

**FORMULATION AND EVALUATION OF POLYHERBAL OIL FOR THE
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ABSTRACT

Rheumatoid arthritis (RA) is a chronic, systemic, inflammatory autoimmune disease that primarily affects synovial joints and progressively leads to cartilage destruction, bone erosion, deformity, disability, and reduction in quality of life. It is one of the most common inflammatory arthropathies worldwide, affecting nearly 0.5–1% of the global population. RA is more prevalent in women and commonly appears between 30–60 years of age. Modern treatment of RA includes non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, disease-modifying anti-rheumatic drugs (DMARDs), and biological agents. Although effective, these medications are associated with numerous adverse effects such as gastric ulcers, hepatotoxicity, nephrotoxicity, osteoporosis, infections, and immunosuppression. Traditional systems of medicine such as Ayurveda, Unani, and Siddha offer holistic therapeutic strategies for RA. Ayurveda correlates RA with **Amavata**, Unani describes it as **Waja-ul-Mafasil**, and Siddha recognizes it under **Azhal Keelvayu / Vatha disorders**. These systems emphasize correction of body imbalance, detoxification, use of herbs, dietary regulation, external therapies, and rejuvenation. Polyherbal formulations have emerged as an important therapeutic approach because of synergistic effects, multi-target mechanisms, better efficacy, lower toxicity, and long-term safety. Herbs such as **Boswellia serrata**, **Curcuma longa**, **Withania somnifera**, **Tinospora cordifolia**, **Zingiber officinale**, **Colchicum luteum**, **Rasna**, **Amukkara**, and many others are traditionally used. This review provides a highly detailed account of RA pathogenesis, clinical manifestations, diagnosis, treatment limitations, Ayurvedic-Unani-Siddha concepts, medicinal herbs, classical formulations, marketed products, dosage forms, mechanisms of action, scientific validation, and future prospects.

KEYWORDS: Polyherbal oil, Rheumatoid arthritis, Herbal medicine, Anti-inflammatory plants, *Boswellia serrata*, *Withania somnifera*, *Vitex negundo*, *Zingiber officinale*.**❖ INTRODUCTION**

Rheumatoid arthritis (RA) is a chronic, progressive, and systemic autoimmune disorder that primarily affects the synovial joints of the body. It is one of the most common inflammatory joint diseases and is characterized by persistent pain, swelling, stiffness, and gradual destruction of joint structures. Unlike osteoarthritis, which mainly occurs due to wear and tear of cartilage with age, rheumatoid arthritis develops because the

body's immune system mistakenly attacks its own healthy joint tissues. This abnormal immune response causes continuous inflammation in the synovial membrane, leading to joint damage and functional disability if left untreated.

The disease usually begins slowly and may initially present with mild symptoms such as fatigue, body aches, low-grade fever, or stiffness in small joints of the hands

and feet. Over time, inflammation becomes more severe and spreads to multiple joints in a symmetrical pattern, meaning both sides of the body are affected equally. Morning stiffness lasting for more than one hour is considered a classic symptom of rheumatoid arthritis. Patients often find it difficult to perform routine daily activities such as holding objects, walking, climbing stairs, or writing due to pain and reduced joint mobility.

Rheumatoid arthritis is not only limited to the joints but is considered a systemic disease because it can affect several organs and tissues throughout the body. In advanced or uncontrolled cases, complications may involve the heart, lungs, eyes, skin, blood vessels, and nervous system. Long-term inflammation may also increase the risk of cardiovascular disease, osteoporosis, anemia, and fatigue-related disorders. Therefore, RA significantly impacts the physical, emotional, social, and economic well-being of affected individuals.

Globally, rheumatoid arthritis affects approximately 0.5% to 1% of the adult population, making it an important public health concern. It is more common in women than in men, with a female-to-male ratio of nearly 3:1. The disease most commonly develops between the ages of 30 and 60 years, although it can occur at any age, including childhood in the form of juvenile idiopathic arthritis. Genetic predisposition, environmental triggers, hormonal influences, smoking, infections, obesity, and stress are believed to contribute to the onset of the disease.

The exact cause of rheumatoid arthritis remains uncertain; however, modern scientific research has identified several immune and inflammatory pathways involved in its pathogenesis. The disease process begins with activation of immune cells such as T-lymphocytes and B-lymphocytes, which produce inflammatory mediators including tumor necrosis factor-alpha (TNF- α), interleukins (IL-1, IL-6), and other cytokines. These substances promote swelling, pain, and progressive destruction of cartilage and bone. The inflamed synovial tissue proliferates abnormally to form pannus, a destructive granulation tissue that invades nearby cartilage and bone, eventually causing deformity and loss of joint function.

Diagnosis of rheumatoid arthritis is based on clinical examination, laboratory investigations, and imaging techniques. Common diagnostic markers include rheumatoid factor (RF), anti-cyclic citrullinated peptide antibodies (Anti-CCP), elevated erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP). X-rays, ultrasound, and magnetic resonance imaging (MRI) are useful for detecting joint erosion and inflammation. Early diagnosis is extremely important because prompt treatment can slow disease progression and prevent irreversible joint damage.

Modern treatment of rheumatoid arthritis includes non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, disease-modifying anti-rheumatic drugs (DMARDs), and biological agents. These medicines are effective in controlling symptoms and suppressing inflammation; however, long-term use is often associated with adverse effects such as gastric irritation, liver damage, kidney toxicity, immunosuppression, infections, and high treatment cost. In many patients, complete remission is not always achieved, and lifelong therapy may be required.

Due to these limitations, there has been increasing interest in complementary and alternative systems of medicine, especially traditional herbal therapies. Systems such as Ayurveda, Unani, and Siddha have described conditions similar to rheumatoid arthritis centuries ago and offer holistic approaches based on body constitution, detoxification, dietary management, herbal medicines, external therapies, and lifestyle correction. In Ayurveda, rheumatoid arthritis is correlated with **Amavata**, in Unani it is referred to as **Waja-ul-Mafasil**, and in Siddha it resembles **Azhal Keelvayu** or related Vatha disorders. These systems focus not only on symptom relief but also on correcting the underlying imbalance believed to cause disease.

Among various traditional approaches, polyherbal formulations have gained significant attention because they combine multiple medicinal plants to produce synergistic therapeutic effects. Such formulations may provide anti-inflammatory, analgesic, antioxidant, immunomodulatory, and rejuvenating actions simultaneously. Herbs like *Boswellia serrata*, *Curcuma longa*, *Withania somnifera*, *Tinospora cordifolia*, and *Zingiber officinale* are widely recognized for their beneficial role in joint disorders. Polyherbal medicines are available in several dosage forms including tablets, capsules, powders, decoctions, oils, and topical gels.

In the present era, there is a growing need to integrate traditional knowledge with modern scientific validation. Detailed research on herbal medicines, standardization of formulations, toxicity evaluation, and clinical trials are essential to establish their efficacy and safety. Therefore, a comprehensive review of rheumatoid arthritis from the perspectives of Ayurveda, Unani, Siddha, and polyherbal therapeutics is highly relevant for developing safer, affordable, and effective long-term management strategies.

Ayurveda, Siddha and Unani Systems: Herbs and Drugs Used for the Treatment of Rheumatoid Arthritis

Rheumatoid arthritis is a chronic autoimmune inflammatory disorder that causes pain, swelling, stiffness, and gradual destruction of joints. Since it is a long-term disease that often requires prolonged treatment, many patients seek safer and holistic alternatives in traditional systems of medicine. Ayurveda,

Siddha, and Unani systems have described conditions similar to rheumatoid arthritis and have used medicinal plants, mineral preparations, oils, decoctions, and polyherbal formulations for centuries. These systems focus not only on reducing pain and inflammation but also on correcting the internal imbalance believed to be the root cause of disease.

1. AYURVEDA SYSTEM

In Ayurveda, rheumatoid arthritis is correlated with **Amavata**. The term *Ama* refers to toxic, improperly digested metabolic waste, while *Vata* is one of the three doshas responsible for movement and pain. According to Ayurveda, when *Ama* accumulates in the body and combines with aggravated *Vata*, it gets deposited in joints causing pain, swelling, stiffness, heaviness, and loss of movement.

Treatment of Amavata involves

- Digestion of *Ama* (Deepana-Pachana)
- Removal of toxins (Shodhana)
- Balancing *Vata* dosha
- Reducing pain and inflammation
- Strengthening joints and tissues

Important Ayurvedic Herbs Used in Rheumatoid Arthritis

1. Ashwagandha (*Withania somnifera*)

Ashwagandha is one of the most important rejuvenating herbs in Ayurveda. It possesses anti-inflammatory, adaptogenic, and immunomodulatory properties. It helps reduce joint pain, weakness, fatigue, and stress associated with chronic arthritis. It is commonly used in powder, tablet, and capsule form.

2. Shallaki (*Boswellia serrata*)

Shallaki is widely used in arthritis due to its strong anti-inflammatory action. It contains boswellic acids which help inhibit inflammatory mediators. It reduces joint swelling, pain, and stiffness while improving mobility.

3. Haridra (*Curcuma longa*)

Turmeric is a powerful anti-inflammatory herb. Curcumin, its active constituent, helps suppress inflammatory pathways. It is used for reducing pain, swelling, and oxidative stress.

4. Guduchi (*Tinospora cordifolia*)

Guduchi is considered an excellent immune-modulating herb. It helps improve digestion, remove toxins, and reduce chronic inflammation.

5. Rasna (*Pluchea lanceolata*)

Rasna is especially useful in musculoskeletal disorders and *Vata* diseases. It helps relieve stiffness, pain, and restricted movement.

6. Ginger (*Zingiber officinale*)

Dry ginger and fresh ginger are used to improve digestion, remove *Ama*, and reduce pain and swelling.

7. Guggulu (*Commiphora mukul*)

Guggulu is one of the most important Ayurvedic anti-inflammatory resins used in chronic joint disorders. It is commonly included in many polyherbal tablets.

Ayurvedic Classical Drugs and Formulations

• Yogaraj Guggulu

Used in chronic joint pain, stiffness, and arthritis.

• Mahayograj Guggulu

A stronger preparation for severe and long-standing arthritis.

• Simhanada Guggulu

Used when *Ama* is prominent along with swelling and digestive weakness.

• Rasnadi Kwath / Rasna Saptak Kwath

Used for pain and *Vata* disorders.

• Dashmool Kwath

Useful for inflammation and generalized pain.

• Mahanarayan Taila

Medicated oil used externally for massage.

2. SIDDHA SYSTEM

In Siddha medicine, rheumatoid arthritis resembles conditions such as **Azhal Keelvayu**, **Vatha Keelvayu**, or other *Vatha* disorders. According to Siddha philosophy, disease occurs due to imbalance of three humors:

- Vatham
- Pitham
- Kapham

Joint diseases are mainly associated with aggravated *Vatham*.

Treatment focuses on

- Restoring humor balance
- Detoxification
- Reducing inflammation
- Improving mobility
- External oil therapies

Important Siddha Herbs Used in Rheumatoid Arthritis

1. Amukkara (*Withania somnifera*)

Used as a strengthening and anti-inflammatory herb. It improves stamina and relieves chronic pain.

2. Nilavembu (*Andrographis paniculata*)

Known for anti-inflammatory and immune-supportive properties.

3. Rasna

Used in pain, stiffness, and inflammatory joint conditions.

4. Kadukkai (Terminalia chebula)

Useful as a detoxifier and digestive corrector.

5. Sukku (Dry Ginger)

Used for pain, swelling, and digestive weakness.

6. Milagu (Black Pepper)

Improves circulation and enhances drug absorption.

7. Thippili (Piper longum)

Used for pain, metabolism correction, and bioavailability enhancement.

❖ **Siddha Drugs and Formulations****1) Amukkara Chooranam**

Powder preparation for weakness, arthritis, and pain.

2) Rasnadi Chooranam

Used in pain disorders and inflammatory conditions.

3) Vatha Kesari Thailam

External medicated oil used for massage in joint disorders.

4) Murivenna Type Oils

Used for inflammation and pain relief.

5) Parpam and Chendooram Preparations

Mineral-herbal formulations used under expert supervision.

3. UNANI SYSTEM

In Unani medicine, rheumatoid arthritis is commonly compared with **Waja-ul-Mafasil**, meaning pain of joints. It is believed to occur due to imbalance of bodily humors and accumulation of morbid matter in joints.

The four humors are

- Dam (Blood)
- Balgham (Phlegm)
- Safra (Yellow bile)
- Sauda (Black bile)

Treatment aims to:

- Remove morbid matter
- Correct temperament
- Reduce inflammation
- Improve circulation
- Restore joint function

Important Unani Herbs Used in Rheumatoid Arthritis**1. Suranjan (Colchicum luteum)**

One of the most famous Unani anti-arthritic drugs. It reduces inflammation and joint pain.

2. Asgandh (Withania somnifera)

Used for strengthening muscles and joints.

3. Zanjabeel (Ginger)

Used as anti-inflammatory and analgesic.

4. Filfil Siyah (Black Pepper)

Improves circulation and enhances efficacy of formulations.

5. Haldi (Turmeric)

Used for chronic inflammation and swelling.

6. Sana Makki

Used for cleansing and detoxification.

7. Roghan-e-Zaitoon (Olive oil)

Used externally for massage.

❖ **Unani Formulations****1) Majoon Suranjan**

Classical semi-solid preparation used in arthritis and gout.

2) Habb-e-Suranjan

Tablet form used for pain and swelling.

3) Roghan-e-Ajaib

Medicated oil for massage and external application.

4) Jawarish Preparations

Improve digestion and metabolism.

COMMON HERBS USED IN ALL THREE SYSTEMS

Some medicinal plants are common across Ayurveda, Siddha, and Unani systems due to their proven therapeutic value.

Herb	Common Use
Ashwagandha	Strengthening, anti-inflammatory
Ginger	Pain relief, digestion
Turmeric	Anti-inflammatory
Black Pepper	Improves absorption
Boswellia	Joint pain and swelling
Rasna	Stiffness and pain

❖ **DOSAGE FORMS USED**

Traditional medicines are available in multiple dosage forms:

Internal Use

- Tablets
- Capsules
- Churna (powder)
- Decoction (Kwath/Kashayam)
- Syrup
- Semi-solid preparations (Majoon)

External Use

- Oils
- Liniments

- Ointments
- Poultices
- Paste applications

Polyherbal Formulations Used Overall in the Treatment of Rheumatoid Arthritis

Polyherbal formulations play a significant role in the management of rheumatoid arthritis (RA) across traditional systems of medicine such as Ayurveda, Siddha, and Unani. Rheumatoid arthritis is a complex autoimmune and inflammatory disorder involving multiple pathological mechanisms such as chronic inflammation, pain, immune dysfunction, oxidative stress, stiffness, and progressive joint destruction. Because of this multi-factorial nature, treatment with a single herb may not always be sufficient. Therefore, combinations of several medicinal herbs are commonly used to provide synergistic and broader therapeutic effects.

Polyherbal formulations are preparations containing two or more medicinal herbs in carefully selected proportions. These combinations are designed to enhance efficacy, reduce toxicity, improve absorption, and target multiple symptoms simultaneously. In rheumatoid arthritis, polyherbal medicines are used to reduce pain, inflammation, swelling, morning stiffness, restricted movement, fatigue, and tissue degeneration. They are available in several dosage forms such as tablets, capsules, powders, decoctions, oils, liniments, ointments, and medicated ghees.

➤ IMPORTANCE OF POLYHERBAL FORMULATIONS IN RA

Rheumatoid arthritis involves

- Persistent joint inflammation
- Autoimmune reaction

- Synovial swelling
- Oxidative damage
- Cartilage destruction
- Pain and stiffness
- Weakness and fatigue

Since many mechanisms are involved, polyherbal therapy offers advantages over single-herb therapy.

Benefits of Polyherbal Therapy

- Synergistic therapeutic effect
- Multi-target action
- Lower required dose of each herb
- Reduced adverse effects
- Improved patient tolerance
- Better chronic disease management
- Long-term safety potential

🌿 SCIENTIFIC BASIS OF POLYHERBAL FORMULATIONS

Polyherbal formulations work through multiple pathways

1. Anti-inflammatory

Reduce TNF-alpha, IL-1, IL-6

2. Analgesic

Decrease pain mediators

3. Antioxidant

Neutralize free radicals

4. Immunomodulatory

Regulate autoimmune activity

5. Chondroprotective

Protect cartilage

Polyherbal Formulations Used in Rheumatoid Arthritis

Sr. No.	Formulation Name	System of Medicine	Major Ingredients	Dosage Form	Main Uses in Rheumatoid Arthritis
1	Yogaraj Guggulu	Ayurveda	Guggulu, Pippali, Chitrak, Ginger, Triphala	Tablet	Joint pain, stiffness, inflammation
2	Mahayograj Guggulu	Ayurveda	Guggulu, Metallic Bhasma, Trikatu, Triphala	Tablet	Chronic RA, severe pain, weakness
3	Simhanada Guggulu	Ayurveda	Guggulu, Castor oil, Triphala, Sulfur	Tablet	Ama-related arthritis, swelling
4	Rasna Saptak Kwath	Ayurveda	Rasna, Guduchi, Eranda, Punarnava	Decoction	Pain, stiffness, inflammation
5	Dashmool Kwath	Ayurveda	Ten medicinal roots	Decoction	Swelling, body pain, Vata disorders
6	Mahanarayan Taila	Ayurveda	Sesame oil, Ashwagandha, Bala, Dashmool	Oil	External pain relief, stiffness
7	Amukkara Chooranam	Siddha	Amukkara, Sukku, Milagu, Thippili	Powder	Weakness, joint pain
8	Rasnadi Chooranam	Siddha	Rasna, Dry ginger, Pepper	Powder	Arthritis pain, stiffness
9	Vatha Kesari Thailam	Siddha	Herbal oils, camphor, roots extracts	Oil	External massage, pain relief

10	Nilavembu Kudineer Combo	Siddha	Nilavembu, Ginger, Pepper, Kadukkai	Decoction	Inflammation, immune support
11	Majoon Suranjan	Unani	Suranjan, Asgandh, Ginger, Pepper	Semi-solid paste	RA, gout, swelling
12	Habb-e-Suranjan	Unani	Suranjan, herbal extracts	Tablet	Joint pain, stiffness
13	Roghan-e-Ajaib	Unani	Herbal oils, camphor	Oil	Massage, pain relief
14	Jawarish Formulations	Unani	Digestive herbs	Semi-solid	Correct metabolism, Ama-like symptoms
15	Rumalaya Forte	Proprietary Herbal	Boswellia, Guggulu, Licorice	Tablet	Joint pain, inflammation
16	Rumalaya Gel	Proprietary Herbal	Menthol, Boswellia, Ginger	Gel	Local pain relief
17	Shallaki Tablets	Proprietary Herbal	Boswellia serrata extract	Tablet	Swelling, mobility improvement
18	Joint Care Capsules	Proprietary Herbal	Turmeric, Ashwagandha, Boswellia, Ginger	Capsule	Chronic arthritis support
19	Ortho Oil	Proprietary Herbal	Sesame oil, Garlic, Ginger, Camphor	Oil	Massage, stiffness relief
20	Arthrella Tablets	Proprietary Herbal	Turmeric, Boswellia, Ashwagandha	Tablet	Pain and inflammation

❖ Evidence on Specific Medicinal Herbs

Boswellia serrata

Several studies have investigated *Boswellia serrata* for arthritis. *Boswellia* exhibits anti-inflammatory activity by inhibiting 5-lipoxygenase pathways, reducing leukotrienes, matrix metalloproteinases, nitric oxide, and cyclooxygenase-2. Clinical studies have shown improvement in pain and joint function in arthritic conditions.

Boswellia remains one of the most widely used herbs in Ayurvedic polyherbal anti-arthritic formulations.

Curcuma longa (Turmeric)

Curcumin, the major constituent of turmeric, has demonstrated anti-inflammatory action through suppression of NF- κ B signaling and inflammatory cytokines. Multiple reviews recognize curcumin as a promising supportive agent in RA for reducing pain, swelling, and oxidative stress.

Zingiber officinale (Ginger)

Ginger contains gingerols and shogaols which exhibit anti-inflammatory and analgesic effects. Literature suggests that ginger may help reduce joint pain and improve mobility when used as part of multi-herbal therapy.

Ashwagandha (Withania somnifera)

Ashwagandha has been widely discussed for its adaptogenic and immunomodulatory effects. It may help improve fatigue, weakness, and chronic inflammatory symptoms in RA patients.

Polyherbal Formulations in Traditional Systems

Ayurveda

Ayurvedic medicine correlates RA with *Amavata*, caused by accumulation of *Ama* and vitiation of *Vata dosha*.

Classical formulations such as *Yogaraj Guggulu*, *Mahayograj Guggulu*, *Simhanada Guggulu*, *Rasna Saptak Kwath*, and *Mahanarayan Taila* are extensively used for pain, stiffness, and swelling.

These formulations combine herbs such as *Guggulu*, *Ginger*, *Rasna*, *Castor oil*, *Guduchi*, and *Triphala* to provide multi-dimensional benefits.

Siddha

Siddha medicine considers RA under *Vatha* disorders such as *Azhal Keelvayu*. Common formulations include:

- *Amukkara Chooranam*
- *Rasnadi Chooranam*
- *Vatha Kesari Thailam*

These medicines aim to balance *Vatham*, improve circulation, and reduce chronic pain.

Unani

In Unani medicine, RA resembles *Waja-ul-Mafasil*. Classical formulations include:

- *Majoon Suranjan*
- *Habb-e-Suranjan*
- *Roghan-e-Ajaib*

Suranjan (*Colchicum luteum*) is one of the principal anti-arthritic herbs used in Unani literature.

❖ Recent Advances in Polyherbal Delivery Systems

A 2025 study developed a transdermal polyherbal patch containing *Boswellia serrata*, *Curcuma longa*, *Ginger*, and *Piper nigrum* for rheumatoid arthritis management. The study used permeation enhancers and polymeric matrices to provide sustained anti-inflammatory action.

This demonstrates that traditional herbs can now be incorporated into modern dosage forms such as patches, gels, nanoparticles, and controlled-release systems.

Common Nanotechnology-Based Formulations for RA

Nanoformulation Type	Drug Commonly Loaded	Purpose
Liposomes	Methotrexate, Dexamethasone	Target inflamed joints and reduce toxicity
Polymeric nanoparticles	Curcumin, Boswellic acid	Sustained release and improved bioavailability
Nanoemulsions	NSAIDs, herbal oils	Better skin penetration and topical delivery
Solid lipid nanoparticles (SLN)	Aceclofenac, Diclofenac	Controlled release and stability
Nanostructured lipid carriers (NLC)	Curcumin, Ketoprofen	Enhanced anti-inflammatory action
Polymeric micelles	Methotrexate, corticosteroids	Improved solubility and targeting
Hydrogels with nanoparticles	Sinomenine, biologics	Localized sustained joint delivery
Gold/silver nanoparticles	Herbal extracts	Anti-inflammatory and antioxidant effects

Examples of Nano-Based RA Formulations Reported**Liposomal Methotrexate**

- Liposomes improve methotrexate targeting to inflamed synovial tissues.
- Reduce systemic toxicity and gastrointestinal side effects.

Curcumin Nanoparticles

- Curcumin has poor bioavailability normally.
- Nanoencapsulation increases absorption and anti-inflammatory action.

Nanoemulsion-Based Topical Gels

- Used for transdermal delivery of anti-inflammatory drugs and herbal oils.
- Improve penetration through skin and synovial tissue.

Targeted Liposomes

- Surface-modified liposomes target inflammatory receptors like CD44.
- Used for precise drug delivery to arthritic joints.

Intelligent Polymeric Micelles

- Stimuli-responsive micelles release drugs at inflamed joints where pH and ROS levels are altered.

Nanotechnology-Based Herbal Formulations

Herbal Compound	Nano System
Curcumin	Nanoparticles, liposomes
Boswellic acid	Lipid nanoparticles
Resveratrol	Polymeric nanoparticles
Ginsenoside	Multifunctional liposomes
Coenzyme Q10	Targeted nanoparticles

❖ Marketed or Clinically Used Nano-Related RA Products

Some advanced nano/liposomal systems used in inflammatory diseases and RA-related therapy include

Product	Technology	Status
Liposomal corticosteroid formulations	Liposomes	Clinical/research use
Nanoemulsion diclofenac gels	Nanoemulsion	Marketed topical products
PEGylated biologics	Nano-sized PEG technology	Approved
Liposomal dexamethasone	Nanoliposomes	Clinical studies

❖ Advantages of Nanotechnology in RA

Advantage	Benefit
Targeted delivery	Drug accumulates at inflamed joints
Reduced dose	Less systemic toxicity
Sustained release	Longer therapeutic action
Improved bioavailability	Better absorption of herbal compounds
Enhanced penetration	Better transdermal delivery
Reduced side effects	Safer chronic therapy

Evaluation Parameters for Nanotechnology-Based / Polyherbal Anti-Rheumatoid Formulations

1. Physical evaluation
2. Physicochemical evaluation
3. Nanoparticle characterization
4. Stability studies
5. Biological evaluation
6. Safety studies

1. Physical Evaluation

Parameter	Purpose
Colour	Visual appearance
Odour	Characteristic smell
Appearance	Homogeneity and clarity
Texture	Smoothness and consistency
Phase separation	Stability of emulsion/oil
Spreadability	Ease of topical application
Washability	Ease of removal from skin
Greasiness	Skin feel evaluation

2. Physicochemical Evaluation

Parameter	Significance
pH	Skin compatibility
Viscosity	Flow and spreadability
Specific gravity	Density determination
Refractive index	Purity and uniformity
Acid value	Free fatty acid content
Saponification value	Average molecular weight of fatty acids
Iodine value	Degree of unsaturation
Peroxide value	Oxidative rancidity
Moisture content	Stability and microbial growth
Drug content	Amount of active constituent
Conductivity	Emulsion characterization

3. Nanotechnology-Specific Evaluation Parameters

Parameter	Purpose
Particle size	Determines penetration and stability
Polydispersity index (PDI)	Uniformity of particle distribution
Zeta potential	Stability of nanoparticles
Entrapment efficiency	Amount of drug encapsulated
Surface morphology	Shape and structure
Drug release study	Sustained release pattern
In-vitro diffusion study	Skin permeation ability
TEM/SEM analysis	Microscopic characterization

4. Rheological Evaluation

Parameter	Importance
Flow property	Application behavior
Thixotropy	Structural recovery
Consistency index	Product stability
Shear stress	Spreading performance

5. Stability Studies

Study	Observation
Accelerated stability	Stability under stress conditions
Freeze-thaw cycle	Emulsion resistance
Centrifugation test	Phase separation tendency
Temperature stability	Heat resistance
Photostability	Light sensitivity

6. In-Vitro Evaluation

Test	Purpose
Diffusion study	Drug permeation
Release kinetics	Drug release pattern
Skin irritation test	Safety on skin
Anti-oxidant activity	Free radical scavenging

In-Vivo Evaluation for Rheumatoid Arthritis

Animal Model	Purpose
Paw edema model	Anti-inflammatory activity
CFA-induced arthritis	Rheumatoid arthritis model
Formaldehyde-induced arthritis	Chronic inflammation
Freund's Complete Adjuvant model	Joint destruction studies

8. Microbiological Evaluation

Parameter	Purpose
Total microbial count	Product safety
Fungal count	Contamination check
Preservative efficacy	Shelf-life support

CONCLUSION**Main Outcomes**

The present review on the formulation and evaluation of polyherbal oil for Rheumatoid Arthritis highlights that rheumatoid arthritis is a complex, chronic autoimmune disorder involving persistent synovial inflammation, cytokine overproduction, oxidative stress, and progressive joint destruction. Traditional systems such as Ayurveda, Siddha, and Unani provide effective holistic approaches using polyherbal combinations with anti-inflammatory, analgesic, antioxidant, and immunomodulatory properties.

Key medicinal plants such as *Boswellia serrata*, *Curcuma longa*, *Withania somnifera*, and *Zingiber officinale* demonstrated significant therapeutic potential through inhibition of inflammatory mediators (TNF- α , IL-1, IL-6), suppression of COX and LOX pathways, and reduction of oxidative stress. Polyherbal oils, especially in topical form, showed advantages such as localized action, improved patient compliance, reduced systemic side effects, and enhanced mobility in arthritic conditions.

Furthermore, advancement in formulation technologies such as nanoemulsions, liposomes, and lipid-based carriers has significantly improved the penetration, stability, and bioavailability of herbal constituents, making them more effective in managing chronic inflammatory diseases.

Research Gap

Despite promising results from traditional and experimental studies, several research gaps still exist:

- Limited large-scale clinical trials validating polyherbal formulations in rheumatoid arthritis
- Lack of standardized preparation methods and quality control parameters for herbal oils
- Insufficient pharmacokinetic and pharmacodynamic studies of multi-herb combinations
- Inadequate toxicity and long-term safety data for chronic use
- Limited integration of nanotechnology with traditional herbal systems in clinical practice
- Variability in herbal composition leading to inconsistent therapeutic outcomes

These gaps highlight the need for more structured, evidence-based research to establish reproducibility and clinical reliability.

Future Recommendations

Future research should focus on:

- Development of standardized and validated polyherbal formulations with defined active markers
- Integration of nanotechnology-based delivery systems to enhance penetration and efficacy
- Conducting well-designed preclinical and clinical trials to establish safety and efficacy
- Advanced characterization techniques such as HPLC, GC-MS, and LC-MS for quality assurance
- Exploration of targeted drug delivery systems for site-specific action in inflamed joints
- Development of stable, cost-effective, and patient-friendly topical formulations such as nanoemulsion oils and transdermal systems
- Bridging traditional knowledge with modern pharmacological science for evidence-based herbal therapeutics

In conclusion, polyherbal oil formulations represent a promising complementary therapeutic strategy for the management of rheumatoid arthritis by offering multi-targeted action with improved safety and efficacy. With proper standardization, scientific validation, and advanced formulation techniques, these herbal systems have the potential to become reliable alternatives or adjuncts to conventional therapy in the future management of chronic inflammatory joint disorders.

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