



Review Paper

NATURAL PRODUCTS IN RHEUMATOID ARTHRITIS MANAGEMENT: HERBAL THERAPEUTIC APPROACHES

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ABSTRACT

Introduction: Rheumatoid arthritis (RA) is a chronic autoimmune disease that cause severe pain, joint deformity, and functional disability, affects more than 1% of individuals globally. Despite their effectiveness, traditional therapy like biologics and DMARDs are frequently constrained by adverse effects, poor response, and high cost. Consequently, interest in alternative and supplemental herbal therapies has grown significantly.

Methods: According to data from clinical trials, systematic reviews, and experimental research, this study offers a detailed evaluation of the effectiveness, safety and mechanisms of action of herbal remedies used in rheumatoid arthritis. Among the herbs that were critically examined were *Curcuma longa* *turmeric), *Boswellia serrata*, *Zingiber officinale* (ginger), *Camellia sinensis* (green tea), *Uncaria tomentosa* (cat's claw), and *Tripterygium wilfordii* (Thunder God Vine).

Results: Research data shows that these herbal remedies have significant antioxidant, immunomodulatory, and anti-inflammatory properties. Clinical research indicates improvement in disease symptoms such as joint pain, swelling, and stiffness in the morning. Certain herbal remedies exhibit therapeutic effects similar to those of nonsteroidal anti-inflammatory drugs (NSAIDs) but with a better tolerability profile. Many of these herbs affect inflammatory processes by modulating pathway such as cyclooxygenase-2 (Cox-2), nuclear factor kappa b (NF-kB), and cytokine mediated signalling, according to mechanistic studies. However, several issues still exist, such as inconsistent product quality, the possibility of herb- drug interactions, and the lack of standardized formulations. While the majority of herbal remedies have shown acceptable safety profiles, *Tripterygium wilfordii* requires careful monitoring because of its toxicity.

Discussion: When used in combination with traditional therapy for rheumatoid arthritis (RA), herbal medicines may provide additional therapeutic effects that could enhance overall disease management and improve clinical outcomes. However, there are still insufficient data to justify its general incorporation in to standard clinical practice. To prove their long-term safety, identify the best dosage schedules, and elucidate any possible interactions with frequently prescribed antirheumatic drugs, more carefully planned, extensive randomized controlled trials are required.

Conclusion: Owing to their various pharmacological effects such as anti-inflammatory, immunomodulatory and anti-oxidant properties, herbal therapies are a promising approach for the management of rheumatoid arthritis (RA). There is more preclinical and clinical data to suggest that these natural remedies may help with symptoms relief and better illness management. However, extreme quality control, standardized formulations and comprehensive regulatory control are necessary to ensure their safety, efficacy and consistency before they can be commonly used in conventional clinical applications. To maximize therapeutic results & lessen the risk associated with incorrect use or herb-drug interactions, medical experts should also monitor herbal medicines.

Keywords: Rheumatoid arthritis (RA), Autoimmune disease, Herbal medicine, Anti-oxidant, Anti-inflammatory, Immunomodulation, Cytokine, Herb-Drug interaction.

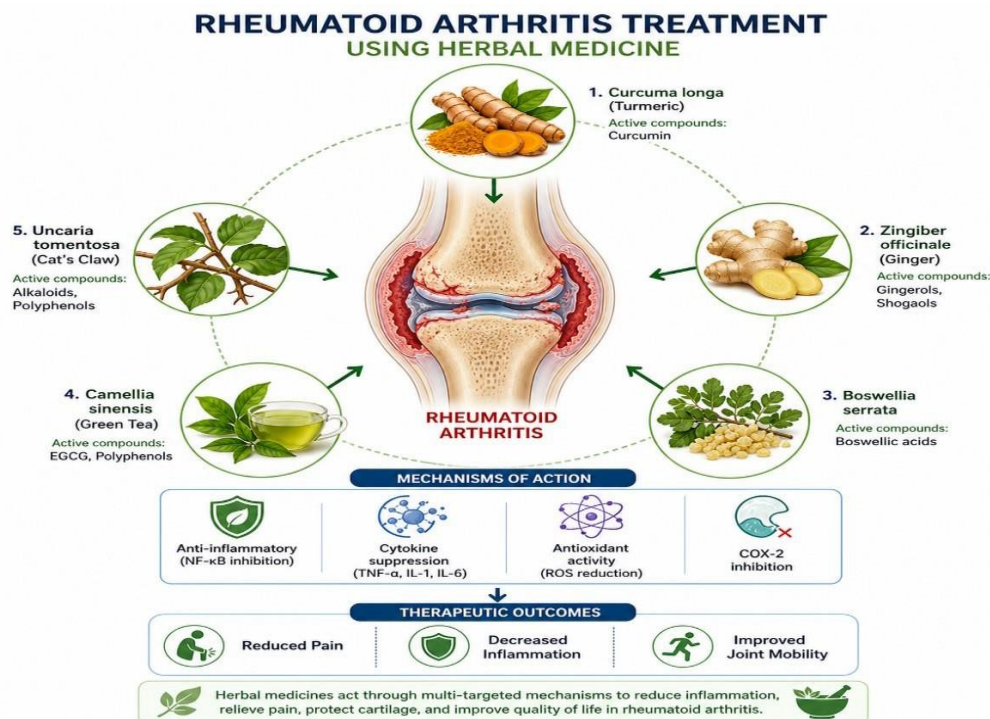
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Graphical Abstract



I. INTRODUCTION

1.1 Overview of Rheumatoid Arthritis (RA)

Rheumatoid arthritis (RA) is a chronic systemic autoimmune disease that causes continuous joint deterioration, pain stiffness & functional impairment by activating the synovial membranes [1-2]. About 0.5-1% of adults globally suffer from RA, which significantly lowers quality of life and increases morbidity and death rates due to systemic effects such as interstitial lung disease, osteoporosis and cardiovascular disease [3-4]. Rheumatoid factor and citrulline antibody production, immune dysregulation and chronic inflammation caused by pro-inflammatory mediators like TNF- α , IL-1 and IL-6 are all part of the complex pathogenesis of RA, which also involves susceptibility to genes and environmental factors [5-6]. Early diagnosis and intensive therapy are crucial to improve future prospects and prevent life-threatening joint injuries [7].

1.2 Limitation of Conventional Rheumatoid Arthritis Therapies

The most common treatment for rheumatoid arthritis (RA) is disease-modifying antirheumatic drugs (DMARDs). These include biologic DMARDs, such as tumor necrosis factor (TNF) inhibitors, interleukin -6 (IL-6) receptor antagonists, and T-cell co-stimulation modulators and conventional synthetic DMARDs such as methotrexate, sulfasalazine, and hydroxychloroquine [8-9]. These therapies have considerably improved disease management; however, many patients have an inadequate response to therapy or a decrease in efficacy over time, requiring a rise in dose or change of therapy [10-11]. In addition, DMARDs can cause adverse effects including

gastrointestinal toxicity, hepatotoxicity, myelosuppression & increased risk of infections, particularly with biologic agents [12-13]. Furthermore, the high cost of biologic DMARDs further reduce their availability, particularly in resource -limited environment [14]. These limitations highlight the ongoing need for supplementary or alternative therapeutic approaches that can increase effectiveness, lessen side effects or provide healthier choices [15].

1.3 Rationale for Exploring Herbal Treatments

Rheumatoid arthritis (RA) is an autoimmune disease. Although conventional medicines have advanced, RA is still a therapeutic challenge. The growing demand for complementary and alternative medicine (CAM), particularly phytotherapy, as supporting measures in the management of diseases has been stimulated by the existence of side effects, treatment costs, and heterogeneity in therapeutic response [16]. For centuries, herbal remedies have played a significant role in the management of inflammatory, immunomodulatory, and antioxidant effects in traditional Chinese medicines. This suggests that they play a role in reducing inflammation and controlling the immune response linked to RA [17-19]. Herbal therapies may offer synergistic benefits with Conventional medications, lessen adverse effects, enhance symptom management, or provide for patients who do not respond to or cannot tolerate existing medicines. This is the rationale for investigating herbal remedies for RA [20-21]. This study aims to provide a comprehensive overview of common herbal remedies, their effectiveness, suggested mechanisms of action, safety issues, and how their potential use in conjunction with traditional medications to treat RA.

2. POPULAR HERBAL REMEDIES FOR RHEUMATOID ARTHRITIS

Numerous herbal remedies have been utilized historically and scientifically assesses for their capacity to manage RA symptoms and progression. These are some of the most studied and utilized herbs in the field.

2.1 Turmeric (*Curcuma longa*)

Turmeric, a spice commonly used in Asian cuisine and traditional medicine, contains curcumin, the most potent curcuminoids [22]. Curcumin possesses potent antioxidant, anti-inflammatory and immunomodulatory properties [23]. its ability to reduce nuclear factor- kappa B (NF-kB), a crucial regulator of the inflammatory gene activity, and inhibit the production of pro-inflammatory cytokines such as TNF- α , IL-1 β and IL-6 as well as cyclooxygenase-2 (COX-2) and lipoxygenase (LOX), is linked to its anti-inflammatory effects [24-25]. Compared to non-steroidal anti-inflammatory drugs (NSAIDs), turmeric supplements have been found in clinical studies to considerably reduce inflammation, pain, and morning stiffness in patients with RA with fewer adverse effects [26-27].

2.2 Boswellia (*Boswellia serrata*)

Boswellic acid found in the tree resin of *Boswellia serrata*, commonly referred to as Indian Frankincense, for its therapeutic qualities [28]. The main way that Boswellic acids reduce inflammation is by blocking 5- Lipoxygenase enzyme which is involved in the production of leukotrienes, which are powerful inflammatory mediators [29]. By affecting T lymphocyte proliferation and cytokine production they also seem to alter immunological responses [30]. *Boswellia* extracts have been shown in clinical trial to alleviate joint pain, swelling and function in RA patient with good tolerance [31-32].

2.3 Ginger (*Zingiber officinale*)

Bioactive substances such as gingerols and shogaols, which have potent anti- inflammatory and antioxidant properties, are found in ginger a popular spice [33]. Ginger inhibits prostaglandin and Leukotriene production, suppresses NF-kB activation and reduce pro-inflammatory cytokines [34]. Supplementing with ginger may help individual with RA experience less pain, according to studies [35-36].

2.4 Green Tea (*Camellia sinensis*)

Polyphenols, especially epigallocatechin-3-gallate (EGCG), are potent antioxidant and anti-inflammatory agent, are abundant in green tea [37]. EGCG inhibits several inflammatory mediators and enzymes that contribute to cartilage degradation in RA, such as COX-2, inducible nitric oxide synthase (iNOS), and matrix metalloproteinases (MMPs) [38]. Additionally, EGCG can decrease the generation of pro-inflammatory cytokines and alter immune cell activity [39]. Epidemiological research and certain clinical trials have shown that regular green tea drinking may be linked to

improved disease activity in established cases and a lower chance of developing RA [40-41].

2.5 Cat's Claw (*Uncaria tomentosa*)

Cat's claw, a vine indigenous to the Amazon rainforest, contain oxindole alkaloids and other substances with anti-inflammatory and immunomodulatory properties [42]. TNF- α production and NF-kB activation are inhibited, and T-cell and B-cell activity is modulated among other mechanisms of action [43]. According to clinical research by reducing inflammatory reaction cat's claw may help with RA patients, especially those with active disease, experience less joint discomfort and swelling [44-45].

2.6 Thunder God Vine (*Tripterygium Wilfordii*)

Traditional Chinese Medicine uses the powerful herb Thunder god vine (TGV) To treat autoimmune conditions. Its primary active ingredient, triptolide, has potent anti-inflammatory Immunosuppressive and antiproliferative properties [46-47]. It may reduce T- cell activation cause Inflammatory cells to undergo apoptosis and preventing the synthesis of certain pro-inflammatory cytokines [48]. 0 disease activity including joint pain and function; In some cases, these improvements are comparable to or even better those of methotrexate [49-50]. However, there is a greater chance of negative effects0 when using it; thus,close observation is necessary [51].

3. EFFICACY OF HERBAL TREATMENTS

Over time, there has been a significant increase in research on the application of herbal remedies for treating rheumatoid arthritis. Several herbal remedies may be beneficial in the treatment of RA, according to results of clinical trials and systemic reviews [52-53]. The efficacy of ginger, turmeric and *Boswellia* in regulating the inflammatory and immunological responses linked to the illness has been extensively examined [54-55]. Numerous studies have shown improvements in pain, joint symptoms and physical function after using herbal remedies; however, the quality data varies, and some have significant limitations [56]. The publication comprised of multiple meta- analysis, which improved the field by merging data from several studies, and enabled a more comprehensive assessment of the potential use of specific herbal therapies in Rheumatoid arthritis [57].

3.1 Assessment of Pain Reduction and Improvement in Joint Symptoms

The motive Behind RA therapy is pain management, and various herbal treatments has shown promising results in reducing pain [58]. A verbal rating scale (VRS), visual analog scale (VAS), or numerical rating scale (NRS) are commonly used to measure pain severity. An interval of time periods, such as the previous day or the previous seven days, my be covered by these scales. Additionally, each scale type has benefit and drawbacks that need to be taken into account. while planning trials for persistent pain [59]. Studies utilizing the combination of *Boswellia* & curcumin have shown significant reduction in pain scores; some evidence suggests that these effects are comparable

to those of conventional nonsteroidal anti-inflammatory drugs (NSAIDs) with a positive safety profile [60-61]. Numerous herbal extracts have the potential to help individuals with RA by lowering inflammatory activity & reducing joint pain and inflammation [62-63].

3.2 Evaluation of Functional Outcomes and Quality of Life Measures

Natural product produced from plants such as curcumin, *Boswellia serrata*, green tea and cat's claw, are a promising therapeutic option for rheumatoid arthritis. Furthermore, they improve the standards of life & healthcare facilities [64]. Functional tests such as the wellness evaluation survey or autoimmune impact measuring scales (AIMS), are commonly used to quantify improvements in daily activities and overall physical function [65]. Numerous studies have demonstrated that herbal remedies can increase the HAQ (health assessment questionnaire) score, indicating a more effective operational limit. Furthermore, certain herbal treatments have demonstrated favourable trends in QOL (quality of life) measures, which include social, psychological, and physical well-being suggesting a wider benefit beyond joint complaints [66-68].

4. POTENTIAL MECHANISMS OF ACTION

The beneficial effects of herbal medicines for RA have been attributed to a wide range of biologically active substances that work through various mechanism, frequently focusing on important immunological and inflammatory pathways.

4.1 Anti-inflammatory Effects

The strong anti-inflammatory properties of several herbal substances are essential for their effectiveness in RA [69]. The suppression of important mediators of inflammation and signalling pathways frequently mediates these effects [70]. For instance, gingerols from ginger, curcumin from turmeric, and boswellic acids from *Boswellia serrata* can inhibit the stimulation of NF- κ B, a powerful regulatory pathway of inflammation, which lowers the gene transcription that promote disease [71-72]. In addition, they reduce the formation of prostaglandins and leukotrienes by inhibiting the activity of enzymes such as COX-2 and 5-LOX [73-74]. Moreover, these substances have the ability to suppress the release and form of pro-inflammatory cytokines including TNF- α , IL-1 and IL-6, which are the key factors in the pathophysiology of RA [75-76].

4.2 Immune-modulating Properties

In addition to their direct anti-inflammatory benefits, several herbal remedies have noteworthy immune-modulating properties that may aid in the restoring the immunological balance in patients with RA [77]. T cells, B cells and macrophages are among the immune cells whose cell division, proliferation and normal activity are affected by this action [78]. For example, triptolide from Thunder God Vines can inhibit T-cell growth and activation, which lowers allergic reaction [79]. It has been

demonstrated that green tea catechins, especially EGCG, affect the cytokine profile in Favor of an anti-inflammatory state and modify the activity of regulatory T cells [80]. These herbs may assist suppressing the abnormal immunological responses typical of RA by modifying cytokine cascades and immune cell activity [81-82].

4.3 Antioxidant Activity

Oxidative stress which results in inflammation, joint deterioration, and systemic issues has a major impact on the pathophysiology of RA [83]. Numerous herbal compounds contain antioxidants that can reduce oxidative damage that combat reactive oxygen species (ROS) [84]. Flavonoids and polyphenols found in herbs like turmeric, green tea and ginger have a strong ability to destroy free radicals [85-86]. By reducing oxidative stress these herbs help avoid damage to ligament cellular structures chondrocyte articulation, & other joint tissues, which may stop the disease's progression and reduce its symptoms [87-88].

4.4 Cartilage Protection and Regeneration

Joint decay particularly cartilage loss is a major hallmark of severe rheumatoid arthritis and significantly reduce function [89]. There has been interest in the possibility of several herbal therapies to protect joint tissues & stop further cartilage deterioration [90]. Research shows that the biologically active substances included in *Boswellia* & curcumin can inhibit matrix-metalloproteinases (MMPs) and other degradative enzymes that denature proteins & fibres in the cartilage matrix [91-92]. Furthermore, it has been found that several herbal extracts boost the formation of extracellular matrix components & stimulate chondrocyte activity, both of which are essential for maintaining joint cartilage structure [93]. These results show that herbal medicines may help preserve joint structure & function, but there is currently little evidence to back up this assertion, & further research is required to ascertain their clinical relevance in the treatment of RA [94].

5. SAFETY CONSIDERATIONS

Despite the therapeutic benefits of herbal therapy as well as they are also associated with risk including their side effects, adverse effect, Drug interaction & variability in product quality therefore, suitable measures are taken as necessary for safe and effective use of herbal drugs.

5.1 Adverse Effects and Drug Interactions

Despite being "natural" herbal medicines may have negative side effects mild adverse effects on the gastrointestinal such as nausea and diarrhoea are frequently the most prevalent [95]. But some plants, such as thunder god vine are known to have more serious toxicities, such as nephrotoxicity, and reproductive problems, which call for close observation [96]. Drug herb interaction is a major problem particularly when using traditional RA treatments [97]. For example, when coupled with warfarin or antiplatelet medications, herbs

having anticoagulant qualities (such as ginger and turmeric) may raise the risk of bleeding [98]. However more research is required to establish a specific relationship between immunomodulatory herbs & biological products or immunosuppressive drugs [99]. Patients must disclose any usage of herbal supplementals to their healthcare provider in order to avoid any risks [100].

5.2 Quality Control and Standardization of Herbal Products

One of the major problems of herbal medicine is lack of proper oversight of quality and homogeneity [101]. Herbal substances differ significantly in terms of active ingredient content, product quality, & the presence of impurities such as heavy metals, pesticides residues and known pharmaceutical auxiliary compounds [102]. These differences could affect safety & therapeutic results, resulting in uneven treatment response [103]. As a result, it is essential to equivalent amounts of active compounds in different preparations by ensuring uniform quality through standardization [104]. Implementing medications manufactured in accordance with GMP regulations and backed by rigorous quality testing might increase product reliability about potency, purity, & general quality [105-106].

5.3 Monitoring and Reporting of Adverse Events

However herbal medicines are generally thought to be non-toxic, adverse effects & herb-drug interactions can occur. As a result, careful monitoring of their use remains of paramount importance. Health-care provider should frequently consult about patient's use of herbal supplement & discuss any potential adverse reactions [107-108]. Furthermore, whenever using of herbal medicines, patients should be instructed to report any unusual symptom or potential negative side effects [109]. Moreover, improving the pharmaceutical monitoring system for herbal products could produce more accurate safety data, enabling early detection of risks & enhancing scientifically supported regulatory bodies guidelines [110-111].

6. HERBAL THERAPIES IN COMBINATION WITH CONVENTIONAL MANAGEMENT

To obtain the most effective treatment outcomes & reducing any safety issues, the combination of herbal drugs with standard RA treatment should be addressed carefully.

6.1 Communication with Healthcare providers regarding Herbal Product Use

Due to herbal products are frequently used along with traditional drugs, patients should inform their health care providers of any herbal treatments, they currently use or plan to take, this enables treatment to be adequately evaluated and also minimizes the possibility of unwanted interactions. Clinicians can evaluate possible interaction, keep an eye out for negative consequences, and offer well-informed advice thanks to this honest interaction [112].

Given that numerous individuals use complementary and alternative medicine (CAM), healthcare professionals should take a respectful approach and start conversation about CAM use [113]. Effective patient care and safety are guaranteed by this cooperative approach [114].

6.2 Potential Herb-Drug Interactions and Contraindications

As previously mentioned, the possibility of herb drug interaction is a major concern [115]. Herbs can influence drug absorption (e.g. via cytochrome P450 enzymes), or have beneficial pharmacological Consequences [116]. For example, herbs that affect blood clotting may interact with coagulation inhibitors, while autoimmune herbs may interfere with immunosuppressive medication such as DMARDs [117]. Some herbal remedies may also be unsuitable in certain groups of people, such as pregnant or Kidney condition [118]. A complete knowledge of these interaction and potential risks is essential for safe incorporation [119].

6.3 Complementary Role of Herbal Treatments in Multimodal RA Management

Herbal remedies can augment multimodal RA treatment when taken correctly and under medical supervision [120]. By easing symptoms, inflammation, or enhance general health, which might make it possible to take traditional drugs at lower dosages or lessen their adverse effects [121-122]. In order to improve treatment outcomes and enhance patient standard of life, herbal medicine should be used in addition to standard DMARDs, particularly in cases with chronic RA [123-124]. The objective is to develop a customized treatment plan that incorporates the best aspects of both based on data and traditional herbal methods [125].

7. PATIENT EDUCATION AND COUNSELLING

In order to enable people to make knowledgeable decisions regarding herbal therapy for RA, appropriate patient instruction and counselling are essential.

7.1 Evidence-Based Recommendations for Herbal Treatments

Research-based information about the effectiveness and safety remedies should be given to patient [126]. Numerous herbal therapies may be helpful, according to research evidence is available however, the quality of data differ significantly among different techniques. Among the medicinal plants evaluated Boswellia, ginger & curcumin have shown considerably higher clinical evidence indicating that they may be utilized as supplementary therapies for rheumatoid arthritis [127]. Reports that are mostly based on empirical observations or traditional use should be separated from evidence from clinical trials [128]. Patients should receive precise information about dosage, possible side effects, & suitable therapeutic goals in order to facilitate informed decision - making and promote the safe use of herbal drugs [129].

7.2 Limitations of the Current Research and Need for Further Studies

The drawbacks of the existing studies on herbal remedies for RA must be acknowledged [130]. Many studies lack rigorous methodology (e.g. Adequate blinding, placebo control), are tiny or have a limited duration [131]. Further studies on the best concentration, long-term health benefits, and effects of integrating other plants or herbs with traditional medications are also necessary [132]. patients should understand that although herbal therapies show promise, they are not a cure for arthritis and should not be used in place of or in addition to traditional, scientifically proven medical care. It is possible to control patient's expectations and encourage appropriate use by highlighting the need for additional high-quality studies [133-134].

7.3 Encouraging Open Communication and Shared Decision-Making

It is essential to promote truthful interactions among patients and healthcare professionals. Patients should be able to talk about their interest in herbal remedies without worrying about being evaluated. Better adherence and satisfaction result from collaboration in decision-making, in which patients and physicians work together to evaluate treatment alternatives, including herbal remedies, based on the best available research, individual needs, and values. This cooperative approach ensures that every facet of a patient's care is taken in to account and builds confidence [135-138].

8. FUTURE DIRECTIONS AND RESEARCH NEEDS

Further investigation is required in an array of key areas to maximize the benefits of herbal therapy for RA.

8.1 Clinical Trials with Larger Sample Sizes

More reliable indication of the effectiveness & safety of herbal remedies would require more clinical research with significant sample sizes & randomized placebo-controlled models [139]. The studies should comply with established international guidelines for clinical research in order to provide an appropriate study design, binding & outcome evaluation [140]. This will improve the evidence regarding of healthcare guidelines.

8.2 Long-term Safety and Efficacy Assessments

Even though short-term trials have demonstrated promising outcomes, long-term safety and efficacy studies of herbal treatments for RA are of paramount importance [141]. To identify chronic side effects and analyse the consequences on joint degradation & onset of disease, ongoing investigations are necessary [142]. This will improve understanding of their role in chronic health disease management [143].

8.3 Exploration of Combination Therapies (Herbal and Conventional)

The benefits & drawbacks of combining herbal therapies with conventional RA treatment should be investigated [144]. To determine whether a specific herbal remedy can enhance the efficacy of DMARDs, reduce their adverse effects, or allow dose reduction, more research is needed

[145]. Research on synergistic effects & potential pharmacodynamic or pharmacokinetic interactions is crucial for developing safe and effective combination procedures [146-147].

Research should be done on the possible advantages and disadvantages of mixing herbal remedies with traditional RA medicine [144]. Further research is required to ascertain whether a particular herbal cure can improve the effectiveness of DMARDs lessen their negative effects, or permit dose decrease [145]. For the creation of safe and efficient combination techniques, research on synergistic effects & possible pharmacodynamic or pharmacokinetic interactions is essential [146-147].

8.4

Identification of Biomarkers and Personalized Treatment Approaches

A significant development of biomarkers that can detect of a patient's reaction to particular herbal medication [148]. Personalized therapeutic approaches may be possible by selecting herbal medicines based on each patient's unique characteristics and disease profile [149]. The metabolic & genetic factors influencing responses to herbal compounds may be explained by research in molecular biology & pharmacogenomics, using this information, clinicians can improve patient outcomes and prescribe more effective treatment [150].

Expert Opinion:

The research study provides a comprehensive evaluation of herbal remedies for rheumatoid arthritis. Phytochemicals, pharmacological processes are regularly studied, clinical data that is now available is pointed out, & their future application as additional therapeutic agent is explored. The report acknowledges the existing limitation as well including the need for additional clinical validation, issue with standardization, and variations in study design. The review provides a fair and fact-based discussion that increases our understanding of herbal medicines. Researchers & medical professionals involved in the study & treatment of RA may also find it to be a useful resource.

Limitations:

Despite the promising findings reported in numerous investigations, the current clinical evidence remains limited by small sample sizes & short study durations. Inadequate standardization of herbal products & poor-quality control practices remains significant challenges. These limitations may affect the accuracy, reproducibility, and overall therapeutic potential of the results that are reported.

Recommendation:

To evaluate the long-term safety & effectiveness of herbal therapy, future studies should include multidisciplinary research with randomized controls and significant patient populations. In order to determine which patient groups are more likely to respond to specific herbal treatments, biomarker technology should also be looked towards. Moreover, greater awareness is needed to be concentrated

on standardizing herbal formulation and developing trustworthy quality control techniques. In addition to promoting the safe use of herbal remedies in the treatment of rheumatoid arthritis, addressing these concerns may increase the validity and repeatability of research findings.

9. CONCLUSION

9.1 Summary of Key Findings on Herbal Treatments for RA

A wide range of herbal treatments have been investigated as supportive strategies for effective treatment of rheumatoid arthritis. The most researched include thunder god vine, green tea, ginger, curcumin, *Boswellia serrata* and cat's claw, which lower inflammation & help alleviate symptoms, including joint pain & stiffness, according to experimental and clinical research. Some evidence also suggests a potential protective effect on joint tissues & cartilage. However, the quality of the data varies between studies and the results described in the existing literature are not always reliable. Furthermore, it is important to carefully assess safety issues, adverse reactions & interactions with traditional anti-rheumatic medicines. Therefore, more clinical research is needed to establish how these herbal remedies can be used to treat RA.

9.2 Recommendations for Healthcare Professionals and Patients

To reduce the incidence of emerging herbal-drug interaction and side effects, medical practitioner should

List abbreviations

RA	Rheumatoid Arthritis
CAM	Complementary and Alternative Medicine
DMARDs	Disease-Modifying Antirheumatic Drugs
IL	Interleukin
COX-2	Cyclooxygenase-2
LOX	Lipoxygenase
EGCG	Epigallocatechin-3-gallate
TGV	Thunder God Vine (<i>Tripterygium wilfordii</i>)
NSAIDs	Non-Steroidal Anti-Inflammatory Drugs
MMPs	Matrix Metalloproteinases
ROS	Reactive Oxygen Species

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motivate patients to acknowledge their consumption of herbal medicine. The available scientific data should serve as a framework for guidance about herbal remedies & products with inadequate clinical approval should be recommended with being cautious. Rather than being substitutes for well-established therapeutic methods, herbal remedies should be viewed as an adjuvant to traditional rheumatoid arthritis treatment. Apart from that, choosing high quality medications & promptly reporting adverse reaction serve as vital steps in providing patient safety and achieving optimal health care.

9.3 Areas for Future Research and Development

Future studies should focus on well-planned clinical trials with a significant number of patients & continuous ongoing surveillance periods in order to ascertain the long-term safety and therapeutic efficacy of herbal remedies in rheumatoid arthritis. Further research is needed to identify predictive biomarkers that may aid patient classification & optimize treatment outcomes. It is also imperative to carefully assess the predicted synergistic effects of herbal therapy when taken with traditional anti-rheumatic medicines. Optimising herbal composition & finding suitable dose regimens remain vital research areas. These programs could add to the database of evidence encouraging the use of herbal medications & boost integrating them into overall RA therapeutic plans.

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