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Original Article

Can Moringa Serve As A Substitute For NSAIDS In Pain Management? A Bibliometric Analysis

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ABSTRACT

Introduction: Pain management often relies on NSAIDs, but their long-term use poses risks, including GI toxicity, cardiovascular events, renal damage, and neurotoxicity. Moringa oleifera offers a safer, plant-based alternative with anti-inflammatory properties. This study uses bibliometric analysis to explore moringa's scientific potential as an analgesic substitute. **Materials and methods:** This research aims to explore the evolution of scientific disciplines by finding and identifying trends, patterns, and correlations in scientific texts related to certain topics. The main things this study looked at were Moringa oleifera and pain, utilizing both quantitative and qualitative methods. **Results and discussion**: Moringa oleifera offers multi-pathway analgesic effects with low toxicity. Enhanced with synergistic compounds, it rivals NSAIDs in safety and efficacy, though standardization and bioavailability remain key challenges; **Conclusions:** This bibliometric study gives Moringa oleifera provides a safe, multi-targeted alternative to NSAIDs for chronic pain, with enhanced efficacy when combined with bioavailability boosters and synergistic anti-inflammatory compounds. This research was conducted in July 2025.

Keywords: moringa, pain, analgetic, NSAID, bibliometric, substitute

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INTRODUCTION

Pain is one of the most prevalent clinical complaints, and its management remains a cornerstone of medical care. Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) are widely used due to their efficacy in reducing inflammation and alleviating nociceptive discomfort. However, long-term use of NSAIDs has been associated with significant adverse effects, prompting concerns over their safety profile.

Among the most documented complications are:

- Gastrointestinal toxicity, including peptic ulceration, bleeding, and perforation[1];
- Cardiovascular risks, such as increased incidence of myocardial infarction and stroke, particularly with selective COX-2 inhibitors[2];
- Renal impairment, leading to reduced glomerular filtration and possible acute kidney injury[3];
- Neurotoxicity, with emerging evidence linking NSAIDs to potential exacerbation of neurodegenerative processes through altered neuroinflammatory pathways[4].

Given these risks, there is growing interest in safer, plant-based alternatives that provide effective analgesia while minimizing systemic toxicity.

One such candidate is Moringa oleifera, a tropical plant long utilized in traditional medicine. Moringa contains bioactive compounds such as quercetin, kaempferol, and isothiocyanates, which exhibit anti-inflammatory and antioxidant properties[5]. These constituents have shown potential in modulating pro-inflammatory cytokines like TNF-α and IL-6, suggesting moringa's possible involvement in peripheral and central pain regulation[6].

Despite increasing interest in phytotherapeutics, the scientific literature on moringa's analgesic potential remains fragmented. This study addresses that gap through bibliometric analysis, aiming to map the scope, impact, and thematic evolution of research surrounding moringa as a potential substitute for NSAIDs in pain management. By analyzing publication trends, citation networks, and institutional contributions, this paper highlights moringa's emerging scientific relevance and therapeutic promise

MATERIALS AND METHODS

This bibliometric study investigates the scientific landscape surrounding Moringa oleifera and its relationship to pain, employing data sourced from Scopus, a widely recognized and reputable database for peer-reviewed literature. The research was conducted in July 2025.

To perform the bibliometric analysis, the following methodological steps were undertaken:

§ Search Term Identification: The keyword "Moringa oleifera" was entered into the Scopus search interface, targeting the topic fields—specifically title, abstract, and keywords.

§ Search Refinement: No filters were applied to the search results, ensuring a comprehensive dataset.

§ Data Extraction: The search yielded a total of 126 documents. These were downloaded in multiple formats to facilitate analysis:

- CSV (Comma-Separated Values): This format includes essential bibliographic details such as title, author, affiliation, publication year, source, abstract, and keywords.
- RIS (Research Information System): This format provides more granular metadata, including citation references.

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The extracted data were subsequently analyzed using two specialized bibliometric tools: Biblioshiny, an R-based interface for the bibliometrix package, and VOSviewer, a software application designed for constructing and visualizing bibliometric networks.

Quantitative Analysis

Figure 1 illustrates an increase in the quantity of documents, reaching a total of 15 papers by 2024. The earliest article, titled Contribution to the study of the anti-inflammatory activity of Moringa oleifera (moringaceae) written by Ndiaye M. et al. in 2022(7), while the most recent document is from 2025. entitled Unlocking the secrets of a miracle tree (Moringa oleifera) in Tanzania: Integrating traditional therapy with modern science written by Nchimbi, H.Y., next is A Review of Moringa oleifera (Miracle tree) and its Potential Phytochemistry, Traditional, Health Benefits, Pharmacological Applications written by Sivakumar, T., next is A critical review on Moringa oleifera: current status, physicochemical attributes, and food industrial applications written by Jaglan, P. et all, next is Wound healing potential of some medicinal plants written by Soto, J.A., et all, and next article is An Overview on Diabetic Neuropathy written by Singh, U. , Sharma, R. , Kumar, R[8-12].

According to Figure 2. Most relevant source is Journal of Ethnopharmacology with nine journals. The Journal of Ethnopharmacology has been indexed in Scopus continuously since its first volume appeared in 1979. Its most recent SCImago Journal Rank (SJR) is 1.142 for the year 2024, reflecting its strong influence in pharmacology and drug discovery. The journal is published by Elsevier Ireland Ltd. It welcomes original research and review articles on a broad spectrum of topics, including the traditional use of medicinal plants and natural products, phytochemical isolation and characterization of bioactive compounds, pharmacological and toxicological evaluations, clinical and preclinical studies of herbal therapies, omics-based investigations of complex botanical extracts, conservation and sustainable utilization of ethnobotanical resources, and studies on the interaction between plant-derived agents and the gut microbiota.

Next is The Journal of Evidence-Based Complementary and Alternative Medicine with five journals, has been indexed in Scopus since 2005, with its coverage recorded through 2022. Its most recent SCImago Journal Rank (SJR) is 0.469 for the year 2022. The journal is published by Hindawi Publishing Corporation in the United States. It welcomes manuscripts reporting randomized controlled trials in complementary and alternative therapies, mind-body interventions such as mindfulness, and other medicine-related research within the field of complementary and alternative medicine. And Next is The American-Eurasian Journal of Sustainable Agriculture with four journals was indexed in Scopus from 2009 through 2014. Its most recent SCImago Journal Rank (SJR) value is 0.125 for the year 2017. The journal is published by the American-Eurasian Network for Scientific Information (AENSI). It accepts original research papers, review articles, and other contributions reporting investigations in agricultural and environmental sciences—including agronomy and crop science, food science, horticulture, and related sustainable agriculture topics

According to Figure 3, The most cited document is “Analgesic effects of methanolic extracts of the leaf or root of Moringa oleifera on complete Freund’s adjuvant-induced arthritis in rats” was published in the Journal of Chinese Integrative Medicine (Zhong xi yi jie he xue bao) in February 2011 as Volume 9, Issue 2 (pages 216–222)[13]. In this study, male Wistar rats received a single subcutaneous injection of complete Freund’s adjuvant (CFA) to induce arthritis, and were then treated intraperitoneally with methanolic extracts of Moringa oleifera leaf or root at doses of 200, 300, and 400 mg/kg on days 0, 3, and 6 post-CFA. Thermal hyperalgesia and mechanical allodynia were assessed at each time point, with indomethacin (5 mg/kg) serving as a positive control. The 300 mg/kg and 400 mg/kg doses of both leaf and root extracts produced analgesic effects comparable to indomethacin, significantly reducing pain sensitivity at days 3 and 6 ($P < 0.05$ or $P < 0.01$). A combined leaf + root extract given at 200 mg/kg also significantly attenuated thermal hyperalgesia, and prophylactic administration of the combination before CFA injection yielded a synergistic enhancement of analgesia compared to either extract alone. These results demonstrate that methanolic extracts of M. oleifera leaf and root effectively alleviate CFA-induced arthritic pain in rats, with combination therapy offering superior pain relief[13].

In Figure 4, The most contributed manuscript based on the title “Mitigative potentials of methanol leaf extract of Moringa oleifera on chronic carbamazepine-induced haemo-biochemical and thyrotoxicity in male Wistar rats” was published in the journal Pharmacological Research – Modern Chinese Medicine in 2022, appearing online on 26 January 2022 as article 100055.

In this study, thirty-two adult male Wistar rats were allocated to four groups that received, once daily for 15 weeks by oral gavage, either distilled water (control), M. oleifera methanol leaf extract (200 mg/kg), carbamazepine (20 mg/kg), or carbamazepine followed 30 minutes later by M. oleifera extract. Blood and serum samples were collected at the end of the treatment period to assess hematological parameters (including PCV, RBC, WBC and hemoglobin), liver enzymes (ALT, AST, ALP, total protein, albumin) and thyroid hormones (TSH, T_3, T_4). Chronic carbamazepine administration produced significant disturbances in blood cell counts, elevated hepatic enzyme activities and depressed thyroid hormone levels, while co-treatment with M. oleifera extract significantly attenuated these adverse effects. The authors conclude that the methanol leaf extract of Moringa oleifera effectively mitigates carbamazepine-induced hematological, biochemical and thyroid dysfunctions, likely owing to its rich nutritional and bioactive phytochemical profile.

According to Figure 5. Here are 3 authors with the most writings. The first is the writing is Rahmatullah, M. with 4 documents. with the following article title: An ethnobotanical survey of Rajshahi district in Rajshahi division, Bangladesh., Medicinal plants of the Garo tribe inhabiting the Madhupur forest region of Bangladesh., An ethnobotanical survey of Jessore district in Khulna division, Bangladesh., and An ethnobotanical survey of Jessore district in Khulna division, Bangladesh[14-17].

Next there is the author Hossain, M. with 3 documents, Here are some articles he wrote : An ethnobotanical survey of Rajshahi district in Rajshahi division, Bangladesh., An ethnobotanical survey of Jessore district in Khulna division, Bangladesh., An ethnobotanical survey of Jessore district in Khulna division, Bangladesh[14-16]. Next there is the author Jahan, R. with 3 documents, Here are some articles he wrote: An ethnobotanical survey of Rajshahi district in Rajshahi division, Bangladesh., An ethnobotanical survey of Jessore district in Khulna division, Bangladesh., An ethnobotanical survey of Jessore district in Khulna division, Bangladesh[14-16].

According to Figure 6, The pie chart titled "Documents by Subject Area" presents a visual breakdown of document distribution across various academic fields. The largest portion, comprising 35.3%, is dedicated to Pharmacology, Toxicology, and Pharmaceutics, indicating a strong focus in this domain. Medicine follows with 23.5%, reflecting its significant share. Both Biochemistry, Genetics and Molecular Biology and Agricultural and Biological Sciences each account for 12.3%, showing balanced contributions. Smaller segments include Chemistry (5.9%), Veterinary (2.0%), Chemical Engineering, Environmental Science, and Multidisciplinary fields (each at 1.5%), as well as Immunology and Microbiology (1.0%) and Other subjects (3.4%). This chart effectively illustrates the concentration of scholarly documents, emphasizing the predominance of health and life sciences in the dataset.

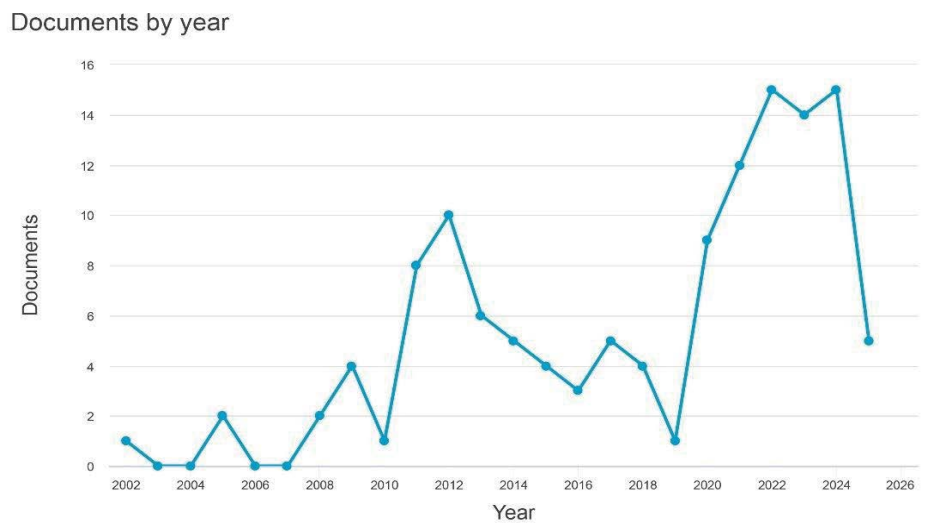

Figure 1. Documents by year

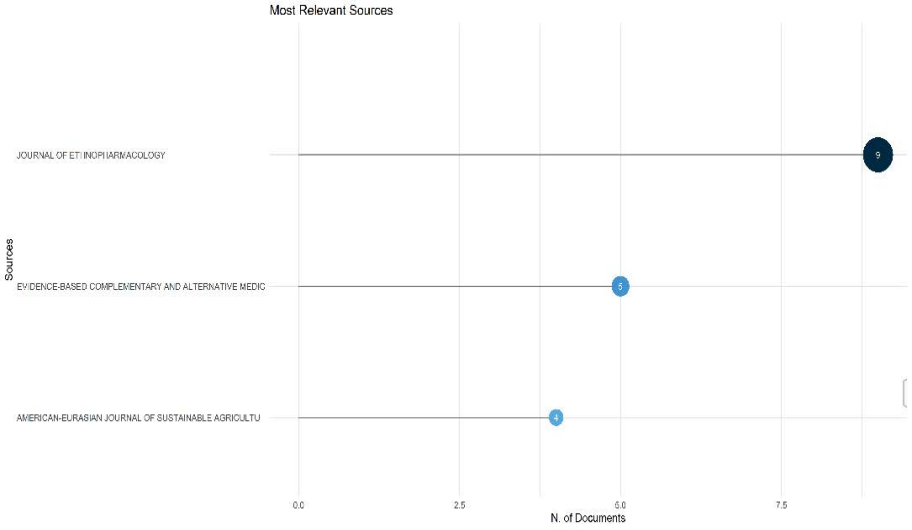

Figure 2. Most Relevant Sources

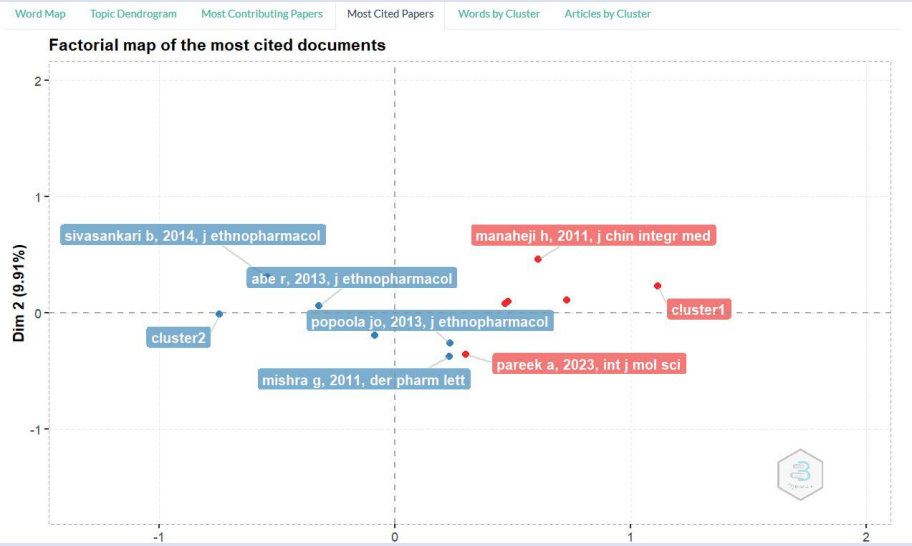

Figure 3. Factorial map of the most cited documents

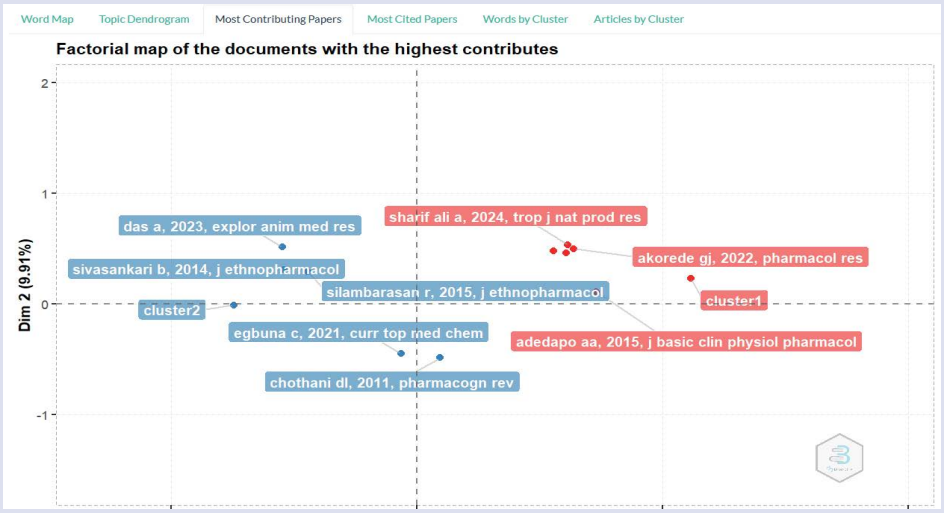

Figure 4. Factorial map of the documents with the highest contributes

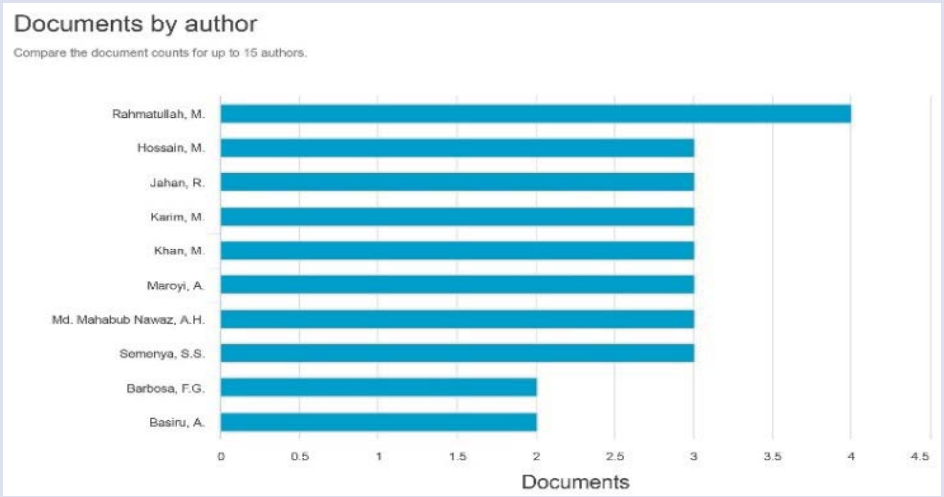

Figure 5. Documents by Author

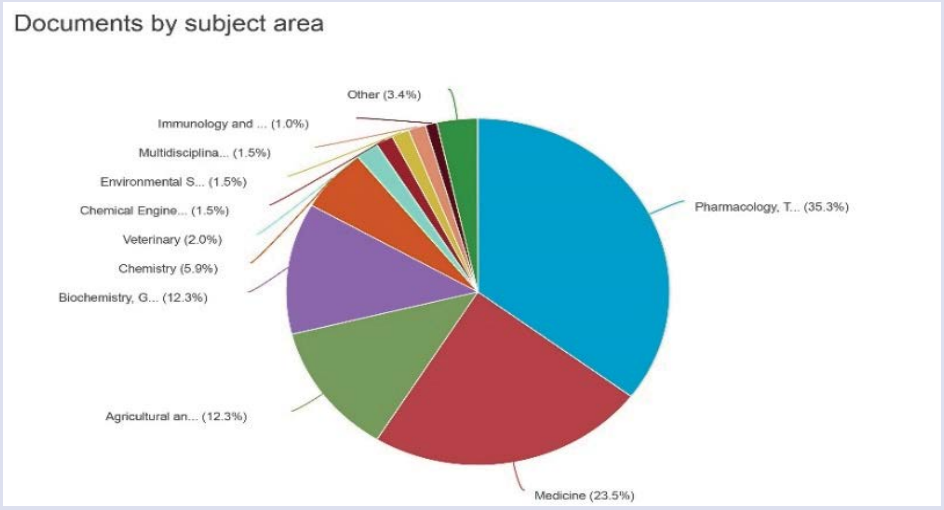

Figure 6. Documents by Subject Area

According to Figure 7, in first place, the producer of the most documents is affiliated with University of Development Alternative with 4 documents; next in second place is affiliated with University of Fort Hare, Banaras Hindu University, University of Limpopo and Universidade Federal do Ceará with 3 documents.

Figure 8 indicates that the examined areas remain unassociated with other regions delineated by edges. The domain encompasses: Aegle marmelos extract, Lantana camara extract, Andographis paniculata extract, Urinary tract disease, Ricinus communis extract, Rural area, Heart disease, Abortion, Dogbite, Snakebite, India, Oleaceae, Musaceae, Pipeaceae, Scabies, Solanaceae, Euphorbiaceae, Calotropis procera, Ficus benghalensis, Vitex negundo, Senna tora, Datura metel, Clerodendrum, Aristolochia, Achyranthes aspera, Ficus hispida, Amaranthus spinosus, Senna alata, Sida acuta, Senna occidentalis, Aged, Major clinical study, Non insulin dependent diabetes, Oxidative stress, Essential oil, Neuropathic pain, Berberine, Rat, Animal tissue, Drug screening, Drug potency, Drug safety, Placebo, Drug activity, Acetylsalicylic acid, Methanol, Antioxidant activity, Enzyme activity, Apigenin, Kaempferol, Rutose, Flavonoid, Phytochemical, Rosemary, Animal model, Mouse, Toxicity, Nonhuman, Unclassified drug, Moringa oleifera extract, Article, Review, Humans, Moringa oleifera, Medicinal plant, Traditional medicine, Diabetes mellitus, Diarrhea, Vomiting, Sore throat, Liver disease, Asthma, Dysentery, Jaundice, Helminthiasis, Garlic extract, Stomach pain, Wound, Indigestion, Eczema, Myrrh, Otalgia, Measles, Fabaceae, Amaranthaceae, Ethnobotany, Questionnaire, Papaya, Asteraceae, Ocimum tenuiflorum, Ginger, Tamarindus indica, Coconut, Middle aged, Adult, Annona muricata, Nigeria, Cardiovascular disease, Obesity, Fatigue, Systematic review, Antibacterial activity, Liver protection, Analgesic activity, Antiinflammatory activity, Chemistry, Antinociception.

According to Figure 9. In the overlay visualization, it appears that the keywords that are being researched a lot approaching 2020 are the parts colored yellow, namely : scorpion sting, mangifera indica extract, momordica charantia extract, guava extract, rutaceae, major clinical study, morus alba, systematic review, rosemary, prevalence, berberine, neuropathic pain, essential oil, oxidative stress, phytochemical, kaempferol, glycoside, apigenin, flavonoid, toxicity, antioxidant activity, enzyme activity, and animal tissue.

As illustrated in Figure 10. In the visual circulation density, it appears that the part that is already saturated with research is yellow, while the part that is not yet saturated is slightly yellow and dominantly green, namely keywords : Aegle marmelos extract, Lantana camara extract, Andrographis paniculata extract, Scorpion sting, Urinary tract disease, Ricinus communis extract, Mangifera indica extract, Momordica charantia extract, Rural area, Heart disease, Abortion, Common cold, Dog bite, Snakebite, India, Tinea, Oleaceae, Musaceae, Stomach disease, Indigestion, Biodiversity, Wound, Jaundice, Helminthiasis, Hepatitis, Bronchitis, Cholera, Guava extract, Conjunctivitis, Ficus benghalensis, Acanthaceae, Vitex negundo, Senna tora, Cucurbitaceae, Measles, Bark, Vomiting, Calotropis gigantea, Datura metel, Clerodendrum, Amaranthaceae, Fabaceae, Acne, Melicaceae, Aristolochia, Cassia fistula, Achyranthes aspera, Questionnaire, Solanum, Centella asiatica, Ficus hispida, Ficus, Amaranthus spinosus, Azadirachta indica, Senna alata, Guava, Tamarind, Maize, Ocimum gratissimum, Sida acuta, Attitude to health, Plant preparations, Coconut, Middle aged, Aged, Avocado, Annona muricata, Major clinical study.

According to Figure 11, On the thematic map based on the title, the following is an explanation for each keyword in each quadrant in the thematic map resulting from bibliometric. Here is an explanation of the meaning of each quadrant in the thematic map and examples of document titles relevant to keywords in each quadrant.

Niche Themes: The concept of "indigenous knowledge de" represents a focused exploration of traditional healing systems, possibly drawing from Germanic ethnobotanical records or regional frameworks. These studies delve into culturally rooted plant-based practices that offer insights beyond conventional pharmacology, making them valuable but less connected to the broader scientific mainstream. Alongside this, the theme "infections South Africa" reflects concentrated research on infectious diseases in South Africa, often informed by local plant therapeutics. It showcases region-specific efforts to combat bacterial or viral threats through indigenous remedies. Example document title: "Ethnobotanical Insights into Infection Management in South Africa: Indigenous Knowledge Revisited."

Motor Themes: This quadrant was empty in the current image, suggesting no themes were identified as both central and well-developed. However, this absence highlights a valuable opportunity for future bibliometric mapping—to discover which clusters truly drive the intellectual engine of this field In bibliometric analysis, motor themes are those with both high density (well-developed internally) and high centrality (strongly connected to other themes), making them the intellectual engines of a field. In the current mapping of Moringa oleifera research, the motor quadrant is empty, indicating no single

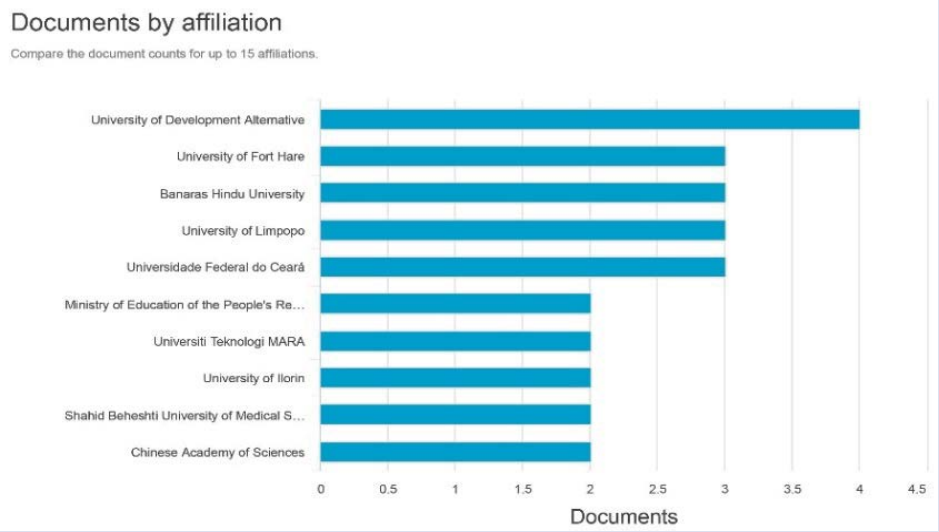

Figure 7. Documents by affiliation

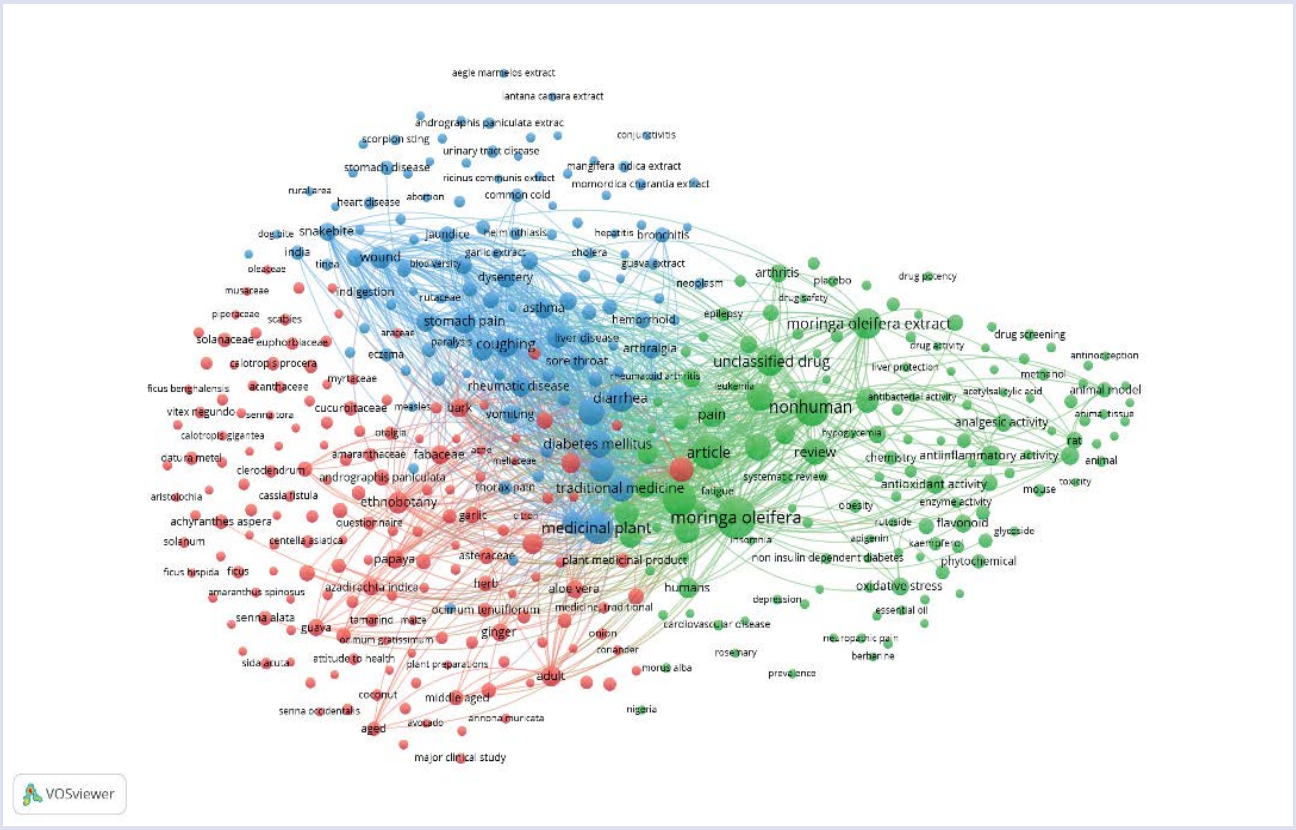

Figure 8. Network Visualization

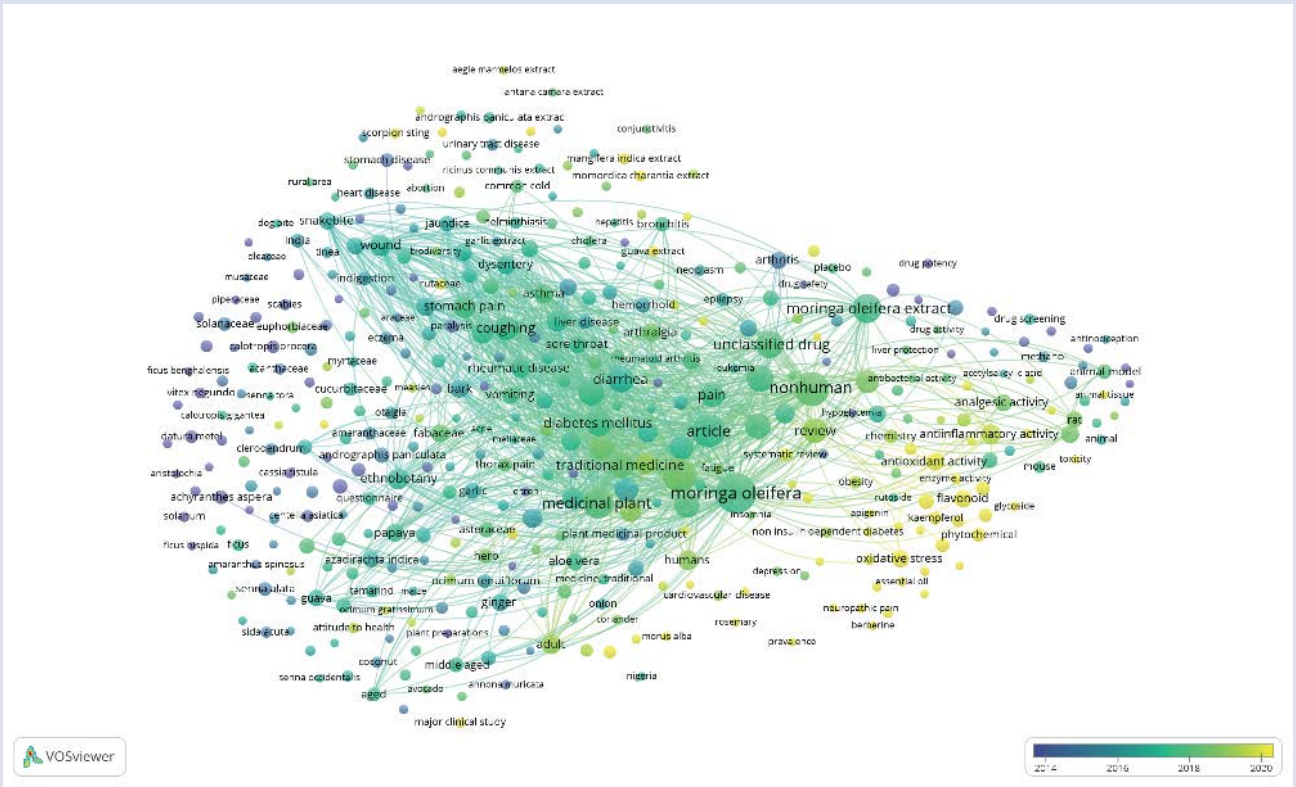

Figure 9. Overlay visualization of scopus, database using Vosviewer

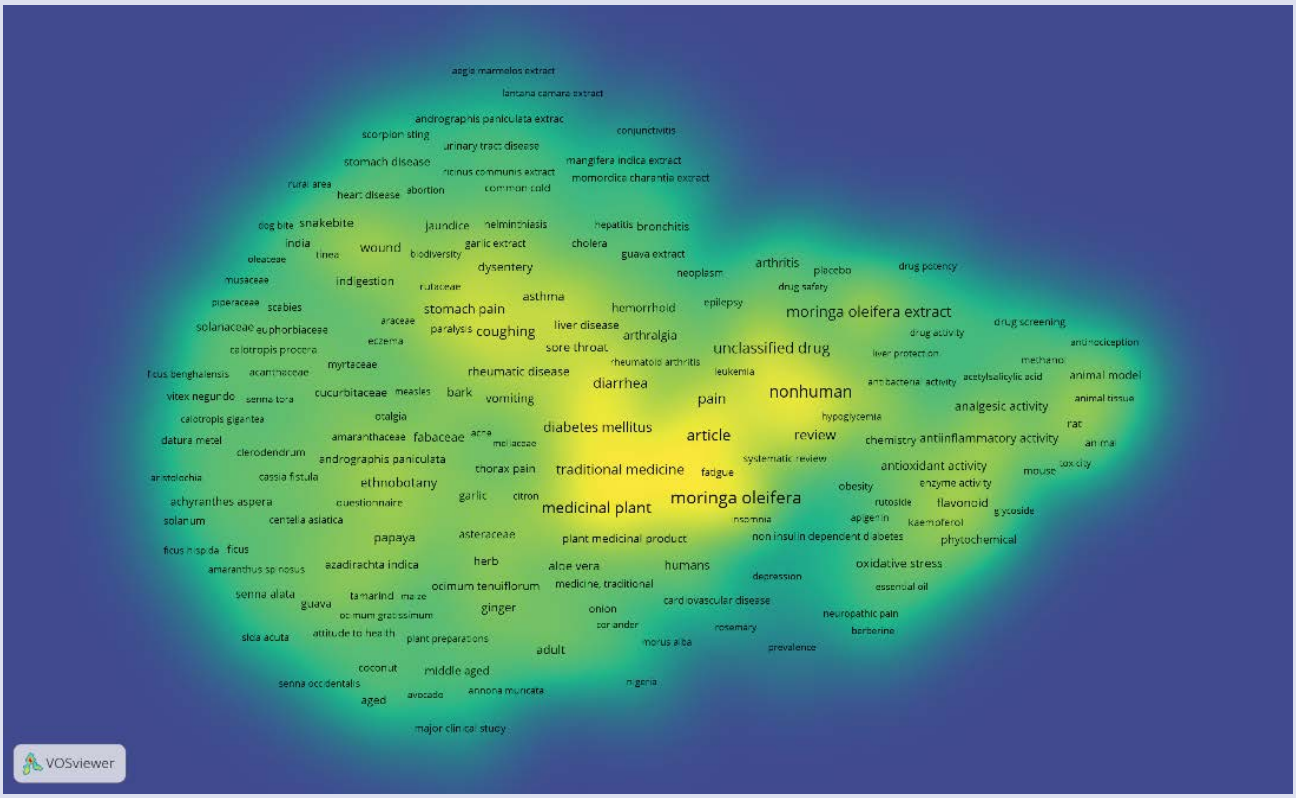

Figure 10. Density visualization

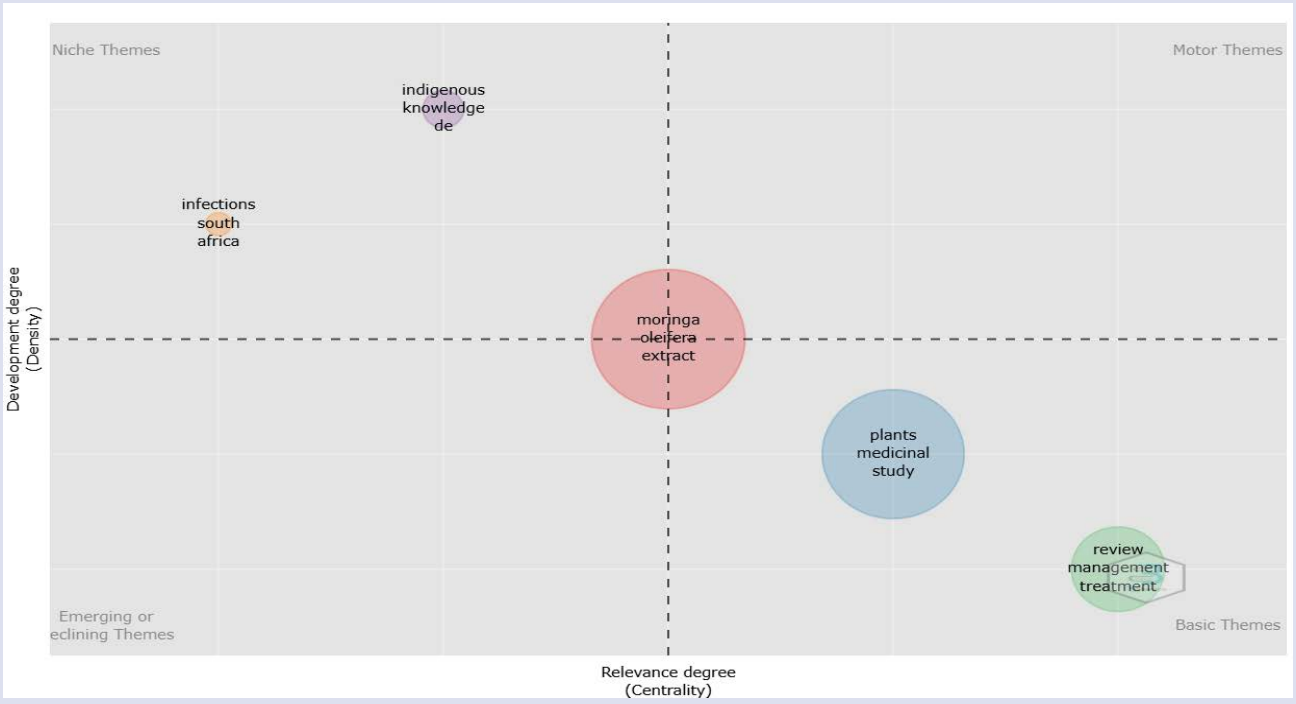

Figure 11. Thematic map

cluster simultaneously demonstrates deep internal cohesion and broad linkages. This absence suggests a gap where integrative, high-impact studies could emerge—such as multidisciplinary trials combining phytochemical profiling, mechanistic pharmacology, and clinical validation of Moringa extracts—to become the next driving force in the domain.

Emerging or Declining Themes: No themes appeared in this quadrant either, which might indicate gaps in current research that are underexplored or possibly waning in interest. These zones are particularly fertile for innovation, as revitalizing or pioneering work here could shape future scholarship. Emerging or declining themes occupy the low-density, low-centrality quadrant, reflecting topics that

are either at the nascent edge of research or losing traction. For Moringa oleifera and pain, this quadrant also registers no current themes, pointing to underexplored avenues. For instance, novel applications of Moringa-derived compounds in neuropathic pain models or re-examining historical ethnobotanical uses for modern analgesic development could revitalize interest and seed future scholarship here.

Basic Themes: The theme "review management treatment" reflects the essential groundwork in scholarly conversation around medicinal plants—reviewing how they're used to manage and treat various diseases. This theme is foundational, often providing the empirical or theoretical basis for applied and clinical studies. It demonstrates strong relevance, though perhaps lacking in the nuanced development seen in niche or central topics. Example document title: "Systematic Review of Medicinal Plant Use in Disease Management and Treatment." Basic themes have high centrality but low density, indicating they are foundational to the discipline but require deeper internal development. Within Moringa oleifera literature, the theme "review management treatment" typifies this quadrant. Systematic overviews of Moringa's anti-inflammatory and analgesic properties provide essential context for subsequent mechanistic and clinical research. Strengthening this base with meta-analyses or more nuanced subtheme syntheses (e.g., pain type–specific efficacy) would enrich and solidify the field's groundwork.

Central Themes: "moringa oleifera extract" stands out as a highly central and well-developed theme, anchoring the field with robust studies into its pharmacological actions, antioxidant capacity, and therapeutic versatility. Paired with "plants medicinal study," which encompasses broad investigative efforts into phytotherapy, this quadrant represents the intellectual heart of the domain. These themes form the pivot around which other research strands—clinical, mechanistic, and ethnomedical—rotate. Example document title: "Phytochemical and Therapeutic Properties of Moringa Oleifera: A Central Review of Medicinal Plant Studies." Central themes display both high density and high centrality, representing topics that are well-developed and serve as hubs linking various research strands.

In the Moringa oleifera domain, "moringa oleifera extract" alongside "plants medicinal study" embodies this quadrant. Extensive investigations into the extract's phytochemistry, antioxidant capacity, and therapeutic applications anchor the field. Building on these hubs by integrating omics-driven target identification or advanced formulation strategies will reinforce and expand the core intellectual network.

According to Figure 12, There was an evolution of changes in themes in research in 2002-2020 with the keywords review, moringa, plants, herbal, and africa. The theme then changed in 2021–2025 to ethnobotanical, comprehensive, study, health, plants, moringa.

RESULTS AND DISCUSSION

Biomolecular Mechanism of Moringa as an Analgesic

Moringa oleifera is a botanically rich source of bioactive compounds, including flavonoids, isothiocyanates, terpenoids, and phenolic acids, which collectively exert analgesic effects through multiple molecular pathways. One of its primary mechanisms involves the inhibition of pro-inflammatory cytokines such as TNF-α, IL-6, and IL-1β, achieved through the downregulation of NF-κB and MAPK signaling pathways Table 1. In addition, moringa's flavonoids selectively modulate COX-2 activity while sparing COX-1, thereby reducing inflammation without inducing gastrointestinal toxicity—a common side effect of conventional NSAIDs. Its potent antioxidant activity further contributes to pain relief by neutralizing reactive oxygen species, which are known to sensitize nociceptors under oxidative stress. Preliminary studies also suggest that moringa compounds may interact with endogenous opioid receptors and sensory ion channels such as TRPV1, indicating a potential role in modulating both peripheral and central pain mechanisms. These multi-targeted actions position moringa as a promising natural agent for managing inflammatory and neuropathic pain[13,36,90,92,96,100].

Pharmacokinetics and Pharmacodynamics

Pharmacokinetic studies reveal that moringa flavonoids possess moderate oral bioavailability, primarily due to hepatic first-pass metabolism. Peak plasma concentrations are typically achieved within one to two hours after ingestion, and the elimination half-life ranges from three to six hours depending on the formulation and delivery matrix Table 1. In terms of pharmacodynamics, animal models have demonstrated dose-dependent antinociceptive effects, particularly in writhing and tail-flick tests. These effects are significantly enhanced when moringa is administered in standardized extract forms, underscoring the importance of formulation quality in achieving consistent therapeutic outcomes[53].

Enhancing Moringa's Analgesic Formulation

To further optimize its analgesic potential, moringa can be co-

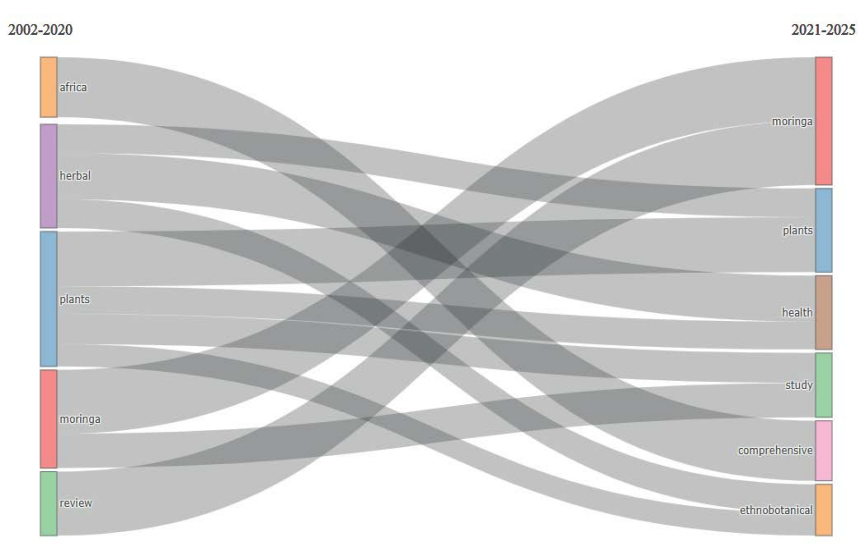

Figure 12. Thematic Evolution

Tabel 1. Qualitative analysis of Can Moringa Serve As A Substitute For NSAIDS In Pain Management

No.	Type of pain/disease studied	Dosage of moringa used	Duration of therapy	Reference no
1.	Joint pain, fungal infection, colds, flu, cancer, diabetes, malaria.	Seed oil (15%), leaves (13%), bark (10%), others variably.	Traditional use duration unspecified; data reflect historical community practices.	(9)
2.	Multifaceted: inflammation, diabetes, ulcers, infections, cardiovascular, fertility disorders	Varied: leaves, seeds, extracts—no standardized dose consistently reported.	Range: single dose to several weeks in reported studies cited	(11)
3.	Diabetes, inflammation, heart disease, cancer, joint pain, infections treated.	varied: leaves, seeds, extracts—no fixed standard applied.	Therapy duration differed—acute, subacute, chronic protocols were observed.	(8)
4.	Cancer, diabetes, hypertension, infection, obesity, arthritis, neurodegeneration, inflammation.	Variable: 50–500 mg/kg orally; extract type determined dosing.	Ranges: single dose to 12-week treatment in animal model	(12)
5.	Diabetic neuropathy with emphasis on distal symmetrical polyneuropathic pain.	Not specified; therapeutic context inferred, lacking experimental dose reporting.	Unreported; narrative focus without clinical trial duration information provided.	(10)
6.	Body pain, diabetes, ulcers, stomach ache, high blood pressure, wounds.	Not quantified; leaves, seeds, roots used in various preparations.	Traditional use—routine consumption or symptomatic application, not time-bound.	(18)
7.	Postnatal perineal wound pain, inflammation, infection, and healing complications.	Moringa extract included in nanofiber dressing—precise dose not reported.	Not specified; generally applied until wound shows complete healing signs.	(19)
8.	Chloramphenicol-induced anemia in adult Wistar rats; hematological dysfunction.	500 mg/kg oral aqueous leaf extract once daily per rat.	Administered daily for 28 days in controlled animal experiment.	(20)
9.	Gout-induced arthritis, hyperuricemia, and acetic acid-triggered visceral pain.	100–500 mg/kg/day aqueous extract orally administered to rats.	Once daily for 28 days; 7 days for hyperuricemia.	(21)
10.	Headache, sore throat, stomach pain, flu, diarrhea, fever.	Leaves prepared as infusions or baths; exact dose unspecified	Used symptomatically as needed; no standardized timeline reported.	(22)
11.	Gastrointestinal issues, blood pressure, diabetes, infection, pain, general discomfort.	Unspecified; leaves consumed via infusion, food additive, topical application.	Symptom-based use—frequency and duration not uniformly reported or regulated.	(23)
12.	Inflammation, diabetes, cancer, bacterial infection, obesity, neurodegenerative pain conditions.	Not specified; focus on isothiocyanate extraction and molecular profiling.	Unspecified; therapeutic potential discussed without clinical treatment timelines.	(24)
13.	Sciatic nerve injury-induced neuropathic pain; central and peripheral origins.	Crude leaf powder—exact concentration not consistently specified across models.	Daily administration over 28 days in controlled rodent experiments.	(25)
14.	Functional gastrointestinal disorders—abdominal pain, bloating, bowel habit abnormalities.	Moringa not specified; focus centered on general dietary fiber use.	Duration unspecified; therapeutic activity linked to ongoing fiber supplementation.	(26)
15.	Joint pain, headache, diarrhea, asthma, anemia, inflammation, cancer.	Not specified; general reference to traditional and nutritional applications.	Unreported; traditional use implies ongoing or symptom-based application.	(27)
16.	Rheumatoid arthritis, joint inflammation, stiffness, swelling, deformity, disability symptoms.	Not specified; mentioned among herbal options without dosage details included.	Unspecified; reference to complementary therapies used chronically by patients.	(28)
17.	Cardiovascular conditions—hypertension, stroke, chest pain, heart failure, more.	Dose not specified; usage observed in traditional herbal formulations.	Unspecified; traditional use likely aligned with chronic symptom management.	(29)
18.	Epilepsy—seizure disorders, including temporal lobe and drug-resistant types.	Not specified; moringa absent from experimental models in reviewed studies.	Unreported; moringa not investigated within epilepsy therapy timelines here.	(30)
19.	Alzheimer's disease—cognitive decline, memory loss, behavioral and motor changes.	Moringa not specified; no dosage details provided or discussed.	Moringa use absent in reviewed Alzheimer's treatment studies.	(31)
20.	COVID-19 symptoms—fever, cough, fatigue, cold, general pain, breathlessness.	Used in steam baths; leaf-based remedies, dose not quantified.	Once daily or 2–3 times/day depending on preparation.	(32)
21.	Aromatase inhibitor-associated joint and muscle pain in breast cancer.	Standardized extract (Biochemistry Lab); oral administration during daily therapy.	Thirty days; assessed via pre-test and post-test comparison metrics.	(33)
22.	Chemotherapy-induced peripheral neuropathy (CIPN); TRPV1-mediated neuropathic pain.	No in vivo dose; focused on metabolite-receptor binding affinity.	Not applicable; computational modeling without experimental treatment duration.	(34)
23.	Stiff shoulder, neck, joint, and muscle pain; sleep fatigue.	Daily 12 mg glucomoringin from Moringa seed extract tablets.	Four consecutive weeks with weekly assessments of subjective improvement.	(35)
24.	Pain induced in Wistar rats via formalin and acetic acid	Moringa oleifera administered orally at 200 mg/kg daily dosage	Treatment lasted fourteen days following induction of experimental pain models	(36)
25.	Juvenile Idiopathic Arthritis with autoimmune inflammation of joint synovium	No specific moringa dosage reported; herb discussed as adjuvant	Duration of herbal use not specified; discussed as supportive therapy	(37)
26.	Heavy metal exposure risk via medicinal leaf extracts from India	Moringa oleifera leaf powder tested; dosage not clearly specified	No therapeutic use described; study focused on safety profile only	(38)
27.	Musculoskeletal, reproductive, respiratory issues treated by traditional tribal healers	Moringa oleifera leaves used; frequency or dosage not reported	Duration of herbal usage unspecified; applied symptomatically as needed	(39)

28.	Neuropathic, inflammatory, metabolic, infectious, and chronic degenerative condition	Dosage ranges from 70 mg/kg to 2000 mg/kg	Therapy duration varies widely, from 3 to 60 days	(40)
29.	Multisystem disorders including inflammation, malnutrition, infections, and chronic conditions	Dosage varies widely; no standard therapeutic dose was identified	Therapy duration not specified; implied as traditional, ongoing treatment	(41)
30.	Pain and inflammation evaluated using topical polyherbal gel formulations	Moringa used in gel at 1%, 3%, and 5% concentrations	Therapy lasted one to seven days in rabbit irritation test	(42)
31.	Bone pain and stomach aches addressed by traditional Hmar practices	Bark paste topically applied; precise dosage not clearly mentioned	Duration undefined; applied symptomatically based on local healer knowledge	(43)
32.	Gastric ulcers and lactation stimulation reported by traditional Kuria healers	Moringa leaves boiled; seeds chewed or mixed in porridge	Duration not specified; traditional use implies ongoing or situational application	(44)
33.	Oxidative stress-related conditions addressed by natural antioxidant-rich plants	Moringa mentioned as antioxidant source; exact dosage not specified	Therapy duration unspecified; antioxidants considered for long-term preventive use	(45)
34.	Diabetes mellitus managed with stem cell therapy and phytomedicine support	Moringa oleifera highlighted for antidiabetic use; no dosage specified	Duration not stated; discussed as ongoing naturopathic supportive strategy	(46)
35.	Pulmonary embolism possibly triggered by prolonged moringa leaf extract use	Moringa leaf extract taken daily for five consecutive months	Therapy spanned five months before acute symptoms prompted hospitalization	(47)
36.	Broad ailments treated via oral and topical traditional plant preparations	Moringa oleifera leaves utilized; specific dosage not consistently recorded	Duration unspecified; applied symptomatically within indigenous healing practices	(48)
37.	Various conditions including inflammation, ulcers, diabetes, and cardiovascular disorders	Moringa dosage ranged from 25 to 400 mg/kg orally	Treatment duration varied between single dose and repeated administration in studies	(49)
38.	Traditional ailments including rheumatic pain treated by Barak Valley healers	Moringa bark paste applied externally; specific dose not specified	Duration not described; use guided by local healer practices	(50)
39.	Type 2 diabetes mellitus and its associated complications in Zimbabwe	Extracts used in rats and humans; specific dose varies	Duration ranges from single dose to four-week clinical trials	(51)
40.	Temporomandibular joint inflammatory pain induced with formalin in rats	Semisynthetic moringa derivative (MC-H) given orally, 1 μg/kg	Administered once daily for fourteen days pre- and post-induction	(52)
41.	Chronic inflammatory, neuropathic, and visceral pain conditions across models	Moringin from Moringa oleifera studied; dosage varies across formulations	Duration differs per study; repeated and acute treatments both applied	(53)
42.	Neuropathic pain and thyrotoxicity induced by chronic carbamazepine exposure	Moringa extract administered orally at 200 mg/kg daily dose	Therapy continued once daily via gavage for fifteen weeks	(54)
43.	Gastrointestinal and metabolic disorders addressed via microbiota modulation mechanisms	Moringa cited for bioactivity; dosage information not explicitly mentioned	Therapy duration not specified; effects discussed as long-term dietary impact	(55)
44.	Various infections and metabolic disorders treated using Moringa seed oil	Dosage not specified; focus on biochemical composition and activity	Duration of therapy not stated; efficacy claims under investigation still	(56)
45.	Periodontitis caused by Porphyromonas gingivalis bacterial inflammation in Wistars	Moringa leaf extract applied post-infection; dosage amount not specified	Administered over seven days; IL-6 levels monitored periodically	(57)
46.	Wide range of traditional diseases treated using ethnobotanical plant remedies	Moringa oleifera mentioned among plants; specific dosage not provided	Duration not detailed; therapies guided by indigenous knowledge and tradition	(58)
47.	Asthma-related airway inflammation modulated by immunological and natural therapies	Moringa seed extract used; exact dosage not clearly specified	Duration not specified; discussed as complementary relief method in asthma	(59)
48.	Tramadol-induced organ toxicity investigated through oxidative stress mechanisms	Moringa oleifera leaves extract given orally at 100 mg/kg	Treatment spanned thirty consecutive days alongside tramadol exposure in rats	(60)
49.	Bacterial infections, especially diarrhea, typhoid, and oral diseases studied.	Dosage of moringa ranged from 6.25 to 50 mg/ml.	Therapy duration not specified; mostly single-dose in vitro assays.	(61)
50.	Chronic stress and anxiety disorders were modeled in zebrafish	Moringa doses were 500, 1000, and 2000 mg/L administered.	Therapy duration lasted 14 days of chronic stress induction.	(62)
51.	Digestive disorders, including diarrhea, stomach aches, and dysentery mentioned	not specified; general nutritional use implied.	not discussed; traditional daily consumption customary historically	(63)
52.	Viral infections, including herpes, HIV/AIDS, and Newcastle disease virus.	Dosage used was 20 g daily of leaf powder.	Therapy duration lasted for 60 days in HIV patients.	(64)
53.	Oral ailments, including toothaches, ulcers, and dental caries discussed.	Dosage details vary, but toothpaste used 8–10% leaf powder.	Duration of therapy not standardized; traditional and topical applications cited.	(65)
54.	Digestive, urological, respiratory diseases treated with traditional medicinal plant remedies.	Moringa not mentioned in this study; dosage unreported or unknown	Therapy duration unspecified; ethnobotanical knowledge focuses on plant usage traditions.	(66)
55.	Temporomandibular joint disorder involving inflammation and orofacial pain symptoms.	Moringa oleifera derivatives reduced hypernociception in rat TMD models.	Duration not specified; acute inflammation tested in preclinical experiments only.	(67)
56.	Arthritis, joint problems, and pain were the focus diseases studied.	3000 mg Moringa ethanol extract used per single dose unit.	Stability and efficacy evaluated over 6 to 12 months.	(68)
57.	Gastrointestinal pain, fever, respiratory issues, inflammation, and general aches	Dosage not quantified; traditional infusions using leaves or stalks.	Used ad hoc, frequency depends on illness and availability.	(69)

58.	Musculoskeletal ailments including pain, stiffness, swelling, arthritis, paresis.	Dosage unspecified; Moringa cited among multi-herb traditional formulations.	Duration varies by ailment; informants indicated days to weeks.	(70)
59.	Type 2 diabetes mellitus with insulin resistance and secretion defect.	Moringa oleifera identified as source; specific dosage not reported	Review-based; therapy duration not specified across included studies	(71)
60.	Diabetes, hypertension, joint pain, rabies, and snake bites treated	Moringa oleifera reported; specific dosage not standardized or quantified.	Not specified; use likely seasonal or condition-dependent application.	(72)
61.	Fever, skin diseases, insomnia, dizziness, snakebite, and blood issues.	Usage recorded; specific moringa dosage not provided or standardized.	Duration unreported; treatments applied contextually based on ailment type.	(73)
62.	Pain-related use; beta-linalool targets antimicrobial, cicatrizing, analgesic effects.	Moringa oleifera leaf extract used; exact concentration not specified.	Evaluated during micropropagation; duration not provided or standardized.	(74)
63.	Tuberculosis, asthma, pneumonia, rhinitis, sinusitis, sore throat treated.	Moringa not mentioned; dosage information absent from this study.	Treatment duration not reported; varies with healer and condition.	(75)
64.	Hypertension studied via ethnobotanical, biochemical and mechanistic data review.	Moringa reported as hypotensive plant; specific dosage not stated.	Therapy duration not defined; systematic review covered multiple studies.	(76)
65.	Diabetes, HIV/AIDS, cancer, tuberculosis, and body pain treated.	Moringa oleifera leaves used; specific dosage not explicitly defined.	Duration of therapy not documented; usage contextually community-defined.	(77)
66.	Breastfeeding-related lactation insufficiency and inadequate milk production investigated.	Moringa evaluated as galactagogue; specific dosage data not provided.	Therapy duration varied; studies spanned newborn to six months	(78)
67.	Neurogenic pain explored via TRPA1 activation by moringin compound.	Moringin tested in vitro; EC50 reported as 3.14 μM.	In vitro assay; no therapeutic duration was evaluated directly.	(79)
68.	Tramadol-induced testicular toxicity, oxidative stress, fertility dysfunction studied.	100 mg/kg/day aqueous moringa extract administered orally to rats.	Therapy lasted four weeks during controlled laboratory experiment.	(80)
69.	Stomach pain, high cholesterol, uric acid, anxiety disorders treated.	Moringa used traditionally; dosage unspecified in ethnobotanical documentation.	Therapy duration not standardized; usage culturally habitual and situational.	(81)
70.	Joint pain targeted via anti-inflammatory effect of herbal formula.	Moringa oleifera included in Sattakavata; exact dosage not stated.	Not specified; study focused on chemical analysis, not treatment.	(82)
71.	Joint pain relief studied via Sattakavata Thai herbal formulation	Moringa oleifera included; extract concentration not directly specified.	Therapy duration unreported; study focused on analytical method development	(83)
72.	Fatigue specifically treated; Moringa highly cited among Bapedi healers.	Leaves used dried; precise Moringa dosage not reported directly.	Duration not specified; application informed by healer practice and tradition.	(84)
73.	TMJ inflammatory hypernociception and pain responses in animal models.	MC-D7, MC-D9, MC-H tested from 1–10 μg/kg doses.	Fourteen-day toxicological assay followed by short-term behavioral evaluation	(85)
74.	Pain models included thermal, chemical, and depression-like behaviors in mice.	Administered Moringa leaf extract at 100, 200, 400 mg/kg.	Therapy lasted 14 days with daily oral administration.	(86)
75.	Diabetes, high cholesterol, ulcers, kidney infections, and urinary issues.	Moringa leaves consumed with mate or tereré, dosage unspecified.	Therapy duration not specified in ethnographic observations or interviews.	(87)
76.	Diabetic neuropathic pain with hyperalgesia and mechanical allodynia studied.	Moringa seed extract at 40, 60, 80 mg/kg used.	Eight weeks of daily treatment post-diabetes induction in mice.	(88)
77.	Neuropathic pain in multiple sclerosis using EAE mouse model.	Topical 2% moringin cream applied twice daily on limbs.	Therapy lasted 21 days from symptom onset to sacrifice.	(89)
78.	Analgesia, pyrexia, and inflammation studied using healthy Wistar rats.	Extracts of leaves tested; dosage specifics not explicitly stated.	Acute test durations varied; specifics not clearly mentioned.	(90)
79.	Fever, diabetes, ulcer, hypertension, wounds, sexual dysfunction studied ethnobotanically.	Clerics boiled leaves; exact moringa dosage not specified or quantified.	Frequency-based use; no fixed therapeutic duration was reported.	(91)
80.	Acute and chronic inflammatory pain studied using rat models.	Polar/non-polar extracts at 30–300 mg/kg orally administered.	Therapy duration not specified; varies across experimental pain models.	(92)
81.	Communicable diseases including diarrhoea, respiratory infections, HIV, malaria.	Moringa cited in ethnomedicine; dosage details not mentioned.	Duration undefined; based on traditional usage and cultural practices.	(93)
82.	Fever, bronchial issues, body and rheumatic pain addressed.	Leaf and pod vegetables consumed; dosage not clearly stated.	Traditional use pattern; therapy duration not specifically reported.	(94)
83.	Diabetes, hypertension, ulcers, gangrene, pain, cataracts, neuropathy documented.	Leaves and roots used; preparation involved juice or decoction.	Usage varied; frequency ranged from once to thrice weekly.	(95)
84.	Rheumatic, articular pain and inflammation assessed in rodent models.	Methanolic leaf extract administered at 50–200 mg/kg body weight.	Observation period spanned three hours post-injection in inflammation models.	(96)
85.	Diverse ailments managed; specific pain conditions not distinctly categorized here.	Moringa highly cited; preparation methods reported but dosage unspecified.	Duration based on tradition; exact therapy length not mentioned.	(97)
86.	Arthritic pain in elderly Filipino patients medically diagnosed with arthritis.	Topical moringa seed oil extract applied once per session.	Three daily trials with multiple assessments over one hour.	(98)
87.	Tribal remedies included fever, headache, body pain, and nausea.	Moringa used traditionally; dosage preparation details not explicitly recorded.	Duration unspecified; dependent on illness severity and cultural healer protocol.	(99)
88.	Fever, inflammation, and pain induced in rats and mice models.	Oral doses used: 50, 100, 200, 400 mg/kg.	Monitored over hours post-induction; acute short-term treatment model.	(100)

89.	Pain, inflammation, and digestive issues addressed through ethnomedical practices.	Dosage unspecified; used empirically by traditional healers in formulations.	Duration varies; typically continued until symptoms resolve naturally.	(101)
90.	Fever, body pain, digestive issues treated via folk remedies.	Empirical use; dosage not standardized or scientifically quantified.	Duration depends on healer protocol and symptom persistence.	(102)
91.	Rheumatic pain and inflammation assessed via membrane stabilization method.	Petroleum ether extract: 10–100 µg/mL showed increasing inhibition.	Incubation lasted 30 minutes for in vitro hemolysis assay.	(103)
92.	Painful urinary tract infection with burning and frequent urination symptoms.	40 mL bark decoction (15 g/100 mL), twice daily.	Continued for twenty-one days with weekly patient follow-ups.	(104)
93.	Arthritis: inflammation, joint pain, swelling managed with herbal therapies.	Ethanolic seed extract; 21-day rat model using 200 mg/kg.	Administered daily for twenty-one days in treated rats.	(105)
94.	Rheumatic pain, fever, diabetes, cough treated via folk remedies	Moringa cited ethnobotanically; dosage details not clearly mentioned.	Duration not specified; traditional use pattern inferred from interviews.	(106)
95.	Body pain, weakness, hypertension, diabetes, HIV/AIDS, epilepsy, ulcers	Dosage unspecified; leaf decoctions commonly prepared and consumed orally	Duration varied; not standardized across ethnic groups or conditions studied	(107)
96.	Diabetes, acidity, hypertension addressed through indigenous plant knowledge system.	Leaf juice of moringa taken orally until symptoms resolve	Duration flexible; treatment continued until perceived health improvement achieved.	(108)
97.	Bone fracture, osteoporosis, hemorrhoidal pain, joint inflammation, body pain.	Moringa in combination studied; precise dosage not specified clearly.	Typically ranged four to ten weeks across human clinical trials.	(109)
98.	Circulatory diseases, endogenous and lifestyle illnesses, using indigenous plant therapies.	Dosage not stated; Moringa used traditionally for internal conditions.	Duration unclear; usage persisted depending on symptom resolution feedback.	(110)
99.	Body pain, stomach ache addressed with traditional plant-based therapies.	Moringa bark paste applied topically; exact dosage not specified.	Duration varies; treatment continues until symptoms visibly lessen or resolve.	(111)
100.	Wound healing, tissue repair investigated via ethnobotanical plant remedies.	Moringa mentioned; bark paste applied externally without stated dose.	Duration not standardized; based on wound response and healing rate.	(112)
101.	Snake bite, scorpion sting, dog bite treated via folk remedies.	Moringa root bark paste applied externally; dosage not standardized.	Treatment continued until visible recovery; duration not explicitly mentioned	(113)
102.	Neuropathic pain from diabetic nerve injury via constriction model.	Moringa extract: 100–300 mg/kg orally, once daily, 21 days.	Therapy lasted 21 days; effects assessed throughout experiment.	(114)
103.	Rheumatism, sore neck, kidney problems, blood pressure, eye allergies.	Leaves dried and eaten; root applied with palm oil.	Duration varied; therapy ceased after visible improvement or symptom relief.	(115)
104.	Sickle cell anemia with pain-related complications and organ dysfunction.	Extracts tested at 10–20 mg/ml concentrations in vitro.	Incubation duration ranged from thirty minutes to two hours.	(116)
105.	Urolithiasis causing severe renal pain, infection, and urinary obstruction.	Moringa oleifera root-wood extract studied; dose unspecified in review	Treatment durations varied; generally continued until calculi dissolved.	(117)
106.	Rheumatism, joint pains, body aches treated using tribal herbal remedies.	Bark paste used rectally; specific dosage not detailed clearly.	Duration not specified; therapy continued until symptoms were relieved.	(118)
107.	Insect bites, earache treated with plant-based traditional formulations.	Moringa bark mixed with garlic and ginger; dose unclear.	Duration not specified; remedy applied until symptoms fully resolve.	(119)
108.	Inflammation pain, diabetes, hypertension, skin problems, respiratory and kidney issues.	Leaves pounded or decocted; specific moringa dosage not provided.	Duration unspecified; use continued until relief or improvement observed.	(120)
109.	Abdominal pain, inflammation targeted via chitin-binding protein therapy.	Mo-CBP4 injected intraperitoneally at 3.5 and 10 mg/kg.	Administered 30–60 minutes prior; effects measured post-injection.	(121)
110.	Rheumatism, skin diseases, asthma, viral infections, venomous bites treated.	Moringa bark, leaves, seeds used; precise dosage not reported.	Therapy duration unclear; traditionally continued until recovery or symptom relief.	(122)
111.	Wound healing activity explored using various medicinal plant extracts.	Moringa leaf paste applied topically; exact quantity not standardized.	Therapy duration depended on wound size and healing progression.	(123)
112.	Joint pain, asthma, fever, tuberculosis, hypertension, skin disorders treated.	Leaf juice, root bark, decoction used; dosage varies greatly.	Duration ranged widely; traditionally continued until full symptom resolution.	(124)
113.	Pain, jaundice, anaemia, diarrhoea treated using indigenous plant remedies	Moringa leaf and fruit decoction used; quantity not defined.	Typically twice daily; continued until symptom resolution or relief.	(125)
114.	Arthritis-related inflammatory pain induced by complete Freund's adjuvant injection	Moringa leaf/root extracts at 200–400 mg/kg intraperitoneally administered.	Treatment spanned 6 days; effects measured on days 3, 6.	(13)
115.	Nociceptive pain modeled by chemical and thermal stimulation in mice.	Moringa leaf extracts orally administered at 100 mg/kg dosage.	Evaluations conducted post-dose; timing aligned with experimental pain tests.	(126)
116.	Multiple diseases studied including malaria, syphilis, epilepsy, and jaundice.	No moringa dosage mentioned—focus was Balanites aegyptiaca only.	Duration varies; epilepsy therapy lasted approximately ten consecutive days.	(127)
117.	Helminthiasis: parasitic worm infections causing pain and systemic symptoms.	Moringa used for antihelminthics, dosage not specified directly.	Duration of moringa therapy not indicated in the article.	(128)
118.	Moringa used for cancer treatment, not specifically pain-related.	One cup of blended ripe leaf juice, twice daily.	No specific duration mentioned, therapy presumed continuous until improvement.	(15, 16)

119.	Nasal catarrh, bone fractures, decreased eyesight, sores, body pain.	Bark paste, root-pod-ginger mixture applied locally on wounds.	Bark paste kept on wounds for approximately four days.	(17)
120.	Pain induced by inflammation and noxious stimuli in animals.	Aqueous leaf extract administered: 10, 30, 100 mg/kg.	Therapy spanned 1 to 5 hours post-induction models.	(129)
121.	Diabetes mellitus studied—primarily type 2 and its complications.	Moringa oleifera mentioned, dosage details not explicitly specified.	Duration of therapy not indicated in this review article.	(130)
122.	Inflammatory pain, acute nociception, diabetes-induced metabolic disturbances studied.	Intraperitoneal 5.67 and 11.34 mg/100g body weight.	Thirty-day repeated administration in experimental rat models.	(131)
123.	Cancer and cachexia studied through Ayurvedic herbs and principles	Moringa oleifera applied locally in buttermilk-based herbal paste	Duration not specified; traditional external applications used consistently.	(132)
124.	Acute inflammatory pain induced by carrageenin in rat paws	Aqueous root extract given orally at 750 mg/kg dose.	Therapy lasted five hours post-induction in experimental rats.	(7)

formulated with synergistic natural agents. Curcumin, derived from turmeric, is a potent anti-inflammatory compound that inhibits COX-2 and NF-κB, thereby amplifying moringa's effects. Piperine, found in black pepper, enhances the bioavailability of curcumin and flavonoids by inhibiting hepatic glucuronidation. Boswellia serrata extract, which contains boswellic acids, offers complementary anti-inflammatory benefits through 5-lipoxygenase inhibition. Omega-3 fatty acids such as EPA and DHA contribute to pain modulation by regulating prostaglandin and leukotriene synthesis, supporting nerve repair, and reducing chronic inflammation. Magnesium plays a role in NMDA receptor modulation and dampens neural signaling, making it particularly useful in neuropathic pain models. Vitamin D also supports analgesic effects by regulating inflammatory pathways and promoting neuromuscular health Table 1. While these combinations require careful evaluation for pharmacokinetic compatibility and safety, they offer a promising strategy to enhance the efficacy of moringa-based analgesics while maintaining a natural therapeutic profile[6,13,36,90,92,96,100].

Comparison to NSAIDs

When compared to conventional NSAIDs, moringa—especially when enhanced with synergistic compounds—offers a broader therapeutic target profile with significantly lower risks of gastrointestinal, cardiovascular, and renal side effects. Unlike NSAIDs, which primarily act through COX inhibition, moringa engages multiple pathways, including cytokine suppression, antioxidant activity, and receptor modulation Table 1. Although its bioavailability and potency may vary depending on formulation, moringa presents a safer alternative for long-term use. However, one of the key challenges lies in achieving consistent standardization of its active ingredients, a process that is more straightforward in synthetic pharmaceuticals[1-4].

Dosing and Standardization Efforts

Effective doses of moringa leaf extract for inflammatory conditions typically range between 200 to 500 milligrams per day. Nevertheless, the concentration of bioactive compounds such as quercetin and kaempferol can vary significantly depending on geographical origin and extraction methods. To address this variability, marker-based standardization should be implemented to ensure consistent therapeutic potency. Advanced delivery systems, including nanoparticle and liposomal formulations, may further enhance the stability and absorption of moringa's active constituents. Collaborations with phytopharmaceutical laboratories are essential to develop reproducible reference standards and establish moringa as a reliable and effective natural analgesic[13,20,47,54,57,86,96,126] Table 1.

CONCLUSIONS

Moringa oleifera offers a compelling alternative to NSAIDs for pain management, particularly in chronic contexts where long-term NSAID use poses systemic risks. With its pleiotropic biomolecular effects and minimal toxicity profile, moringa presents a phytotherapeutic approach grounded in both tradition and emerging evidence. Co-formulating moringa with bioavailability enhancers and synergistic compounds may significantly bolster its analgesic efficacy.

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