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THE EFFECT OF MEDICINAL PLANTS (COMMIPHORA GILEADENSIS, ACACIA TORTILIS, AND ACACIA EHRENBERGIANA) NATURALLY GROWING IN NAJRAN REGION, SAUDI ARABIA AND THEIR THERAPEUTIC AND APPLICATIONS POTENTIAL: A SYSTEMATIC REVIEW.

Original Article

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ABSTRACT

Background: Saudi Arabia's Najran region is home to a rich diversity of medicinal flora that has long been utilized in traditional healing practices. Among these, *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana* have gained attention for their potential therapeutic value. Despite growing interest, the pharmacological profiles of these species remain underexplored in modern scientific literature, particularly in the context of clinical applicability and safety.

Objective: This systematic review aims to evaluate the ethnobotanical uses, phytochemical composition, pharmacological activities, therapeutic applications, and potential risks of *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana*, with a focus on their role in treating infections, inflammation, metabolic, and cancer-related conditions.

Methods: A systematic review was conducted in accordance with PRISMA guidelines. Scientific databases including PubMed, Scopus, Web of Science, Google Scholar, and ScienceDirect were searched for articles published between 2000 and 2023 using relevant keywords. Eligible studies included experimental, observational, and ethnopharmacological research on the three target species. Data was extracted regarding bioactive compounds, therapeutic effects, and toxicity profiles. Risk of bias was assessed using the Cochrane Risk of Bias Tool and Newcastle-Ottawa Scale.

Results: Eight studies met the inclusion criteria. All three plants demonstrated significant anti-inflammatory, antimicrobial, and antioxidant activity, with *C. gileadensis* additionally showing cytotoxicity against prostate, liver, and cervical cancer cells. *A. tortilis* exhibited antidiabetic and antihypertensive effects, while *A. ehrenbergiana* showed anticancer and wound-healing properties. However, potential risks such as hepatotoxicity, hypersensitivity, and drug interactions were also noted, indicating the need for controlled clinical studies.

Conclusion: The reviewed species exhibit considerable pharmacological potential, supporting their traditional uses. Nevertheless, their integration into modern medicine requires standardized extraction methods, toxicological assessments, and well-designed clinical trials to confirm efficacy and safety in human populations.

Keywords: *Commiphora gileadensis*, *Acacia tortilis*, *Acacia ehrenbergiana*, Traditional Medicine, Antimicrobial, Systematic Review

INTRODUCTION

Traditional medicine has long served as a foundational pillar of healthcare systems worldwide, particularly in regions where access to modern pharmaceuticals remains limited. The persistent reliance on plant-based remedies stems from their rich repository of bioactive compounds, often passed through generations as part of indigenous knowledge systems. In arid and semi-arid environments like the Najran region of Saudi Arabia, traditional medicine has played an especially vital role, with native plant species evolving under harsh ecological pressures to develop unique phytochemical defenses. These bioactive adaptations have made certain plants pharmacologically significant. Among the most noteworthy are *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana*, all of which are endemic to the Najran desert landscape and have been employed for centuries in local healing practices (1,2). Their clinical potential has attracted increasing scientific interest in recent years, particularly for their antimicrobial, anti-inflammatory, antioxidant, and anticancer properties (3). Despite the long-standing use of these species in ethnomedicine, contemporary research remains fragmented and limited in scope. While individual studies have explored specific pharmacological actions or isolated bioactive constituents, comprehensive syntheses that evaluate their therapeutic potential in a clinically meaningful way are lacking. This knowledge gap is particularly concerning given the rise in global interest toward natural, plant-based therapeutics as alternatives to synthetic drugs, many of which carry significant side effect profiles and resistance concerns. Furthermore, as antimicrobial resistance and non-communicable diseases continue to escalate worldwide, the need for novel, effective, and safer therapeutic options have become a public health imperative (4,5). Thus, a systematic review consolidating data on the phytochemistry, pharmacodynamics, and clinical applications of these desert-adapted plants is urgently warranted.

The primary research question guiding this review is: What are the phytochemical profiles, pharmacological activities, and therapeutic applications of *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana* in the context of traditional and contemporary medicine? This review focuses on medicinal plants traditionally used by the population in the Najran region (Population), with a critical evaluation of their bioactive properties and therapeutic benefits (Intervention), without restriction to a specific comparator (Comparison), and aims to assess their potential as pharmacological agents for various diseases (Outcome). Studies published in the past five years were considered, ensuring that the data presented are reflective of the most recent scientific advancements. Research conducted globally but focused on these species was included to provide a comprehensive perspective (6,7). This review incorporates both experimental and observational studies, including in vitro assays, in vivo models, and ethnopharmacological surveys, offering a multidimensional understanding of the medicinal value of these plants. Emphasis is also placed on identifying toxicological profiles, contraindications, and pharmacokinetic limitations to support future clinical translation. By focusing on literature from 2019 to 2024, this review captures recent developments in natural product pharmacology and situates the findings within broader drug discovery efforts. In synthesizing this body of evidence, the review aims to bridge the gap between traditional ethnobotanical knowledge and modern pharmacological research. It highlights the potential of these plants not only as leads for drug development but also as sustainable medicinal resources in regions with limited access to synthetic therapies. Moreover, this review aligns with the principles outlined in PRISMA guidelines, ensuring methodological rigor and transparency. Ultimately, it aspires to provide a robust evidence base that may guide clinicians, researchers, and policymakers in recognizing and leveraging the untapped pharmacological wealth embedded within the flora of the Najran desert.

METHODS

A systematic and comprehensive literature search was conducted in accordance with PRISMA guidelines to identify relevant studies assessing the phytochemical composition and pharmacological properties of *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana*. The databases explored included PubMed, Scopus, ScienceDirect, Google Scholar, and Web of Science. The search strategy employed Boolean operators and combinations of Medical Subject Headings (MeSH) and free-text terms such as: "Commiphora gileadensis" AND "phytochemicals" OR "biological activities" OR "antimicrobial" OR "anti-inflammatory" OR "anticancer" OR "Najran medicinal plants"; "Acacia tortilis" AND "therapeutic application" OR "bioactive compounds" OR "antidiabetic"; and "Acacia ehrenbergiana" AND "ethnomedicine" OR "antioxidants". Manual research was also performed through the reference lists of selected articles to capture additional relevant studies not indexed in the databases. Inclusion criteria comprised original research articles published in English between January 2000 and December 2023, focusing on human or in vitro/in vivo studies evaluating the phytochemical constitution and pharmacological effects of the three specified plants. Eligible study designs included randomized controlled trials (RCTs), experimental studies, observational studies, and ethnobotanical field surveys. Studies were selected if they provided clear data on bioactive constituents, extraction methods, or therapeutic effects—such as antimicrobial, antioxidant, anti-inflammatory, anticancer, or antidiabetic activities. Exclusion criteria included review articles, editorials, letters, animal-only studies without relevance to human health, studies unrelated to the target plants, or those lacking sufficient methodological clarity or extractable data.

The study selection process involved independent screening by two reviewers. Titles and abstracts were initially reviewed for relevance, followed by full-text assessments. Any disagreements were resolved through discussion or by consulting a third reviewer. Reference management was facilitated using EndNote software to remove duplicates and track article eligibility. A PRISMA flow diagram was used to document the selection process and is available upon request. Data extraction was performed using a structured extraction form that captured the following variables: plant species, study location, study design, year of publication, extraction techniques, identified phytochemicals, pharmacological activities investigated, and outcomes. The extracted data emphasized the therapeutic applications most commonly studied across the literature, including antimicrobial, antioxidant, anti-inflammatory, anticancer, and antidiabetic effects. To evaluate the methodological quality and risk of bias across studies, two reviewers independently applied the Newcastle-Ottawa Scale (NOS) for observational studies and the Cochrane Risk of Bias Tool for randomized trials. Bias was assessed in relation to sample selection, performance, detection, attrition, and reporting. Studies were graded as high, moderate, or low quality based on cumulative scoring across domains.

The review employed qualitative synthesis, integrating evidence narratively due to heterogeneity in methodology and outcome measures across the included studies. No meta-analysis was conducted, given the variability in plant part used, extraction methods, and outcome endpoints. However, the synthesis aimed to provide a comprehensive, clinically relevant interpretation of the pharmacological potential of these medicinal species. Eight studies met the inclusion criteria and were included in the final synthesis. Investigated the cytotoxic and antibacterial activities of *Commiphora gileadensis* resin, highlighting its effects against prostate and liver cancer cell lines (8). In vitro evidence for its wound healing and antimicrobial capabilities (9). The resin's antioxidant activity using DPPH and FRAP assays (10). For *Acacia tortilis*, its antidiabetic effect by analyzing its impact on blood glucose regulation in diabetic rats (11). A further study investigated its antioxidant and antihypertensive properties (12). Another study highlighted its antibacterial activity, particularly against *Staphylococcus aureus* (13). Regarding *Acacia ehrenbergiana*, reported its anti-inflammatory efficacy in gastrointestinal inflammation models, and another study evaluated its antimicrobial effects against respiratory pathogens (14,15).

RESULTS

A total of 346 records were initially retrieved from five major databases, including PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar. After the removal of duplicates (n=97), 249 articles remained for title and abstract screening. Following this phase, 181 studies were excluded based on irrelevance to the target plant species or outcomes. The remaining 68 full-text articles were assessed for eligibility, with 60 excluded due to reasons such as insufficient data on pharmacological activity, animal-only studies, or lack of standardization in methodology. Ultimately, 8 studies published between 2000 and 2023 met the inclusion criteria and were incorporated into the final synthesis. The study selection process was documented in accordance with PRISMA guidelines. The eight selected studies were diverse in their methodological designs and geographical locations but shared a common focus on the ethnobotanical, phytochemical, and pharmacological properties of *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana*. Most studies utilized in vitro and in vivo models to assess bioactivity, while others included ethnopharmacological surveys. The sample sizes varied, with laboratory-based studies involving triplicates of each assay, and ethnobotanical surveys involving up to 100 informants. The interventions examined included crude extracts (methanolic, ethanolic, and aqueous), essential oils, and isolated compounds. Primary outcomes evaluated were antimicrobial, antioxidant, anti-inflammatory, anticancer, and antidiabetic effects. Quality appraisal of the studies revealed moderate to high methodological soundness. The Cochrane Risk of Bias Tool was applied to the in vivo studies and indicated low risk in domains of randomization and reporting, but occasional unclear risk regarding allocation concealment. In vitro studies were evaluated using adapted versions of the Newcastle-Ottawa Scale, scoring high on clarity of objective, reproducibility, and appropriateness of bioassay methods. Common limitations across several studies included small sample size and absence of long-term toxicity assessments.

Commiphora gileadensis

Ethnobotanical uses confirmed its widespread application for digestive and liver-related conditions, wound healing, and inflammatory ailments. Phytochemical analyses consistently identified sesquiterpenoids, triterpenoids, and aliphatic alcohol glycosides as the major constituents responsible for its therapeutic action. The plant exhibited notable pharmacological activities, with resin extracts showing potent cytotoxic effects against prostate, liver, and cervical cancer cell lines, in addition to broad-spectrum antimicrobial effects (8,9). Essential oils inhibited both Gram-positive and Gram-negative bacteria, supporting its application in skin and gastrointestinal infections. Anti-inflammatory studies revealed reductions in pro-inflammatory cytokines, underscoring its efficacy in chronic diseases linked to oxidative stress. Applications include topical formulations for wound healing and oral preparations for liver and digestive health, with growing interest in its role in cancer therapeutics. However, risk factors include skin irritation, hepatotoxicity in high doses, and interactions with anticoagulants (10,11).

Acacia tortilis

Ethnobotanical evidence pointed to its use in wound care, diabetes management, respiratory infections, and inflammatory skin conditions. Phytochemical composition featured vicenin, rutin, tannins, and phenolic acids, imparting anti-inflammatory, antioxidant, and antimicrobial properties (12). Pharmacologically, the plant demonstrated antibacterial action against *Staphylococcus aureus* and *Pseudomonas aeruginosa*, as well as antioxidant effects via free radical scavenging. Its antidiabetic activity was validated through blood glucose normalization in diabetic models. Applications include topical antiseptics, skincare agents, and natural oral hypoglycemics. Risks include gastrointestinal disturbances at high doses and hypoglycemia, particularly in diabetic patients on concurrent medication (12,13).

Acacia ehrenbergiana

Ethnobotanical usage highlighted the plant's dual role in medicine and agriculture, especially as a fodder and firewood source alongside wound and infection treatment (14). Its phytochemical profile includes saponins, flavonoids (quercetin, myricetin), alkaloids, and tannins, which jointly contribute to its antimicrobial, anti-inflammatory, and anticancer effects. Extracts exhibited cytotoxicity against breast and colon cancer cells (and flavonoid-rich preparations significantly downregulated inflammatory cytokines in arthritis and gastrointestinal inflammation models. Antibacterial effects were reported against *Escherichia coli* and *Staphylococcus aureus*, reinforcing its traditional use in wound management and respiratory infections. Applications range from adjuncts in cancer therapy to natural remedies for dermatological conditions. Risk factors include hepatotoxicity with long-term use and allergic reactions in sensitive individuals, necessitating caution in application, especially for patients with hepatic comorbidities or known hypersensitivity (14,15).

Table 1. Applications/properties of Commiphora gileadensis.

Application/Properties	Benefits/Role	Dosage type	Target	References
Anticancer	Cytotoxic Effect against prostate, liver, and cervical cancers	Oral/Topical extracts	prostate, liver, and cervical cancers	(Shadid et al., 2023)
Antimicrobial	Inhibit bacterial and fungal growth	Oral/Topical extracts	Skin Infections, gastrointestinal infections	(Shadid et al., 2023)
Wound Healing	Promotes wound healing and prevents infections	Topical resins	Cuts, abrasions, skin infections	(Hannachi et al., 2011)

Table 2. Applications/properties of Acacia tortilis.

Application/Properties	Benefits/Role	Dosage type	Target	References
Antimicrobial	Effective against Staphylococcus aureus and aeruginosa	Topical extracts	Skin Infections, gastrointestinal infections	(Hamadou et al., 2022)
Antioxidant	Reduce Oxidative Stress	Oral/Topical extracts	Oxidative stress-related conditions can prevent	(Datti Gwarzo et al., 2022)
Antidiabetic	It helps regulate blood sugar levels	Oral Extract	Diabetes	(Bhateja & Dahiya, 2014)

Table 3. Applications/properties of Acacia ehrenbergiana.

Application/Properties	Benefits/Role	Dosage type	Target	References
Anticancer	Exhibits Cytotoxicity against breast and colon cancer cells	Oral extracts	Breast cancer and colon cancer	(Eldesoukey, 2018)
Antiinflammatory	Modulates inflammatory response	Oral/Topical extracts	Arthritis, gastrointestinal inflammation, asthma	(I. Mohammad et al., 2017)
Antibacterial	Effective against common Pathogens	Topical extracts	Skin infections, respiratory infection	(Eldesoukey, 2018)

DISCUSSION

Medicinal Properties of Commiphora gileadensis

This systematic review highlights *Commiphora gileadensis* as a plant of significant medicinal relevance, underpinned by both ethnobotanical knowledge and emerging pharmacological data. Its traditional use for inflammatory conditions, skin infections, and gastrointestinal issues is well supported by studies identifying key phytochemicals such as diterpenoids, sesquiterpenoids, and essential oils (16). Experimental research validates its antimicrobial activity against a wide range of pathogens, as well as its anti-inflammatory and analgesic effects. Notably, its resin exhibits cytotoxic effects on prostate, liver, and cervical cancer cell lines, indicating potential for anticancer drug development (17,18). While these results are promising, current evidence is largely limited to preclinical settings, and there remains a lack of human clinical trials evaluating efficacy and safety. The pharmacological mechanisms of action, although partially understood, require further investigation to support its therapeutic integration into clinical protocols (19).

Medicinal Properties of Acacia tortilis

Acacia tortilis is recognized for its pharmacological versatility, with bioactive constituents including flavonoids (rutin, vicenin), tannins, and fatty acids contributing to its antidiabetic, antioxidant, and antimicrobial activities (20). Traditional practices across arid regions have relied on this species for managing wounds, diabetes, and inflammatory skin disorders. Contemporary findings corroborate these uses, with experimental studies demonstrating improved glycemic control and reduced oxidative stress in diabetic models. Furthermore, *A. tortilis* has been effective in inhibiting pathogenic bacteria such as *Staphylococcus aureus* and *Pseudomonas aeruginosa*. Its role in cardiovascular health is also emerging, particularly through its antihypertensive effects (21). Despite its broad therapeutic spectrum, concerns remain regarding gastrointestinal side effects and potential hypoglycemia with excessive or unregulated use. These findings underscore the importance of dosage standardization and the need for controlled clinical validation.

Medicinal Properties of Acacia ehrenbergiana

The review confirms that *Acacia ehrenbergiana* possesses substantial therapeutic efficacy, particularly in managing inflammatory and infectious diseases. Traditionally used for treating wounds, gastrointestinal inflammation, and respiratory ailments, this plant's efficacy is attributed to phytochemicals such as saponins, flavonoids, alkaloids, and tannins (22). Its antibacterial activity against common pathogens and its ability to suppress pro-inflammatory cytokines are consistent across multiple studies. The plant also shows anticancer potential, with extracts demonstrating cytotoxicity against breast and colon cancer cells. These properties make it a strong candidate for adjunctive use in cancer and inflammatory disease management. However, hepatotoxicity and allergic responses have been reported with prolonged use, highlighting the importance of toxicological assessments and patient screening before application (23).

Comparative Analysis of the Three Plants

Comparative evaluation reveals that *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana* share overlapping therapeutic properties—particularly antimicrobial, anti-inflammatory, and antioxidant activities—yet they differ in phytochemical composition and pharmacological strengths. While *C. gileadensis* is particularly notable for its wound-healing and anticancer potential, *A. tortilis* stands out for its efficacy in metabolic syndrome management, especially diabetes and hypertension. Conversely, *A. ehrenbergiana* shows strong anticancer and antimicrobial effects, particularly in skin and respiratory infections (24). These distinctions suggest that while these plants can function independently, their combined use in polyherbal formulations may yield synergistic therapeutic outcomes, especially for chronic inflammatory diseases where multifactorial intervention is beneficial. Such synergy supports the concept of integrated phytotherapy, particularly in communities with limited access to modern pharmaceuticals (24,25).

Therapeutic and Application Potential in Modern Medicine

The findings from this review provide a compelling case for incorporating these three plant species into modern therapeutic frameworks. Their diverse pharmacological profiles make them valuable candidates for natural drug development aimed at treating inflammation, infections, and cancers. However, translating traditional applications into standardized pharmaceutical products necessitates a robust pipeline of phytochemical characterization, bioavailability studies, toxicity profiling, and clinical validation (26). Given their origin from arid ecosystems, these plants also present sustainable alternatives to synthetic drugs with minimal environmental impact. Furthermore, their integration into modern medicine may support the development of regionally tailored treatment options in Saudi Arabia and other biodiversity-rich regions. Successful translation requires collaboration between traditional knowledge holders, researchers, and regulatory bodies to ensure safety, efficacy, and cultural relevance.

Challenges and Research Gaps

Despite their promise, several challenges hinder the widespread medical adoption of these plants. Chief among them is the lack of large-scale, randomized clinical trials, which limits the generalizability and clinical relevance of current findings (26). Most studies to date are either in vitro or animal-based, offering only preliminary insights into pharmacodynamics and pharmacokinetics. Additionally, inconsistencies in extraction methods, plant part usage, and dosage forms make it difficult to standardize protocols or compare outcomes across studies. Another barrier is limited institutional support and research infrastructure in regions like Najran, where these species are most prevalent. Without adequate funding and policy support, ethnobotanical knowledge remains underutilized and risks being lost. Addressing these gaps requires interdisciplinary collaboration, investment in clinical research, and policy reforms to support traditional medicine integration. Ultimately, standardization, quality control, and human trials are essential next steps to fully harness the medicinal potential of *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana*.

CONCLUSION

This systematic review confirms that *Commiphora gileadensis*, *Acacia tortilis*, and *Acacia ehrenbergiana*, native to the Najran region of Saudi Arabia, hold substantial therapeutic promise due to their broad spectrum of pharmacological properties, including anti-inflammatory, antimicrobial, antioxidant, and anticancer activities. Their traditional use is well supported by preclinical evidence, indicating potential applications in managing chronic diseases such as infections, metabolic disorders, and cancer. Clinically, these findings highlight the relevance of these plants as natural, accessible alternatives to synthetic medications, particularly in resource-limited settings. However, the current body of evidence is largely based on in vitro and animal studies, limiting its direct applicability in human medicine. Further research involving well-designed clinical trials and standardized extraction protocols is crucial to validate their safety, efficacy, and dosage, ensuring their integration into modern healthcare practices while preserving the ethnomedical heritage from which they originate.

AUTHOR CONTRIBUTION

Author	Contribution
Hussain Ali Alyami	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Abdelalim Abusabha	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Ibraheam A.M Tarawneh*	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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Malath Al -Mahri	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Mzon Al-Nemrah	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Ghina Al-Atef	Contributed to study concept and Data collection Has given Final Approval of the version to be published
Norah Ahmadi	Writing - Review & Editing, Assistance with Data Curation
Fatimah Al-Nemrah	Writing - Review & Editing, Assistance with Data Curation
Wujud Ali Al Masad	Writing - Review & Editing, Assistance with Data Curation

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