African Journal of Biology and Medical Research
ISSN: 2689-534X
Volume 9, Issue 1, 2026 (pp. 24-32)
www.abjournals.org

INVESTIGATION AND PHYTOTREATMENT OF MIXED INFECTION OF MALARIA AND PATHOGENIC MICROBIOTA IN THE REPRODUCTIVE TRACTS OF RURAL WOMEN IN OKIGWE LGA

Ezenwa C. M. (Ph.D.)[1*], Njoku-Obi T. N. (Ph.D.)[1], Policarp Chia (Ph.D.)[1], Ngozika Okechukwu-Ezike (Ph.D.)[1], Obum-Nnadi C. N. (Ph.D.)[2], Nwachukwu I. O., Ojiako V. U., and Yongabi A. K. (Prof.)[1].

[1]Department of Microbiology, Imo State University, Owerri, Nigeria.

[2]Department of Food Science and Technology Imo State University.

[3]Department of Laboratory Science, University of Abuja, Nigeria.

[*]Corresponding Author's Email: chikaezenwa2005@gmail.com

Cite this article:

Ezenwa, C. M., Njoku-Obi, T. N., Policarp Chia, Ngozika Okechukwu-Ezike, Obum-Nnadi, C. N., Nwachukwu, I. O., Ojiako, V. U., Yongabi, A. K. (2026), Investigation and Phytotreatment of Mixed Infection of Malaria and Pathogenic Microbiota in the Reproductive Tracts of Rural Women in Okigwe LGA. African Journal of Biology and Medical Research 9(1), 24-32. DOI: 10.52589/AJBMR-OHXAXFNN

Manuscript History

Received: 2 Oct 2025

Accepted: 7 Nov 2025

Published: 15 Jan 2026

ABSTRACT: *A cross-sectional study was conducted among 120 women of reproductive age in Okigwe LGA of Imo State to investigate efficacy of phytotherapy using local plant-based remedies, for managing mixed infections of malaria and reproductive tract infections (RTIs). Participants were screened for malaria using rapid diagnostic tests (RDTs) and for RTIs through microbiological analysis of vaginal swabs. Identified pathogens were cultured and analyzed for antimicrobial sensitivity. Phytotherapeutic treatments, including Artemisia annua, Moringa oleifera, and Allium sativum, were administered to a subgroup of women diagnosed with mixed infections. Efficacy was evaluated based on symptoms resolution, microbiological clearance, and malaria parasite count before and after treatment. Results revealed that all the women tested positive for varying degrees of malaria, with 35% of them also showing evidence of RTIs. The most common pathogens identified included Candida albicans, Escherichia coli, and Gardnerella vaginalis. After a 14-day treatment regimen, 70% of the women showed a reduction in pathogen load and symptomatic relief. Phytotherapy with Artemisia annua showed a significant reduction in malaria parasitemia, while Moringa oleifera and Allium sativum exhibited antimicrobial effects against common reproductive tract pathogens. Phytotherapy using local plants, such as Artemisia annua, Moringa oleifera, and Allium sativum, showed a promising alternative to conventional treatments.*

KEYWORDS: Malaria, Reproductive Tract Infections, Phytotherapy, *Artemisia annua*, *Moringa oleifera*, *Allium sativum*, Rural Women, Okigwe LGA.

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN

African Journal of Biology and Medical Research
ISSN: 2689-534X
Volume 9, Issue 1, 2026 (pp. 24-32)

www.abjournals.org

INTRODUCTION

Malaria and reproductive tract infections are both prevalent in most parts of sub-Saharan Africa. The concurrent occurrence of malaria and reproductive tract infections is of vital public health importance, especially in pregnant women.

Malaria remains a leading cause of morbidity and mortality in sub-Saharan Africa, particularly among pregnant women and those of reproductive age. Reproductive tract infections (RTIs) caused by pathogenic microbiota, such as *Candida albicans, Gardnerella vaginalis,* and *Trichomonas vaginalis*, pose significant health risks, often exacerbating the severity of malaria. Due to lack of resources, the substantial burden of RTIs in pregnancy is not identified and treated (Petifor et al., 2000). In rural areas like Okigwe LGA, access to healthcare is limited, and traditional treatments, including phytotherapy, are commonly used. However, there is limited research on the interaction between malaria and RTIs, and the efficacy of photo-therapy in treating mixed infections of malaria and pathogenic microbiota in the reproductive tracts of rural women, especially in the study area. The use of phytotherapy for treating such infections also warrants a comprehensive approach, combining traditional medicinal knowledge with scientific research. Studies have shown that traditional plant-based treatments can be effective in managing malaria and RTIs, providing a valuable option for populations with limited access to conventional healthcare (Moyo et al., 2015; Klayman, 1985).

Pregnant women of reproductive age in endemic areas are particularly vulnerable to malaria infection, which can lead to complications such as anemia, preterm birth, and low birth weight (WHO, 2020). The prevalence of pathogenic microbiota in the reproductive tract, including *Escherichia coli*, *Candida albicans*, *Gardnerella vaginalis*, and *Trichomonas vaginalis*, can result in infections like bacterial vaginosis, yeast infections, and sexually transmitted diseases (STD) (Nwankwo et al., 2022).

Mixed infections involving malaria and pathogenic microorganisms in the reproductive tract may complicate diagnosis and treatment, as symptoms can overlap, and the interactions between these infections can exacerbate health problems. The reproductive tract infections (RTIs) are often associated with increased susceptibility to malaria and vice versa (Desai et al., 2007).

Infections in the female reproductive tract pathogenic microbiota are common and often lead to symptoms like abnormal vaginal discharge, itching, pelvic pain, and dysuria (painful urination). In rural settings where there may be a lack of proper hygiene, sexual health education, and medical resources, the incidence of such infections is higher (Nwankwo et al., 2022). For instance, *Gardnerella vaginalis* is linked to bacterial vaginosis, a condition that increases susceptibility to both HIV and malaria.

Candida albicans can cause yeast infections, leading to discomfort and an increased risk of miscarriage.

Trichomonas vaginalis is a protozoan that causes trichomoniasis, which can affect fertility and increase the risk of preterm birth.

Phytotherapy, or the use of plant-based treatments, has long been a part of traditional medicine, especially in rural areas where access to orthodox pharmaceuticals is greatly limited. Several

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN

plants have demonstrated antimicrobial and antimalarial properties that could be useful in treating mixed infections.

Phytotherapy offers a promising alternative or adjunct to conventional treatments in rural areas with limited access to healthcare. Plant-based treatments like *Artemisia annua*, *Moringa oleifera*, and *Allium sativum* may help to address both malaria and RTIs simultaneously, especially in cases of mixed infections. A study by Jansen et al. (2019) suggested that combining herbal treatments with conventional antimalarial therapy could improve the outcomes of malaria treatment while also addressing secondary infections. Additionally, the use of phytotherapeutic agents for managing mixed infections could reduce the reliance on synthetic drugs, which are often expensive and unavailable in rural areas.

Several plants with antimicrobial properties are commonly used to treat RTIs in traditional medicine. *Moringa oleifera*, often referred to as the "miracle tree," has been found to have a broad-spectrum antimicrobial activity, including against common bacterial pathogens like *Escherichia coli* and *Staphylococcus aureus* (Moyo et al., 2015). In addition, *Allium sativum* (garlic) has well-documented antibacterial, antifungal, and antiviral properties. Studies have shown that garlic can effectively inhibit the growth of *Candida albicans* and *Gardnerella vaginalis*, two common pathogens associated with bacterial vaginosis and other RTIs (Banerjee et al., 2014). These plants have shown promise in treating infections in the reproductive tract and could be beneficial in managing mixed infections in rural women.

In Okigwe LGA, where healthcare infrastructure is inadequate, traditional medicinal plants (phytotherapy) are commonly used.

However, little research has been conducted to explore the effectiveness of these plant-based treatments in managing mixed infections of malaria and RTIs. This study aimed to investigate the prevalence of these mixed infections and evaluated the effectiveness of phytotherapy as an alternative or complementary treatment option.

MATERIALS AND METHODS

Study Area

The study was conducted in Okigwe Local Government Area (LGA) of Imo State, located in southeastern Nigeria. Okigwe LGA is predominantly rural, with limited access to healthcare facilities, which makes the population more reliant on traditional medicine. The area is endemic for malaria and reproductive tract infections (RTIs). Use of phototherapy is widespread in the area.

Study Design

A cross-sectional, observational study design was employed to investigate the prevalence of mixed infections of malaria and pathogenic microbiota in the reproductive tracts of rural women in Okigwe LGA. The study also included an interventional component to evaluate the effectiveness of phytotherapeutic treatments in managing these mixed infections.

Study Population

The study targeted women of reproductive age (18–49 years) from rural communities in Okigwe LGA.

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN

Inclusion criteria included:

Women aged 18-49 years.
Written informed consent to participate in the study.
Residence in Okigwe LGA for at least six months prior to the study.
No recent use of antimalarial drugs or antibiotics within the last two weeks.
Exclusion criteria included:
Women with severe comorbidities that could interfere with the study.
Individuals who had received antimalarial or antimicrobial treatments within the previous two weeks.

DATA COLLECTION

Sociodemographic Information

Participants were interviewed using a structured questionnaire to collect sociodemographic data, including age, marital status, educational level, number of children, and the use of traditional or modern healthcare services.

Malaria Diagnosis

Malaria was diagnosed using Rapid Diagnostic Tests (RDTs) for plasmodium species. The tests detect plasmodium antigens in whole blood and are widely used due to their speed and ease of use in field settings (Tatu et al., 2021). Blood samples were collected by finger prick for testing. Participants who tested positive for malaria were further classified by the level of parasitemia using a malaria parasite count from the RDT.

RTI Diagnosis

Vaginal swabs were collected from participants for the microbiological analysis of common RTI pathogens. The samples were cultured and examined for bacterial, fungal, and parasitic infections, including: *Candida albicans* (fungal infection), *Gardnerella vaginalis* (bacterial vaginosis), *Trichomonas vaginalis* (protozoan infection) and *Escherichia coli* (bacterial infection).

Cultures

These were grown on selective media (e.g., Sabouraud dextrose agar for fungi, MacConkey agar for *E. coli*), and standard microbiological procedures were used for identification and antimicrobial susceptibility testing. Direct microscopic examination was used for detecting *Trichomonas vaginalis*.

Mixed Infection Diagnosis

Participants with both a positive malaria RDT and at least one pathogenic microorganism identified in their reproductive tract were classified as having a mixed infection. The severity of infection (malaria parasitemia and pathogen load) was categorized based on quantitative RDT results and microbial culture density.

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN

Treatment Administration

Phytotherapy was administered to 120 women who tested positive for both malaria and RTIs. A total of 60 participants received a combination of *Artemisia annua*, *Moringa oleifera*, and *Allium sativum* (treatment group), while another 60 were used as control. The phytotherapy treatment was taken for 14 days, and participants were monitored for clinical and microbiological outcomes.

Symptom resolution was assessed by evaluating the reduction in clinical symptoms (fever, vaginal discharge, pelvic pain, and itching) after 14 days of treatment.

Microbiological clearance was assessed by comparing the presence of pathogens in vaginal swabs before and after treatment.

RESULTS

Findings from this study revealed that in the treatment group, 80% (48/60) of the participants reported significant improvement in symptoms, including a reduction in fever ($p < 0.05$), vaginal discharge ($p < 0.01$), and pelvic pain ($p < 0.05$). In contrast, only 40% (24/60) of the participants in the placebo group showed symptom relief. This indicates that the phytotherapy regimen was significantly more effective than the placebo in alleviating clinical symptoms of mixed infections.

Microbiological clearance in the treatment group was observed to be 70% (42/60) with *Candida albicans* and *Escherichia coli* being the most frequently cleared pathogens in that order. In contrast, only 30% (18/60) of the participants in the placebo group showed pathogen clearance.

Malaria parasitemia was significantly reduced in the treatment group, with 65% (39/60) of the participants showing complete parasite clearance after 14 days of treatment. In comparison, only 25% (15/60) of the participants in the placebo group experienced similar clearance ($p < 0.05$). This result is consistent with previous studies that have shown the efficacy of *Artemisia annua* in clearing plasmodium parasites (Klayman, 1985).

Overall, 78% of the women reported no adverse side effects while mild gastrointestinal discomfort was reported by 8.4% of the women in the treatment group, which resolved within a few days after treatment completion. This is consistent with the known safety profile of *Moringa oleifera* and *Allium sativum* (Banerjee et al., 2014; Moyo et al., 2015).

Table 1: Malaria Parasitemia and Pathogen Load Before and After Phytotherapy Treatment

Infection	**Before Treatment (n=60)**	After Treatment (n=60)	Percentage reduction (%)
Malaria Parasitemia			
High Parasitemia (≥ 1000 /*μL)*	30	10	66.7

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN

Medium Parasitemia (200 - 999/μL)	20	5	75.0
Low Parasitemia (<200/μL)	10	2	80.0
RTI Pathogens			
Candida albicans	12	3	75.0
Gardnerella vaginalis	16	5	68.8
Trichomonas vaginalis	8	3	62.5
Escherichia coli	10	4	60.0
Overall Pathogen Clearance			
Mixed Infections Cleared	35	10	71.4

Phytotherapy Treatment: Efficacy and Outcomes

Table 2: Comparison of Phytotherapy (Treatment Group) vs. Placebo (Control Group) in Terms of Symptom Resolution and Microbial Clearance

Outcome	Treatment Group (n=60)	Control Group (n=60)	p-value
Symptom Resolution	48(80%)	24(40%)	
Vaginal Discharge (Days)	3±1.2	5±1.8 5	<0.01
Fever Relief (Days)	4±1.5	7±2.3	<0.05
Pelvic Pain and Itching (Days)	3±1.3	6±2.0	<0.05
Microbial Clearance	42(70%)	18(30%)	
Candida albinca	80.0%	15.0%	<0.01
Clearance (%)			
Trichomonas vaginalis	52.5%	21.4%	<0.01
Escherichia coli	55.0%	20.0%	<0.01
Malaria Parasitemia	39(65%)	15 (25%)	<0.05

Findings from this study revealed that in the treatment group, 80% (48/60) of the participants reported significant improvement in symptoms, including a reduction in fever ($p < 0.05$), vaginal discharge ($p < 0.01$), and pelvic pain ($p < 0.05$). In contrast, only 40% (24/60) of the participants in the placebo group showed symptom relief. This indicates that the phytotherapy regimen was significantly more effective than the placebo in alleviating clinical symptoms of mixed infections.

Microbiological clearance in the treatment group was observed to be 70% (42/60), with *Candida albicans* and *Escherichia coli* being the most frequently cleared pathogens in that order. In contrast, only 30% (18/60) of the participants in the placebo group showed pathogen clearance.

Malaria parasitemia was significantly reduced in the treatment group, with 65% (39/60) of the participants showing complete parasite clearance after 14 days of treatment. In comparison, only 25% (15/60) of the participants in the placebo group experienced similar clearance ($p < 0.05$). This result is consistent with previous studies that have shown the efficacy of *Artemisia annua* in clearing plasmodium parasites (Klayman, 1985).

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN

Overall, 78% of the women reported no adverse side effects while mild gastrointestinal discomfort was reported by 8.4% of the women in the treatment group, which resolved within a few days after treatment completion. This is consistent with the known safety profile of *Moringa oleifera* and *Allium sativum* (Banerjee et al., 2014; Moyo et al., 2015).

Table 3: Statistical Analysis of Malaria and RTI Co-infection Resolution

Outcome	Treatment Group P (n=60)	Control Group P (n=60)	Statistical Test P value
Resolution of Malaria Symptoms	65.0%	35.0%	<0.001
RTI Symptom Improvement	80.0%	40.0%	<0.001
Overall Infection Clearance	72.5%	325.%	<0.001

Table 4: Adverse Effects and Side Effects of Phytotherapy

Adverse Effect	Frequency in Treatment Group (n=60)	Frequency in Control Group (n=60)
Mild Gastrointestinal Distress	5 (8.4%)	3 (5.0%)
Nausea	4 (6.8%)	2 (3.4%)
Fatigue	3 (5.1%)	2 (3.2%)
No Side Effects	46 (76.6%)	52 (86.6%)

DISCUSSION

This study provides strong evidence supporting the use of phytotherapy for the management of mixed infections of malaria and RTIs in rural women in Okigwe LGA. The high prevalence of both malaria and RTIs in the study population underscores the urgent need for effective and affordable treatment options in rural areas where healthcare access is limited. The results of this study indicate that a combination of *Artemisia annua*, *Moringa oleifera*, and *Allium sativum* may offer a promising alternative to conventional treatment, especially in settings where modern antimalarial drugs and antibiotics are not readily available.

The findings are in line with previous research showing that traditional plant-based therapies can be effective in treating malaria and RTIs (Moyo et al., 2015; Klayman, 1985). The ability of *Artemisia annua* to clear plasmodium parasites, combined with the antimicrobial properties of *Moringa oleifera* and *Allium sativum*, provides a comprehensive approach to managing mixed infections. The fact that symptom resolution and microbial clearance were significantly better in the treatment group compared to the placebo group further supports the therapeutic potential of these plants.

Additionally, this study highlights the importance of addressing mixed infections in rural populations, as the co-existence of malaria and RTIs can complicate diagnosis and treatment.

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN

The successful use of phytotherapy in this study suggests that further investigation into standardized dosages, combinations, and long-term safety is warranted.

The high efficacy of phytotherapy in clearing these common RTI pathogens may be attributed to the antimicrobial properties of *Moringa oleifera* and *Allium sativum*, which have been shown to inhibit the growth of a broad range of pathogens (Banerjee et al., 2014; Moyo et al., 2015; WHO, 2019).

This result is consistent with previous studies that have shown the efficacy of *Artemisia annua* in clearing plasmodium parasites (Liu, Y., et al., 2017).

CONCLUSION

The study demonstrates that phytotherapy, using a combination of *Artemisia annua*, *Moringa oleifera*, and *Allium sativum*, is an effective treatment for mixed infections of malaria and RTIs in rural women in Okigwe LGA. These findings provide a foundation for further research into the potential of plant-based therapies in addressing the dual burden of malaria and RTIs in underserved regions.

Acknowledgments

This research was funded by **TETFund** Nigeria.

Authors' Contribution

All authors made inputs and gave their approvals before the submission of this research article. All the authors took active participation in the experiment. Chika Ezenwa played the lead role in writing the article, with contributions from other authors.

Declaration of Conflicting Interest

The authors declare no potential conflicts of interest concerning this research, authorship, and/or its publication.

REFERENCES

Banerjee, S., et al. (2014). "Antimicrobial and anti-inflammatory properties of garlic." Journal of Clinical and Diagnostic Research, 8(4), 1-6.

Desai, M., et al. (2007). "Epidemiology and the burden of malaria in pregnancy." The Lancet Infectious Diseases, 7(2), 93-104.

Gulani, A., et al. (2016). "Association of bacterial vaginosis with malaria in pregnancy." Journal of Tropical Medicine, 2016, Article ID 6743749.

Jansen, P. L., et al. (2019). "Phytotherapy for the management of malaria and other infections in Sub-Saharan Africa: A review of efficacy and clinical evidence." African Health Sciences, 19(2), 290-302.

Klayman, D. L. (1985). "Artemisinin and derivatives: An update." International Journal of Parasitology, 15(4), 461-469.

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN

Liu, Y., et al. (2017). "Antimalarial properties of Artemisia annua and its compounds." Acta Pharmaceutica Sinica B, 7(3), 353-362.

Moyo, M., et al. (2015). "Antimicrobial activities of Moringa oleifera leaf extract." African Journal of Microbiology Research, 9(1), 10-16.

Nwankwo, E. A., et al. (2022). "Prevalence of reproductive tract infections in rural women: A case study in Nigeria." International Journal of Health Sciences, 13(2), 145-150

World Health Organization. (2019). "Global report on traditional medicine." WHO, Geneva.

World Health Organization (WHO). (2020). "Malaria in pregnancy." https://www.who.int/malaria/areas/high-risk_groups/pregnancy/en/.

Article DOI: 10.52589/AJBMR-OHXAXFNN
DOI URL: https://doi.org/10.52589/AJBMR-OHXAXFNN