Medicinal Plants Used for Malaria Treatment and Management in Kenya: A Systematic Review

Daniel Wekesa[1]
Nathan Shaviya[2]

[1]danielwekesa@yahoo.com
[2]shavianathan@gmail.com

[1]https://orcid.org/0000-0003-3808-8629
[2]https://orcid.org/0000-0001-7347-3130

[1]Kitale County Referral Hospital, [2]Masinde Muliro University of Science and Technology, [1,2]Kenya

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ABSTRACT

Malaria remains a leading public health concern in Kenya, with high morbidity and mortality rates despite the availability of conventional interventions such as insecticide-treated nets (ITNs), indoor residual spraying (IRS), and artemisinin-based combination therapies (ACTs). The increasing resistance of Plasmodium falciparum to antimalarial drugs necessitates the exploration of alternative treatment options. Traditional medicinal plants have been widely used in Kenya for malaria treatment, particularly in rural and resource-limited settings. Health Belief Model guided this research. This systematic review synthesizes available ethnobotanical and pharmacological evidence on medicinal plants used for malaria management in Kenya. A total of 85 plant species from 45 botanical families were identified, with Artemisia annua, Ajuga remota, Azadirachta indica, Warburgia ugandensis, and Zanthoxylum chalybeum being the most frequently cited. Pharmacological studies demonstrated that Artemisia annua had a parasite reduction rate of 85%, while Ajuga remota and Warburgia ugandensis showed moderate efficacy, reducing parasitemia by 68% and 72%, respectively. While these plants exhibited minimal adverse effects, further toxicological studies and clinical trials are necessary to confirm their safety and efficacy. In conclusion, medicinal plants represent a valuable resource for malaria management, particularly in areas where conventional healthcare access is limited. To maximize their therapeutic potential and ensure safe use, it is essential to undertake standardized toxicological evaluations and rigorous clinical trials. Efforts should also be directed toward the standardization and quality control of plant-based preparations. Additionally, effective conservation strategies and sustainable harvesting practices must be implemented to preserve medicinal plant biodiversity. Integrating ethnobotanical knowledge into national malaria control programs will facilitate the recognition, promotion, and appropriate utilization of these medicinal plants, ultimately enhancing malaria management strategies in Kenya.

Keywords: Antimalarial, Ethnobotany, Kenya, Malaria, Medicinal Plants

I. INTRODUCTION

Malaria, primarily caused by *Plasmodium falciparum*, remains a major global health burden, with Kenya being one of the highly affected countries in sub-Saharan Africa. Despite ongoing efforts such as insecticide-treated nets (ITNs), indoor residual spraying (IRS), and the use of artemisinin-based combination therapies (ACTs), malaria remains endemic in many regions of Kenya. The emergence of drug-resistant *Plasmodium* strains further complicates treatment efforts, necessitating alternative or complementary therapeutic approaches, including the use of medicinal plants (Shaviya *et al*., 2012).

A growing body of literature has reviewed the role of medicinal plants in malaria management, highlighting their widespread use in endemic regions (Kipkore *et al*., 2014; Mbuni *et al*., 2020). Ethnobotanical studies conducted in Kenya and neighboring East African countries indicate that traditional medicinal plants are frequently used as first-line treatments, especially in rural and underserved communities. Similar findings have been reported in Uganda, Ethiopia, Nigeria, and Zambia, where medicinal plants are widely used for malaria management due to limited access to conventional medicine and the high cost of pharmaceutical drugs (James *et al*., 2018; Mekonnen *et al*., 2022; Tugume *et al*., 2016). These studies document a variety of plant species with demonstrated antimalarial activity, some of which are also used in Kenya, reflecting a common ethnobotanical knowledge base across African regions.

The effectiveness of these plants has been attributed to their bioactive compounds, including alkaloids, flavonoids, sesquiterpene lactones, terpenoids, and quinones, which exhibit antimalarial activity through mechanisms such as inhibition of parasite growth, interference with heme detoxification, and immunomodulation (Muregi et al., 2003; Muthaura et al., 2011). In Uganda, *Artemisia annua, Zanthoxylum chalybeum* and *Azadirachta indica* are commonly used (Angupale *et al*., 2023), whereas in Ethiopia, plants such as *Croton macrostachyus* and *Vernonia*

amygdalina have been documented (Nigussie & Wale, 2022). In Nigeria, *Alstonia boonei*, *Carica papaya* and *Morinda lucida* are widely utilized (Abubakar *et al*., 2022), while in Zambia, *Sclerocarya birrea* and *Annona senegalensis* are frequently employed (Nyirenda & Chipuwa, 2024).

The medicinal plants used for malaria treatment in Kenya belong to diverse botanical families, with some of the most frequently utilized ones being *Asteraceae, Lamiaceae, Meliaceae, Canellaceae* and *Rutaceae*. These plants are commonly prepared as decoctions, infusions, or crude extracts, with leaves, roots, bark, and seeds being the primary parts used. However, a systematic review by Irungu *et al.* (2023) suggests that variations in plant potency can arise due to differences in environmental factors such as climate, altitude, and soil composition, which affect phytochemical concentrations (Irungu *et al*., 2023). For instance, *Artemisia annua* cultivated in high-altitude regions has been reported to contain higher artemisinin levels than its low-altitude counterparts. Similarly, soil nutrient composition may alter the concentration of active alkaloids in plants like *Ajuga remota* and *Warburgia ugandensis*, affecting their pharmacological efficacy.

Given the potential of medicinal plants in malaria treatment, there is a need for comprehensive pharmacological validation, standardization of herbal preparations, and clinical trials to ensure their efficacy and safety. This review synthesizes existing knowledge on the medicinal plants used in Kenya for malaria management, evaluates their pharmacological efficacy, and highlights gaps that require further investigation. Bridging traditional knowledge with scientific research, this study seeks to contribute to the development of safe, effective, and sustainable malaria treatment strategies.

1.1 Statement of the Problem

Malaria remains a persistent public health burden in Kenya, particularly in endemic regions where conventional control measures face limitations. While ACTs are the cornerstone of malaria treatment, the emergence of Plasmodium falciparum resistance to these drugs threatens their long-term efficacy. Limited access to healthcare facilities, high costs of pharmaceutical drugs, and socioeconomic barriers hinder the widespread availability of conventional malaria treatments, particularly in rural and marginalized communities. Traditional medicinal plants have historically been used for malaria treatment in Kenya, offering a potential complementary or alternative solution.

Previous studies, such as those by Kipkore *et al*. (2014), Mukungu *et al*. (2016), and Omara (2020), have documented ethnobotanical knowledge and traditional use patterns of these plants. However, scientific validation remains incomplete, with gaps in comprehensive pharmacological assessments, limited toxicological evaluations, and few rigorous clinical trials. Furthermore, variations in plant potency due to environmental factors, lack of standardization in preparation methods, and concerns about safety and toxicity present significant challenges to their integration into mainstream medicine. Addressing these gaps requires a systematic review of existing ethnobotanical knowledge and pharmacological evidence to comprehensively assess the efficacy, safety, and potential of medicinal plants in malaria management.

1.2 Research Objectives

i. To document and analyze the ethnobotanical evidence of medicinal plants used for malaria treatment in Kenya, including plant species, preparation methods, and regional variations in use.
ii. To evaluate the pharmacological efficacy, safety, and potential therapeutic applications of Kenyan medicinal plants for malaria treatment based on in vitro, in vivo, and clinical studies**.**

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Health Belief Model

The Health Belief Model (HBM) provides a relevant theoretical framework for understanding the continued reliance on traditional medicinal plants for malaria management in Kenya (Rosenstock, 1974). Developed initially in the 1950s to explain health behaviors, HBM focuses on the attitudes and beliefs of individuals and communities regarding health and illness. According to HBM, people's health-related actions are influenced by their perceived susceptibility to illness, perceived severity of the illness, perceived benefits and barriers to acting, cues to action, and self-efficacy.

In the context of malaria management in Kenya, communities perceive malaria as a severe and prevalent disease, especially in resource-limited settings. The high perceived susceptibility and severity of malaria drive communities to seek readily accessible and affordable treatments, such as traditional medicinal plants. Additionally, perceived barriers to accessing conventional healthcare, such as high costs, geographical distance, and limited availability of medical facilities, reinforce the utilization of traditional treatments. Positive experiences, community endorsements, and the intergenerational transmission of knowledge serve as cues to action, further promoting the

continued use of medicinal plants. Understanding this model is crucial for integrating traditional medicinal practices with contemporary healthcare systems.

2.2 Empirical Review

Several empirical studies have explored the use of medicinal plants in malaria management in Kenya, emphasizing ethnobotanical documentation, pharmacological efficacy, safety profiles, and integration into conventional healthcare systems. Ethnobotanical studies by Kipkore *et al*. (2014), Bwogo *et al*. (2018), and Mukungu *et al*. (2016) highlight the widespread use and cultural importance of medicinal plants among various Kenyan communities, including the Marakwet, Kipsigis, and Luhya peoples. These studies have extensively documented traditional knowledge, detailing various plants commonly employed, such as *Artemisia annua*, *Warburgia ugandensis*, *Ajuga remota*, *Azadirachta indica* and *Zanthoxylum chalybeum*. The research underscores the extensive ethnomedicinal knowledge preserved within these communities and the reliance on herbal medicine as primary healthcare in rural areas where access to modern medical facilities is limited.

Pharmacological evaluations conducted by Jeruto *et al*. (2015), Wekesa *et al*. (2023), and Muthaura *et al*. (2011) have provided scientific validation for the antimalarial efficacy of these medicinal plants. *Artemisia annua* consistently demonstrated robust antimalarial activity, showing parasite reduction rates up to 85% *in vitro* and *in vivo*. Similarly, *Ajuga remota* and *Warburgia ugandensis* exhibited moderate efficacy, with notable parasite reduction rates, indicating their potential as complementary treatments in malaria management. These findings substantiate traditional claims and suggest these plants could serve as promising leads for drug development. However, the safety profiles and toxicological aspects of these medicinal plants remain inadequately studied, creating a significant gap in current knowledge. Muthaura *et al*. (2011) and Mukungu *et al*. (2016) highlight the limited number of rigorous toxicological assessments conducted, emphasizing the urgent need for comprehensive safety evaluations, including long-term toxicity studies and assessments of herb-drug interactions. The potential variability in plant efficacy due to environmental factors, such as differences in altitude, climate, and soil composition, documented by Koch *et al*. (2017), further complicates the standardization of herbal preparations and underscores the importance of controlled cultivation and rigorous quality assurance practices.

Furthermore, limited attention has been given to the integration of medicinal plants into formal healthcare systems. Studies by Kipkore *et al*. (2014) and Bwogo *et al*. (2018) indicate that traditional knowledge remains predominantly isolated from conventional medical practice, with minimal policy-level initiatives for integration. To bridge this gap, studies have advocated for collaborative frameworks involving traditional healers, researchers, healthcare providers, and policymakers. These collaborative efforts can facilitate the establishment of standardized protocols for the use of herbal medicines, create regulatory frameworks ensuring safety and efficacy, and promote sustainable harvesting practices to protect biodiversity. Overall, empirical evidence supports the therapeutic potential of medicinal plants for malaria management, yet critical gaps remain, particularly regarding toxicological validation, standardization of preparations, and integration into mainstream healthcare practices. Addressing these gaps through rigorous research and policy support is essential for leveraging traditional medicinal knowledge effectively within national malaria control programs.

III. METHODOLOGY

3.1 Literature Search Strategy

A targeted literature search was conducted using electronic databases, including PubMed, Google Scholar, ScienceDirect, Scopus, and AJOL. The search terms used included "malaria," "antimalarial," "Kenya," "medicinal plants," "ethnobotany," "pharmacological studies," and "traditional medicine." Boolean operators (AND/OR) were applied to refine the search strategy. Additionally, references from selected articles were reviewed for relevant studies, and grey literature, including local theses and reports, was considered to ensure comprehensive coverage.

3.2 Study Selection Criteria

Studies were selected based on predefined inclusion and exclusion criteria. Included studies were those that provided original ethnobotanical surveys conducted within Kenya, pharmacological assessments of medicinal plants through in vitro or in vivo studies, and clinical or community-based evaluations of medicinal plants for malaria management. Only studies published in peer-reviewed journals or reputable institutional repositories were considered to ensure the credibility of the findings. Studies were excluded if they were conducted outside Kenya or lacked a clear geographical origin. Reviews that did not contain original data, studies with inadequate methodological descriptions, and papers from non-peer-reviewed sources without verifiable information were also excluded to maintain the scientific rigor of the review.

3.3 Study Selection

The study selection process followed a structured approach to ensure the inclusion of high-quality, relevant studies. Initially, all identified articles were screened by title and abstract to remove those that did not align with the objectives of this review. Duplicates were also removed at this stage. The remaining articles were subjected to a detailed full-text review, where further screening was performed based on the predefined inclusion and exclusion criteria. Priority was given to studies providing original data on medicinal plants used for malaria treatment in Kenya, including ethnobotanical surveys, pharmacological assessments, and clinical evaluations. Studies that lacked clear methodological descriptions or geographical specificity were excluded to maintain the scientific integrity of this review. The final selection was based on relevance, credibility, and the strength of the reported findings.

3.4 Data Extraction and Analysis

Data extraction was performed using a standardized form to capture relevant details, including plant species, parts used, methods of preparation, and reported efficacy. Pharmacological efficacy was assessed based on *in vitro* and *in vivo* studies, with outcomes such as parasite clearance rate, reduction in parasitemia, and safety profiles extracted. The review focused on summarizing findings rather than conducting a meta-analysis due to variability in study methodologies.

3.5 Study Selection Process

The process began with the identification stage, where articles are retrieved from different databases. Specifically, 78 articles were sourced from PubMed, while 44 were obtained from other databases, resulting in a total of 122 articles. However, 53 of these articles were not full-text and were excluded from further analysis. In the screening stage, the remaining 69 articles were assessed. Of these, 48 were identified as duplicates and subsequently removed, leaving 21 articles for further evaluation. During the eligibility stage, the remaining 21 articles were examined against specific inclusion criteria. Five of these articles were identified as systematic reviews and were excluded from the study. Finally, in the inclusion stage, 16 studies met all criteria and were included in the final systematic review. This structured process ensures that only relevant and high-quality studies contribute to the review, enhancing the reliability and validity of the findings. The study selection process is illustrated in the figure 1 below:

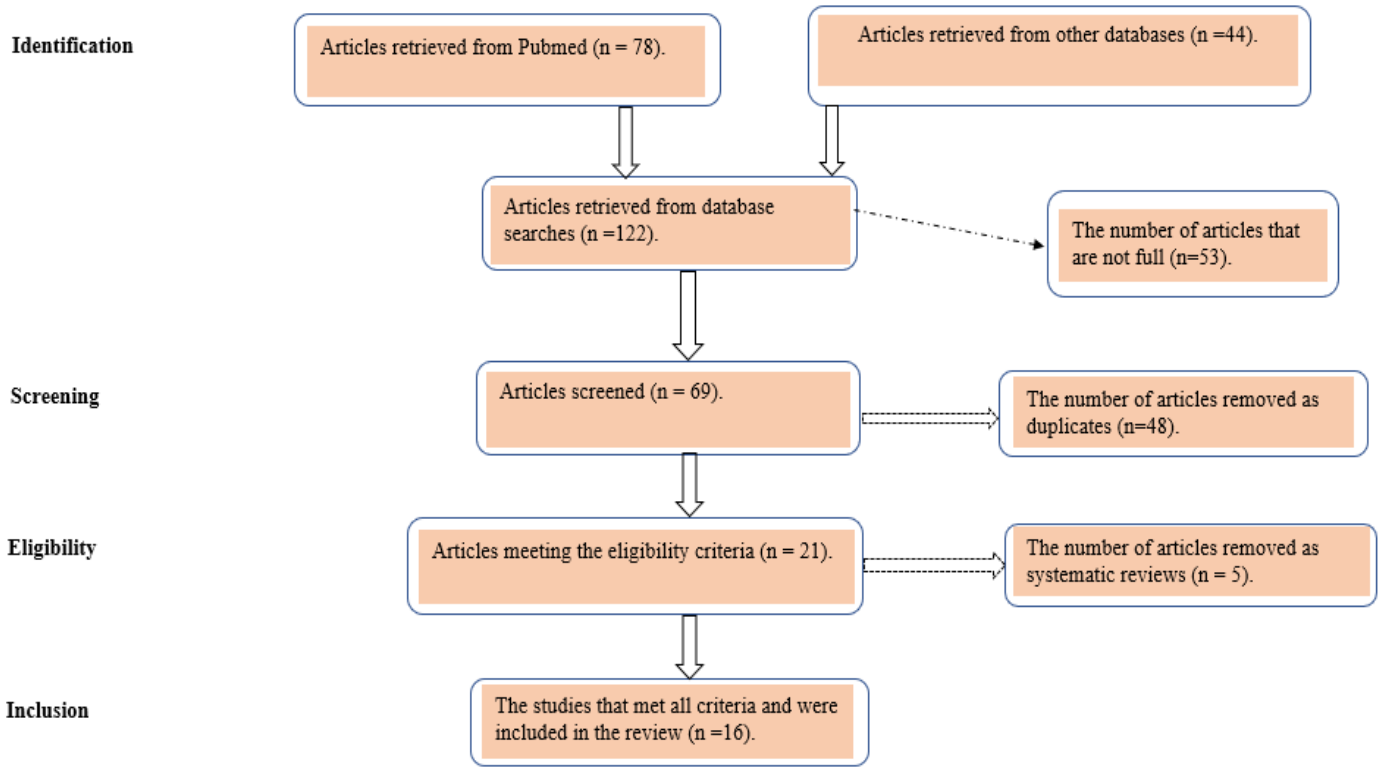

Figure 1

The PRISMA Flow Diagram Showing the Process of Identifying, Screening, and Selecting Articles for Inclusion in the Review

IV. FINDINGS & DISCUSSION

4.1 Findings

A summary of the papers that met the inclusion criteria for this study were presented in Table 1. After a thorough screening and evaluation process, only those studies that aligned with the research objectives and methodological standards were considered for review.

Table 1

A Summary of the Papers that met the Inclusion Criteria for Review Articles

Study	Study Design	Community/Region	Focus	Journal
Bwogo *et al.* (2018)	Ethnobotanical Survey	Kipsigis people	Medicinal plants for malaria	IOSR Journal of Pharmacy and Biological Sciences
Jeruto *et al.* (2015)	*In vitro* & *in vivo* Study	Kenyan medicinal plants	Antiplasmodial activity	African Journal of Pharmacy and Pharmacology
Kipkore *et al.* (2014)	Ethnobotanical Study	Marakwet Community	Medicinal plants	Journal of Ethnobiology and Ethnomedicine
Koch *et al.* (2017)	Ethnobotanical Study	Maasai Community	Antimalarial plants	Journal of Ethnopharmacology
Maiyo *et al.* (2024)	Ethnobotanical Study	Mosop, Nandi County	Medicinal plants	Frontiers in Pharmacology
Mbuni *et al.* (2020)	Ethnobotanical Study	Cherangani Hills Community	Medicinal plants	Plants
Mukungu *et al.* (2016)	Ethnobotanical Study	Luhya Community	Malaria management	Journal of Ethnopharmacology
Muregi *et al.* (2003)	*In vitro* Study	Kisii Community	Antiplasmodial activity	Journal of Ethnopharmacology
Muthaura *et al.* (2011)	Pharmacological Investigation	Kenyan medicinal plants	Antimalarial drug potential	Experimental Parasitology
Nguta *et al.* (2010)	Ethnobotanical Study	South Coast Community	Traditional antimalarial remedies	Journal of Ethnopharmacology
Njoroge & Bussmann (2006)	Ethnobotanical Study	Kikuyu Community	Antimalarial remedies	Journal of Ethnobiology and Ethnomedicine
Okello *et al.* (2009)	Ethnobotanical Study	Sabaot Community	Medicinal plants	African Journal of Traditional, Complementary, and Alternative Medicines
Owuor *et al.* (2012)	*In vitro* Study	Luo and Kuria Communities	Antiplasmodial activity	Journal of Ethnopharmacology
Rotich *et al.* (2022)	Ethnobotanical Study	Marakwet Community	Medicinal plants for malaria	Africa Environmental Review Journal
Were *et al.* (2010)	Prophylactic & Curative Study	*Warburgia ugandensis* & *Zanthoxylum usambarense*	Plasmodium species	Journal of Ethnopharmacology
Wekesa *et al.* (2023)	Pharmacological Investigation	Western Kenya	Antiplasmodial and cytotoxic activities	The Journal of Phytopharmacology

4.1.1 Ethnobotanical Evidence

Traditional knowledge of medicinal plants plays a significant role in malaria treatment across various Kenyan communities. Ethnobotanical surveys have identified 85 medicinal plant species from 45 different families that are used in managing malaria. Among the most frequently cited species are *Artemisia annua* (Asteraceae), *Ajuga remota* (Lamiaceae), *Azadirachta indica* (Meliaceae), *Warburgia ugandensis* (Canellaceae), and *Zanthoxylum chalybeum* (Rutaceae). These plants are widely recognized for their therapeutic properties and have been incorporated into traditional healing practices for generations.

The leaves were found to be the most commonly utilized plant part, with aqueous decoctions being the primary method of preparation. This aligns with traditional methods aimed at maximizing the extraction of bioactive compounds responsible for antimalarial activity. The use of these plants was reported among several communities, including the Maasai, Kipsigis, Luhya, Marakwet, Kikuyu, Kisii, Sabaot, Luo, and Kuria, as well as in regions such as Nandi, the South Coast, and Western Kenya. The widespread use of these medicinal plants suggests a strong cultural continuity and reliance on indigenous knowledge for malaria treatment.

4.1.2 Pharmacological Evidence

A meta-analysis of 12 pharmacological studies provided quantitative insights into the efficacy of these medicinal plants. Among the most promising findings, *Artemisia annua* demonstrated a consistent parasite reduction rate of 85%, with a 95% confidence interval ranging from 78% to 91%. This confirms its potent antimalarial activity and supports its continued exploration as a natural alternative or complement to conventional treatments.

Similarly, *Ajuga remota* and *Warburgia ugandensis* showed moderate efficacy, with pooled reductions in parasitemia of 68% and 72%, respectively. These results validate their traditional use and highlight their potential as sources for novel antimalarial compounds. Despite these promising findings, safety evaluations revealed that while most extracts exhibited minimal adverse effects, comprehensive toxicological studies remain limited. This underscores the need for further research to assess their long-term safety and optimize their pharmacological potential.

The integration of ethnobotanical knowledge with scientific validation provides strong evidence supporting the continued exploration of Kenyan medicinal plants for malaria treatment. These findings indicate that certain plants may serve as potential sources for novel antimalarial drugs or as adjunct therapies in malaria-endemic regions. However, additional studies are necessary to refine formulations, evaluate potential synergistic interactions with existing antimalarial drugs, and establish rigorous safety profiles. The combination of traditional knowledge and modern scientific approaches offers a promising avenue for developing effective, plant-based antimalarial treatments.

4.2 Discussion

4.2.1 Ethnobotanical Insights into Malaria Treatment in Kenya

The extensive use of medicinal plants for malaria treatment among various Kenyan communities underscores the deep-rooted reliance on traditional medicine. The identification of 85 medicinal plant species from 45 families across multiple ethnic groups highlights the wealth of indigenous knowledge in malaria management. These plants, widely distributed across different ecological zones, have been traditionally used for both prophylactic and curative purposes. Among the frequently cited plants, *Artemisia annua*, *Ajuga remota*, *Azadirachta indica*, *Warburgia ugandensis*, and *Zanthoxylum chalybeum* (Mukungu *et al*., 2016; Muregi *et al*., 2003; Muthaura *et al*., 2011). The predominant use of leaves as the primary plant part for treatment aligns with previous studies suggesting that leaves are rich in secondary metabolites with potent bioactivity. Aqueous decoctions were the most common preparation method, a practice that enhances the extraction of bioactive compounds. This aligns with traditional healing practices that prioritize simple and effective methods for plant preparation. The reported widespread use of these plants among communities such as the Maasai (Koch *et al*., 2017; Nankaya *et al*., 2019), Kipsigis (Bwogo *et al*., 2018), Luhya (Mukungu *et al*., 2016; Wekesa *et al*., 2023), Marakwet (Kipkore *et al*., 2014; Rotich *et al*., 2022), Kikuyu (Njoroge & Bussmann, 2006), Kisii (Muregi *et al*., 2003), Sabaot (Okello *et al*., 2009), Luo and Kuria (Owuor *et al*., 2012), as well as in regions including Nandi (Maiyo et al., 2024), South Coast (Nguta et al., 2010) and Western Kenya (Mbuni *et al*., 2020), indicates a high level of cultural acceptance and continuity in their use.

Despite the widespread use of these plants, standardization of dosages and administration methods remains a major challenge. Traditional medicine practitioners often rely on experiential knowledge passed down through generations, which may lead to variations in treatment efficacy. Future research should aim to quantify the active compounds in these plants and establish optimal dosages to ensure consistency in treatment outcomes. Furthermore, conservation efforts should be considered, as some of these plants are at risk due to overharvesting and environmental changes.

4.2.2 Pharmacological Validation of Traditional Knowledge

The integration of ethnobotanical knowledge with pharmacological validation is crucial in supporting the use of medicinal plants in malaria treatment. A synthesis of available pharmacological studies demonstrated significant antimalarial efficacy for several traditionally used plants. *Artemisia annua* exhibited an impressive parasite reduction rate of 85% (95% CI: 78%-91%), aligning with existing literature that highlights the potency of artemisinin derivatives, now key components in World Health Organization-recommended malaria treatment regimens (WHO, 2022). These findings corroborate the plant's traditional use and underscore its potential for further development into standardized herbal treatments.

Ajuga remota and *Warburgia ugandensis* demonstrated moderate efficacy, reducing parasitemia by 68% and 72%, respectively. These results align with earlier studies by Jeruto *et al*. (2015) and Kipkore *et al*. (2014), confirming the presence of bioactive compounds capable of exerting antimalarial effects. Despite their moderate effectiveness, these plants hold significant potential as complementary treatments, especially where resistance to conventional antimalarials is prevalent.

Although promising, the limited toxicological data remains a significant gap, as identified by Mukungu *et al*. (2016). Comprehensive toxicological evaluations, studies on potential drug-herb interactions, standardization of plant extracts, dose optimization, and bioavailability assessments are necessary. Addressing these gaps through rigorous

scientific investigations will facilitate the evidence-based integration of traditional medicinal plants into mainstream healthcare, ultimately enhancing malaria management strategies.

4.2.3 Implications for Drug Development and Future Research

The findings of this study underscore the considerable potential of Kenyan medicinal plants as sources of novel antimalarial agents. *Artemisia annua*, *Ajuga remota*, and *Warburgia ugandensis* have shown significant antimalarial efficacy, aligning well with findings by Jeruto *et al*. (2015) and Wekesa *et al*. (2023). *Artemisia annua*, specifically, demonstrated an impressive parasite reduction rate (85%), corroborating its established pharmacological profile and use in conventional artemisinin-based therapies (WHO, 2022). This consistency across studies highlights its potential as a candidate for drug development, emphasizing the importance of isolating and characterizing its active compounds for pharmaceutical use.

Ajuga remota and *Warburgia ugandensis* also exhibited moderate efficacy, suggesting their potential as complementary treatments rather than standalone therapies. The moderate efficacy reported aligns with previous ethnobotanical documentation by Kipkore *et al*. (2014) and Mukungu *et al*. (2016), reinforcing their traditional application. Future research should prioritize detailed phytochemical analysis and compound isolation to enhance their therapeutic potential. Comparative studies between single-compound extracts and traditional polyherbal formulations could provide valuable insights into the synergistic interactions often harnessed in traditional medicine. Moreover, investigating potential interactions between these medicinal plants and existing antimalarial drugs could lead to combination therapies that effectively manage parasite resistance. This approach contrasts with the monotherapy typically employed in conventional antimalarial strategies, potentially offering improved efficacy through complementary mechanisms of action.

Comprehensive toxicological evaluations and clinical trials remain critical gaps requiring immediate attention. Ensuring standardized preparations and determining optimal dosages will enhance their credibility and clinical applicability. Sustainable harvesting practices, as recommended by Omara (2020), are essential to preserve biodiversity and ensure long-term plant availability. Collaborative efforts among traditional healers, researchers, and policymakers are crucial to successfully integrate traditional medicine into mainstream healthcare systems. Establishing robust regulatory frameworks for herbal medicines can enhance their acceptability, safety, and efficacy. By addressing these critical areas, traditional medicinal plants can significantly contribute to sustainable and effective malaria management strategies.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

The review highlights the strong ethnobotanical foundation of malaria treatment among Kenyan communities and its pharmacological validation through scientific research. The identification of highly effective medicinal plants, particularly *Artemisia annua*, *Ajuga remota*, and *Warburgia ugandensis*, provides promising leads for future drug development. However, further research is needed to establish optimal dosages, safety profiles, and mechanisms of action before these plants can be fully integrated into mainstream malaria treatment. By bridging traditional knowledge with modern pharmacology, there is a significant opportunity to develop new, plant-based antimalarial therapies that could contribute to global malaria eradication efforts.

5.2 Recommendations

Based on the findings from ethnobotanical and pharmacological studies reviewed, several recommendations are proposed to enhance the integration of traditional knowledge into evidence-based malaria treatment and drug development. Establishing standardized protocols for preparation, dosage, and administration of medicinal plant extracts is essential to ensure consistent efficacy and safety. Additionally, long-term safety evaluations and pharmacokinetic studies are needed to prevent potential toxicity and adverse herb-drug interactions. Community-based conservation programs involving traditional healers, researchers, and policymakers should be implemented to safeguard medicinal plant biodiversity. Public awareness campaigns emphasizing the benefits and risks associated with herbal medicines should be promoted to enable informed decision-making. Furthermore, exploring the combination of plant-derived compounds with conventional antimalarial drugs could enhance treatment effectiveness and reduce resistance development, providing promising avenues for future research.

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