HLA-DR4 and HLA-DRB1 alleles increase susceptibility to RA.

Age: Degenerative changes accumulate with aging, making OA more common in older adults.

Sex: RA is more prevalent in women; gout is more common in men.

Autoimmune dysregulation: Aberrant immune activation triggers chronic inflammation in RA and systemic lupus erythematosus (SLE).

Metabolic disorders: Uric acid crystal deposition (gout) and calcium pyrophosphate deposition (pseudogout).

Infection: Septic arthritis may arise from bacterial invasion.

Mechanical stress and trauma: Obesity, repetitive joint use, and prior injury accelerate OA progression.

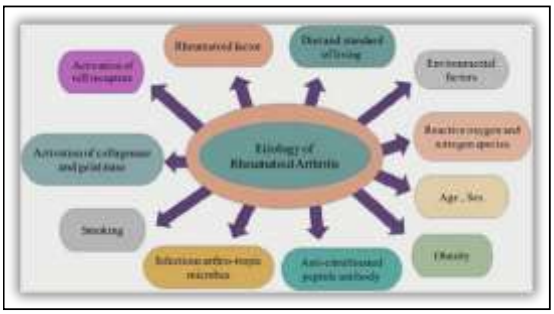


FIG. 5

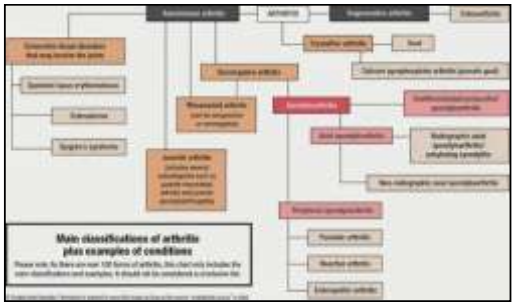


FIG. 6

2. PATHOGENESIS:

- Genetic and environmental factors such as smoking, infections, and hormonal influences initiate immune dysregulation.
- Antigen-presenting cells including macrophages and dendritic cells activate T-lymphocytes.
- Activated T-cells release pro-inflammatory cytokines such as IL-1, IL-6, TNF-α, and IFN-γ.
- Cytokine release stimulates B-cell proliferation and activation [4].
- B-cells differentiate into plasma cells that produce autoantibodies including rheumatoid factor (RF) and anti-citrullinated peptide antibodies (ACPAs).
- Immune complex deposition within the synovial membrane activates the complement system.
- Activated macrophages release inflammatory mediators such as TNF-α and IL-1, promoting synovial hyperplasia and pannus formation.
- Matrix metalloproteinases (MMPs) degrade cartilage and contribute to progressive joint destruction.
- • The inflammatory cascade ultimately leads to joint swelling, stiffness, pain, deformity, and progressive disability.

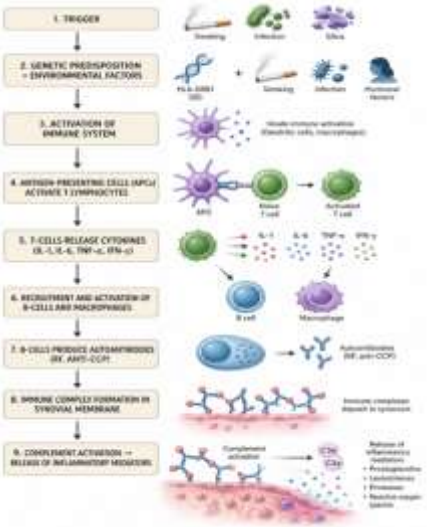


FIG 7

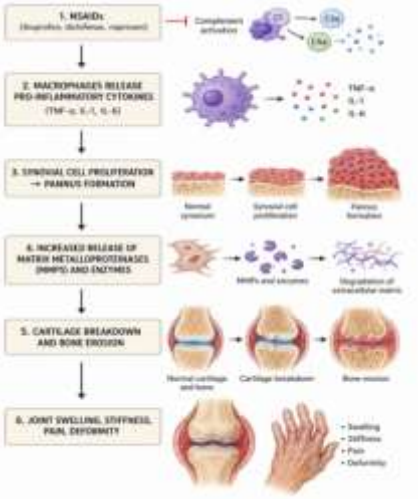


FIG 8

3. CONVENTIONAL THERAPIES FOR ARTHRITIS

1.Classes of Drugs

Provide symptomatic relief by inhibiting cyclooxygenase enzymes, reducing prostaglandin synthesis [5,6].

Corticosteroids

(e.g., prednisone, dexamethasone):

Potent anti-inflammatory and immunosuppressive agents used in acute exacerbations.

DMARDs

(e.g., methotrexate, leflunomide, sulfasalazine, hydroxychloroquine):

Slow disease progression and reduce joint damage.

Biologic agents

(e.g., anti-TNF-α, IL-6 inhibitors, JAK inhibitors):

Target specific cytokines or signaling pathways.

2.Limitations

Gastrointestinal bleeding and ulcers (NSAIDs).

Immunosuppression, osteoporosis, metabolic changes (corticosteroids).

Hepatotoxicity, bone marrow suppression (DMARDs).

High cost and infection risk (biologics) [7].

Hence, there is a need for safer alternatives, especially for long-term therapy.

TABLE NO. 1: Drugs used in Arthritis Management

Class	Action	Drugs
Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)	Reduce pain, inflammation, and stiffness by inhibiting cyclooxygenase (COX) enzymes and prostaglandin synthesis	Ibuprofen, Naproxen, Diclofenac, Indomethacin
Glucocorticoids (Corticosteroids)	Potent anti-inflammatory and immunosuppressive agents used for rapid symptom relief	Prednisolone, Hydrocortisone, Dexamethasone, Methylprednisolone
Disease-Modifying Antirheumatic Drugs (DMARDs)	Alter the progression of disease, suppress immune-mediated inflammation, and prevent joint damage	Methotrexate, Leflunomide, Sulfasalazine, Hydroxychloroquine[8,9]

Rationale for Herbal/Phytomedicine Use

1.Global Perspective

WHO estimates 80% of the world's population relies on traditional medicine for primary healthcare. In Europe and North America, herbal supplements such as turmeric, boswellia, ginger, and willow bark are widely used as complementary therapies.

Countries like India, China, and Japan integrate herbal medicine into modern rheumatology.

2.AYUSH Perspective

The Ministry of AYUSH actively promotes herbal remedies for arthritis.

Research councils like CCRAS (Central Council for Research in Ayurvedic Sciences) conduct clinical trials on herbs such as Boswellia serrata, Tinospora cordifolia, and Withaniasomnifera.

Initiatives like AYUSH e-pharma strengthen herbal drug distribution and awareness [10].

4. HERBAL DRUGS IN ARTHRITIS MANAGEMENT

1. Curcuma longa (Turmeric, Curcumin)

Mechanism: Inhibits NF-κB, COX-2, and LOX pathways; reduces oxidative stress.

Clinical evidence: Curcumin combined with diclofenac improved knee OA outcomes with fewer side effects.

2. Boswellia serrata (Shallaki)

Active compound: Boswellic acids inhibit 5-lipoxygenase.

Benefits: Reduces cartilage degradation, joint swelling, and pain.

3. Withaniasomnifera (Ashwagandha)

Acts as an adaptogen and immunomodulator.
Reduces pro-inflammatory cytokines and oxidative stress.

4. Tinospora cordifolia (Guduchi)

Enhances immune regulation and reduces "Ama" (toxins) in Ayurvedic concept. Shown to inhibit autoimmune arthritis in preclinical studies [11].

5.Commiphora mukul (Guggul)

Contains guggulsterones; exhibits lipid-lowering and anti-inflammatory activity.

6. Zingiber officinale (Ginger)

Active compounds (gingerols, shogaols) reduce TNF-α and IL-1β expression. Provides analgesic and anti-inflammatory effects [12].

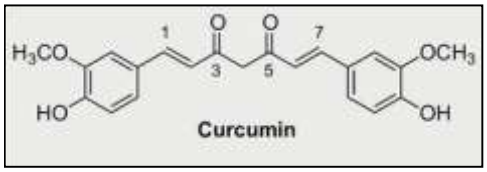


FIG. 9

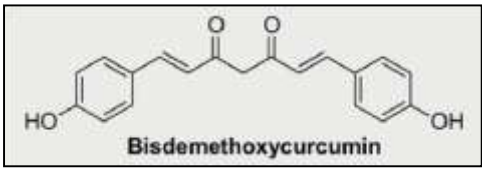


FIG. 10

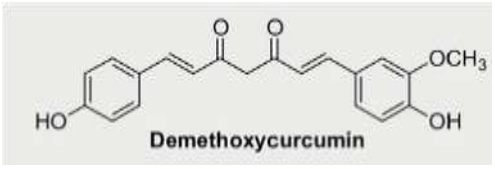


FIG. 11

TABLE NO. 2

Phytoconstituent	Plant source	Description
Sitoindoside	*Withania somnifera*	Used in inflammation and arthritis
Withaferin A and withanolide D	*W. somnifera*	Alkaloid used in arthritis
Bartogenic acid	*Barringtonia racemosa*	Used in inflammation and arthritis
Quercetin	*Cordiospermum halicacabum*	Used in inflammation and arthritis
β-Boswellic acid	*Boswellia serrata*	Used in inflammation and arthritis; Reduced breakdown of glycosamino glycans
Piperine	*Piper nigrum*	Natural alkaloid having activity in arthritis

TABLE NO. 3

Phytoconstituent	Plant source	Description
Sinomenine	*Sinomenium acutum*	Used in rheumatoid arthritis
Cardamonin	*Boesenbergia rotunda*	Used in inflammation and arthritis
Epigallocatechin	*Camellia sinensis*	Polyphenol used in arthritis
Mangostin	*Garcinia mangostana*	Natural xanthonoid used in inflammation and arthritis

Advances in Herbal Drug Delivery

1. Emulgels

Combination of emulsion and gel systems.
Enhance penetration, provide non-greasy texture.
Example: Boswellia + Ginger herbal emulgel.

2. Nanoparticles

Increase solubility and absorption of poorly soluble phytoconstituents like curcumin. Allow targeted delivery to inflamed joints.

3. Phytosomes

Complex of herbal extract and phospholipids.
Example: Curcumin phytosomes with higher oral bioavailability [13].

4. Transdermal Patches

Provide controlled release of herbal actives. Improve patient compliance.

5.Nanoemulsions and Liposomes

Enhance stability and absorption of herbal drugs.
Protect thermolabile compounds from degradation

TABLE NO. 4 : Benefits of Herbal Drugs over Conventional Drugs

Parameter	Herbal Drugs	Conventional Drugs
Mechanism of Action	Multi-targeted action including anti-inflammatory, antioxidant, immunomodulatory, and cartilage-protective effects	Usually acts through a single or specific pathway such as COX inhibition, immunosuppression, or TNF/IL blockade
Safety Profile	Generally associated with fewer gastrointestinal, renal, and hepatic adverse effects when standardized and used appropriately; considered safer for long-term use	Long-term use may lead to ulcers, gastrointestinal bleeding, hepatotoxicity, nephrotoxicity, osteoporosis, and other adverse effects
Tolerance	Better tolerated during chronic administration (e.g., formulations containing turmeric, Boswellia, or Ashwagandha)	Often poorly tolerated during prolonged therapy due to cumulative adverse effects [14]
Holistic Balance	Supports overall immunity, vitality, metabolism, and associated comorbid conditions along with disease management	Primarily focuses on symptomatic or disease-specific treatment; may produce systemic side effects
Drug–Drug Interaction	Comparatively fewer interactions when standardized formulations are used under supervision	Higher potential for interactions, especially with DMARDs, corticosteroids, NSAIDs, and biologics
Cost Effectiveness	Relatively affordable and accessible, particularly in resource-limited settings	Expensive, especially biologics and long-term DMARD therapy
Patient Acceptability	High patient acceptability due to natural origin and perceived safety	Moderate acceptability because of concerns regarding adverse effects, dependency, and long-term toxicity [15]

Role of Standardization &Quality Control

- Lack of uniformity in herbal drug preparations may result in variable therapeutic efficacy and inconsistent clinical outcomes.
- Need for standardization of herbal formulations to ensure quality, safety, and reproducibility.
- Identification and authentication of raw materials are essential to avoid adulteration and contamination.
- Use of standard phytochemical markers such as curcumin and boswellic acids helps maintain consistency in herbal products.
- Adherence to pharmacopeial standards including the Ayurvedic Pharmacopoeia of India (API), World Health Organization guidelines, and Ministry of AYUSH regulations is necessary for quality assurance [16].
- Application of advanced quality control techniques such as HPTLC, HPLC, GC-MS, and DNA fingerprinting improves standardization and authentication.
- Proper standardization ensures product safety, batch-to-batch reproducibility, therapeutic reliability, and enhanced patient trust.

5. CLINICAL EVIDENCE

Case Study A: Curcumin Phytosome (Meriva®) in Osteoarthritis

Design: Prospective randomized clinical trial.

Dose: 500 mg tablets twice daily (1 g/day delivering ~200 mg curcuminoids).

TABLE NO. 5

Observation (Median Decrease After Eight Months)	Treatment Group	Control Group
Decrease in Gastrointestinal Complications	63.4%	8%
Decrease in Management Costs	63.5%	3.7%

Results:

Improved WOMAC and Karnofsky scores.

Reduced use of NSAIDs.

Lowered CRP and ESR levels. No major adverse events.

Conclusion: Curcumin phytosome provides effective and safe OA management.

Case Study B: Boswellia serrata Nano-Emulgel

Design: Preclinical + in vitro diffusion + in vivo animal studies.

Formulation: 5% Boswellia serrata extract in carbopol-based nanoemulgel.

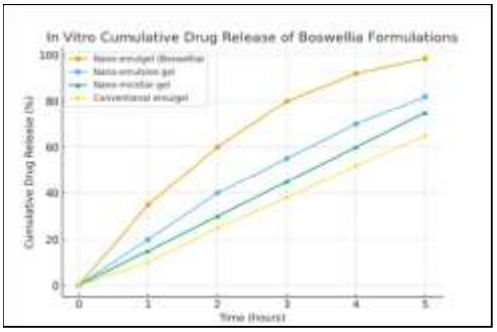


FIG. 12

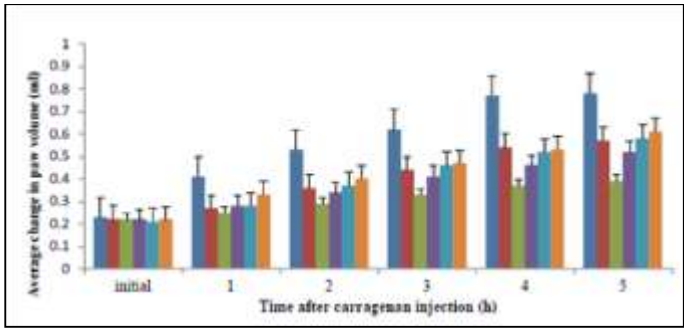


FIG. 13

Results:

~98.5% in-vitro permeation in 5 h.

Superior anti-inflammatory and analgesic effect.

Comparable or better efficacy than diclofenac in some assays [17].

Conclusion: Nano-emulgel offers enhanced local delivery and therapeutic effect

6. FUTURE PROSPECTS:

- Integration of herbal medicines with nanotechnology to enhance solubility, bioavailability, targeted delivery, and therapeutic efficacy.
- Development of novel nanoformulations such as liposomes, phytosomes, polymeric nanoparticles, and nanoemulsions for herbal drugs.
- Need for more randomized controlled clinical trials to establish scientific evidence, safety, and global acceptance of herbal therapies.
- Advancement of personalized phytomedicine approaches based on genetic, metabolic, and disease-specific patient profiles.
- Encouragement of public–private partnerships to promote translational research and commercialization of evidence-based herbal products.
- Strengthening regulatory frameworks and international standardization guidelines for herbal medicines.
- Application of artificial intelligence and machine learning in herbal drug discovery, formulation optimization, and prediction of therapeutic outcomes.
- Increased focus on sustainable sourcing, cultivation, and conservation of medicinal plants for long-term healthcare applications [18,19].

CONCLUSION

Both synthetic and herbal medicines have roles in arthritis therapy. However, the chronic nature of arthritis necessitates safer long-term strategies. Herbal medicines, supported by traditional wisdom and modern clinical validation, provide effective symptom relief and disease modification. Novel delivery systems such as phytosomes and nanoemulgels further enhance their therapeutic profile. Bridging traditional knowledge with

scientific rigor can revolutionize arthritis management and improve patient quality of life.

CONFLICT OF INTEREST:The authors have no conflicts of interest.

REFERENCES

1. Stefan Grässel, Dominik Muschter. Recent advances in the treatment of osteoarthritis. F1000Res.2020;9:325.
2. Daniel H. Solomon, Husni ME, Wolski KE, Wisniewski LM, Borer JS, Graham DY, Libby P, Lincoff AM, Lüscher TF, Menon V, et al. Differences in safety of nonsteroidal anti-inflammatory drugs in patients with osteoarthritis and rheumatoid arthritis. Arthritis Rheumatol. 2018;70(4):537–546.
3. Ahmed KSZ, Ahmed SSZ, Thangakumar A, Krishnaveni R. Therapeutic effect of Parmotrema tinctorum against complete Freund's adjuvant-induced arthritis in rats and identification of novel isophthalic ester derivative. Biomed Pharmacother.2019;112:108646.
4. Shahin Ahmed. Green tea polyphenol epigallocatechin-3-gallate in arthritis: progress and promise. Arthritis Res Ther. 2010;12(2):208.
5. Ahmed S, Anuntiyo J, Malemud CJ, Haqqi TM. Biological basis for the use of botanicals in osteoarthritis and rheumatoid arthritis: A review. J Evid Based Complement Altern Med. 2005;2(3):301–308.
6. Ali Mobasheri. Intersection of inflammation and herbal medicine in the treatment of osteoarthritis. Curr Rheumatol Rep. 2012;14(6):604–616.
7. Henrotin Y, Lambert C, Couchourel D, Ripoll C, Chiotelli E. Nutraceuticals: Do they represent a new era in the management of osteoarthritis? A narrative review from the lessons taken with five products.Osteoarthritis Cartilage. 2011;19(1):1–21.
8. Sengupta K, Alluri KV, Satish AR, et al. A double-blind, randomized, placebo-controlled study of the efficacy and safety of 5-Loxin® for treatment of osteoarthritis of the knee. Arthritis Res Ther. 2008;10(4):R85.
9. Haroyan A, Mukuchyan V, Mkrtchyan N, et al. Efficacy and safety of curcumin and Boswellia combination in osteoarthritis management. BMC Complement Altern Med.2018;18:7.
10. Daily JW, Yang M, Park S. Efficacy of turmeric extracts and curcumin for alleviating symptoms of joint arthritis: A systematic review and meta-analysis of randomized clinical trials. J Med Food. 2016;19(8):717–729.
11. Chandran B, Goel A. A randomized, pilot study to assess the efficacy and safety of curcumin in patients with active rheumatoid arthritis. Phytother Res. 2012;26(11):1719–1725.
12. Gupta SC, Patchva S, Aggarwal BB. Therapeutic roles of curcumin: Lessons learned from clinical trials. AAPS J. 2013;15(1):195–218.
13. Bannuru RR, Osani MC, Vaysbrot EE, et al. OARSI guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. Osteoarthritis Cartilage. 2019;27(11):1578–1589.
14. Smolen JS, Aletaha D, McInnes IB. Rheumatoid arthritis. Lancet. 2016;388(10055):2023–2038.
15. Firestein GS, McInnes IB. Immunopathogenesis of rheumatoid arthritis. Immunity. 2017;46(2):183–196.
16. Kocaadam B, Şanlier N. Curcumin, an active component of turmeric (Curcuma longa), and

its effects on health. Crit Rev Food Sci Nutr. 2017;57(13):2889–2895.
17. Ammon HP. Boswellic acids in chronic inflammatory diseases. Planta Med. 2006;72(12):1100–1116.
18. Ernst E. Herbal remedies for inflammatory disorders. Clin Rheumatol. 2002;21(6):467–473.
19. World Health Organization. WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems. Geneva: WHO; 2004.

HOW TO CITE: Ashish Manwani, Savi Nilawar, Amit Pawar, Pranchi Shethia, Nikhil Rajnani, Nalini Kurup Targeting Arthritis Through Phytomedicine: Mechanistic Understanding and Clinical Evidence, Int. J. of Pharm. Sci., 2026, Vol 4, Issue 6, 4705-4713, https://doi.org/10.5281/zenodo.20748817