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A Review on Medicinal Plants Used as Alternative Treatment for Malaria: An Anti-Malarial Drug

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Abstract

Malaria remains an important risk around the globe public health, particularly in tropical and subtropical areas. Malaria, a disease that infects millions of human beings worldwide, is still caused by numerous *Plasmodium species*, with *Plasmodium falciparum* being the most virulent and common in sub-Saharan Africa. Pregnant women tend to be at high risk despite great success in lowering malaria-related deaths. This study focuses on the usage of natural antimalarial treatments in Ghana, an economy with a severe malaria epidemic. Communities in Ghana rely on those natural remedies due to they perceive them to be efficient and affordable, especially in rural areas. The study's objectives involve figuring out the herbs applied in these preparations, evaluating their scientific validity, as well as deciding if they correspond to the requirements of the FDA for both domestic and foreign marketing. The World Health Organization's World Health Assembly has recognized the elimination of parasitic infections as one of its top goals. The obstacle with current antimalarial drug resistance necessitates people to search for novel treatments. The success rate of various plant-based malaria treatments is looked at in this study. In the end, results indicate the need for additional study in the search for appropriate antimalarial medical products and educate us to understand conventional herbal treatments and their roles in fighting the spread of malaria.

Keywords: Malaria, consequences, vaccination, prevention, treatment, and medicinal plants.

INTRODUCTION

Malaria poses a significant public health threat, particularly in tropical and subtropical regions. Various *Plasmodium* species, such as *Plasmodium falciparum, Plasmodium malaria, Plasmodium ovale, Plasmodium vivax, and Plasmodium knowlesi*, are responsible for causing malaria (Yu et al., 2020). The transmission of these parasites occurs through the bites of female *Anopheles* mosquitoes. *P. falciparum*, being the most contagious species, leads to the highest rates of disease and mortality. Malaria remains a pressing issue, with 619,000 deaths and 247 million reported cases worldwide (Rahi & Sharma, 2022). sub-Saharan Africa (SSA), where malaria cases and fatalities are most prevalent globally (Nkumama et al., 2017). In 2016, the World Health Assembly established a global technical plan aiming to eliminate malaria by 2030. Notably, the reduction in malaria mortality has been significant, but pregnant women in SSA remain the most at-risk population (Angupale et al., 2023).

About 29 countries accounted of malaria for 95% of malaria cases worldwide, southeast Asia region accounted for the second highest burden globally, while only five countries accounted for more than half of the cases. Nigeria accounted for 27%, the democratic republic of Congo 12%, Uganda 5%, Mozambique

4%, and Niger 3% (Pradhan et al., 2022). Five countries in the Region—Bhutan, DPR Korea, Nepal, Thailand, and Timor-Leste—are among 25 countries and one territory worldwide that have been designated as having the potential to eradicate malaria by 2025. The Maldives and Sri Lanka have continued to maintain their status as malaria-free nations. September of 2023 (WHO, 2023).

Ghanaians, particularly in rural areas, widely embrace herbal remedies for malaria treatment due to their perceived effectiveness and accessibility. Herbal treatments vary in plant compositions based on traditional knowledge. The research aims to identify herbs used in Ghanaian herbal antimalarial medications, examine scientific support for their use, and assess compliance with FDA standards (Peprah P et al., 2019).

The World Health Assembly's commitment to achieving a 90% reduction in global malaria occurrence and mortality by 2030 is crucial. Universal healthcare inclusion and access to plasmodium treatment, prevention, and detection are emphasized (Million et al., 2022). The early diagnosis pillar, focusing on swift and effective malaria treatment, relies on remedies incorporating locally renowned herbs (Million et al., 2022).

While significant progress was made post-World War II with the introduction of DDT and chloroquine, recent years pose new challenges. Since 2019, certain regions have witnessed an increase in malaria cases. In 2021, 247 million cases were diagnosed in 87 malaria-endemic nations, with Southeast Asia accounting for 3% of global cases. Children under the age of five remain the most vulnerable, constituting 67% of malaria-related deaths in 2019, attributed to their immunization status (WHO, 2021).

Table 1: Malaria reported cases from 2019- 2022

S/n	year	Number of cases	Number of death	References
1	2019	232000000	568000	(WHO, 2020)
2	2020	245000000	625000	(WHO, 2020)
3	2021	247000000	619000	(Prevention, 2021) (WHO, 2021)
4	2022	247000000	619000	(WHO, 2022)

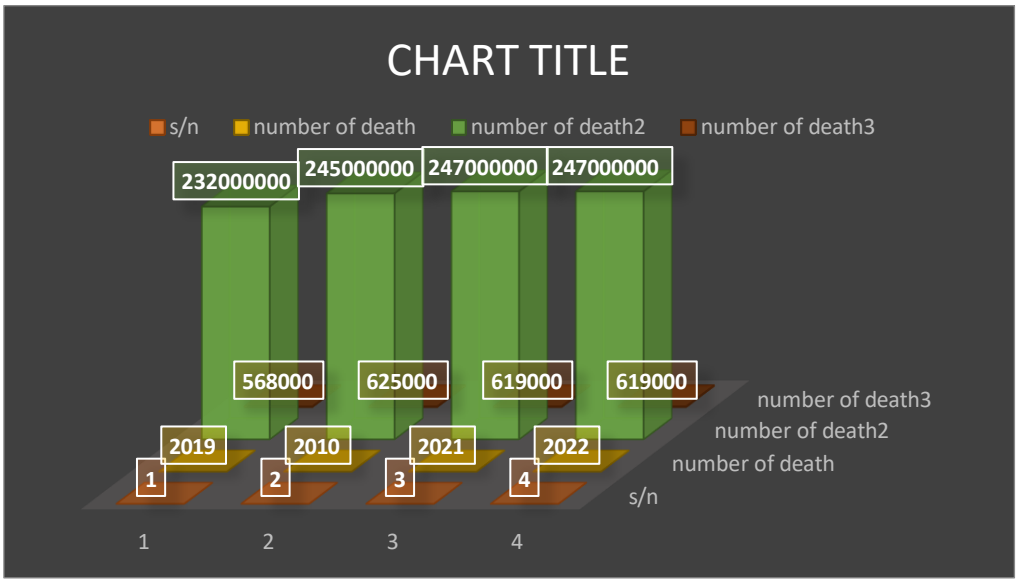
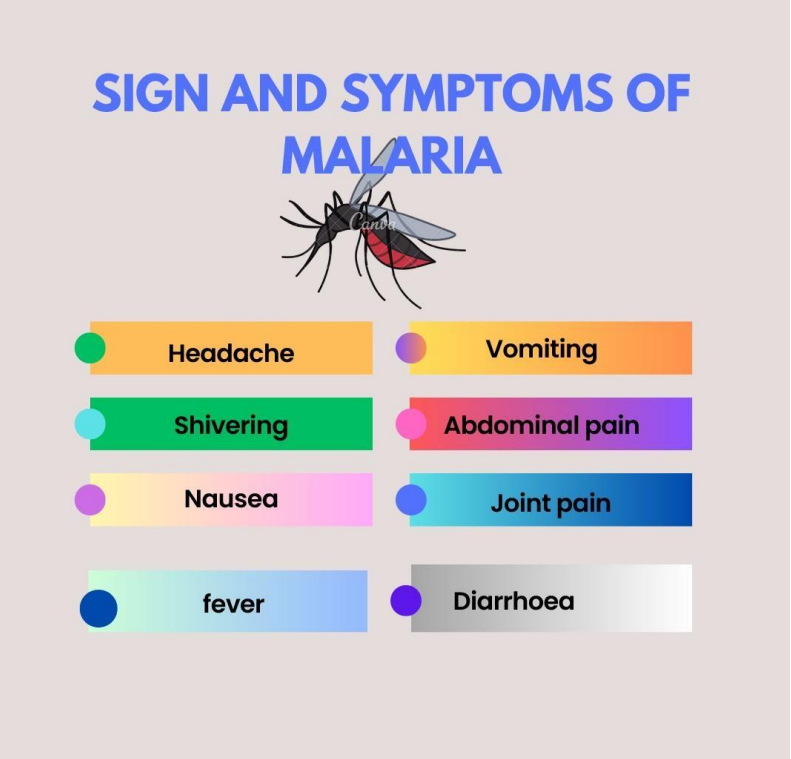


figure 1: Malaria cases in bar chart on the above



Malaria Consequence Globally: A Quick Inform

In tropical and subtropical areas, malaria has a direct impact on the health of local populations and the growth of local economies. 247 million additional cases are anticipated by the World Health Organization (WHO 2021). Fashionable 2021, 29 of the 84 nations where malaria is widespread (including French Guiana) Africa accounted for 95% of entire suitcases and 96% of deaths from the disease worldwide (WHO, 2021). Four nations: Nearly half of all cases were in the Democratic Republic of the Congo (12.3%), Nigeria (26.6%), Uganda (5.1%), and Mozambique (4.1%) (World Malaria Day, 2023).

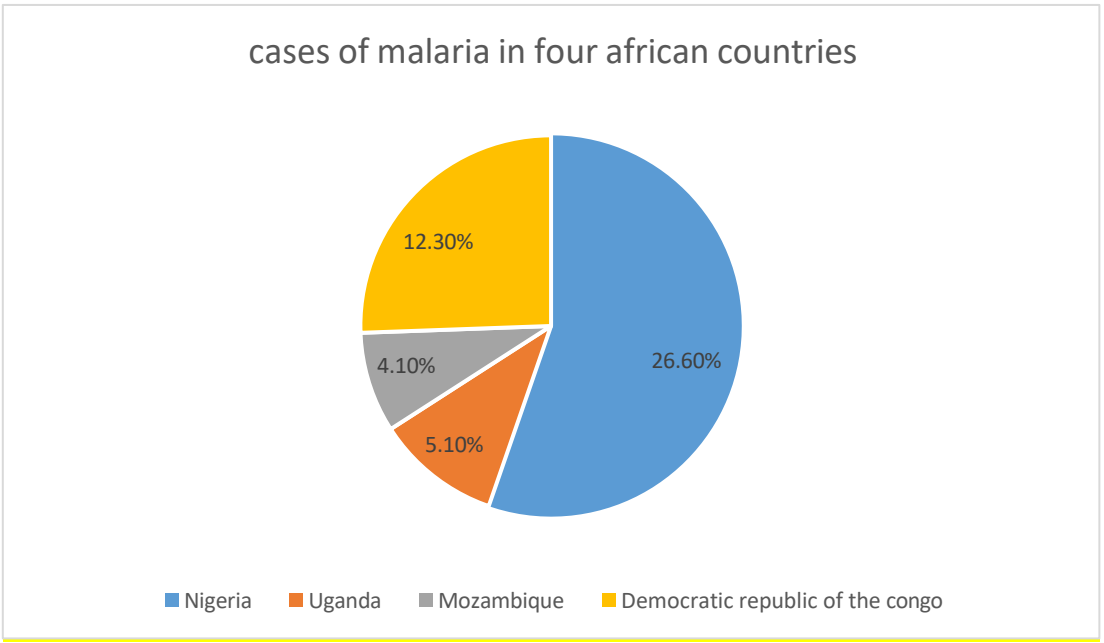


Figure 2: Cases of malaria in four African countries

Nine nations in Southeast Asia were home to endemic malaria in 2021, book-keeping for 5.4 million suitcases in addition to 2% of statistics circumstances global. In 2021, 79% of the world's malaria cases originated in India. *P. vivax* was the culprit in almost 40% of all cases in this area. Malaria cases have dropped by 76% over the past 20 years, or 17.4 million fewer cases in 2021. The attachment of China as a nation with a malaria-free certification is a major recent accomplishment on the Asian continent, 79% of all malaria cases in Latin America are traced to Colombia, Venezuela Brazil, and Colombia. *P. vivax* is responsible for the majority of cases in this area 71.5% in 2021.

The Amazon, which includes nine shapes of Acre, Amapá, Amazonas, Maranho, Mato Grosso, Pará, Rondônia, Roraima, and Tocantins, is the only constituency in Brazil where malaria can be transmitted. Approximately 99.7% of the nation's malaria suitcases are concentrated in fashionable unique parts. *P. vivax* and *P. falciparum* are the two major *Plasmodium* varieties that source anthropoid malaria infections in Brazil. *P. vivax* contagions accounted for 83.0% (114,449) of the reported circumstances, pursued by *P. falciparum* impurities, which were responsible for 17.0% (23,408) of the cases (Siqueira AM, 2016).

Epidemiological data as of 2020 show a yearly decrease in malaria cases, with 139,211 suitcases recorded cutting-edge 2021. Many indigenous communities reside in the Legal Amazon, including the Yanomami, one of the biggest indigenous populations, who had about 11,530 cases of malaria in the previous years, or 9.93% of entirely malaria suitcases in Brazil (WHO, 2021). New approaches and enhancements to disease surveillance and management are nevertheless required.

Argentina (2019), El Salvador (2021), and Paraguay (2018) using nothing instances of malaria on behalf of 3 years consecutively, are among the nations that have received the WHO accreditation of malaria-free nations.

Table 2 Comparative analysis of the *plant* extract

Biological names	English names	Biological activities	Method of application	Part of the plant to be used	references
Carica papaya	Papaya	Treatment of malaria, dengue, typhoid, immunomodulatory and antiviral activity	Juice from fresh *leaves* has been extracted and ingested. Crush the new leaves and consume themselves by way of or without milk.	Leave, fruits and roots	(Pierre et al., 2011) (Nigussie & Wale, 2022a) (Mekonnen et al., 2020) (Million et al., 2022)
Azadirachta indica	Neem	Hemorrhoids, Body Ache, malaria and Skin Infection	consuming prepared *leaves* and water *Leaves* The filtrate is ingested once the newly grown	leaves	(Nigussie & Wale, 2022b) (*Natural Products with Potential*

			apical leaves (buds) have been thoroughly pounded and soaked in water. Lemon, salt, and at times sugar are inserted.		*Antimalarial Effects*, n.d.)
Magnifera India	Mango	Anti-bacteria, anti-inflammatory, anti-malarial Jaundice, Asthma, and antioxidant	As needed, boil stems, barks, and fluids. One may ingest a fresh one.	Bark and leaves	(Ogbuehi & Ebong, 2015) (Omosun G., Okoro I. A., Ekundayo E., 2013) (*Natural Products with Potential Antimalarial Effects*, n.d.)
Cymbopogon citratus	Lemon grass	Gastrointestinal issues, flu, fever, and pneumonia.	Decoction drink	Leaves	(Omosun G., Okoro I. A., Ekundayo E., 2013) (*Natural Products with Potential Antimalarial Effects*, n.d.)
Anacardium occidentale	Cashew nut	Anti-microbial	Plants wash away and bubble in aquatic for 20-50 min 300 ml of the tisane is taken once a day for 1 week or until the indicators fade	Leaves and barks	(State, 2009) (Venugopal et al., 2020) (Nigussie & Wale, 2022b)
Ananas comosus	Pineapple	Antioxidant and anti-microbial infection	Boil the fruit, every part of the plant of Cympobogon citratus, the leaves of Cassia alata, along with	Unripe fruit	(Omosun G., Okoro I. A., Ekundayo E., 2013) (*Natural Products with Potential*

			Psidium guajava.		*Antimalarial Effects*, n.d.) (Hossain & Rahman, 2011)
Allium sativum	Garlic	prevention of cardiovascular diseases and certain digestive cancers to keep about insecticides, fungicides, acaricides, nematicides, as well as bacterial properties	Sliced into pieces and dried for 2-3 days at room temperature in the shade, the dehydrated parts remained condensed to a reasonably satisfactory precipitate using a disintegrator. The dust was disinterested in a Soxhlet kit by 95% ethanol solvent for an old-fashioned 24 hours, the subsequent cutting was concentrated beneath a vacuum (Rota vapor), and the filtrate was melted in concentrated aquatic. The filtrate was later managed orally at 45 mg/kg body weight/day dose in 0.3 ml.	Bulb	(Douiri, 2013) (Nigussie & Wale, 2022a) (Batiha et al., 2020) (Million et al., 2022)
Cordia africana	Wanza(A)	Anti-malaria	Distillation of roots and inside woof via ginger is used up	Barks and roots	(Angupale et al., 2023) (Mekonnen et al., 2020) (*Phytochemical Investigation of*

					Cordia Africana Lam, n.d.)
Lepidium sativum	Feto(A)	Anti-malaria	Dehydrated fruit is blended into precipitate, mixt with castor oil, as well as managed by mouth	Fruits and seeds	(Angupale et al., 2023) (Million et al., 2022)
Maerua oblongifolia	Ja'a (O)	Anti-malaria	Crushed shrubberies cooked with goat milk and sozzled. Can be used in a mixture with the shrubberies of Withania somnifera	leaves	(Angupale et al., 2023) (*Phytochemical Analysis of Maerua Oblongifolia, and Assessment of the Genetic Stability of M*, n.d.)
Silene macro solen	Saerosaero (T)	Anti-malaria	Press and put on fire for disinfection	Roots	(Angupale et al., 2023)
Combretum molle	Agalo (A)	Anti-malaria	eaves to bark dust then combine with tea or coffee before ingesting it.	Leaves a barks	(Angupale et al., 2023)
Terminalia brownie	Sebaea (T)	Anti-malaria	Standardized fresh with water then drink it in the morning time before having breakfast for 4 days.	barks	(Angupale et al., 2023)
Pomona kituiensis	Laalata (O)	Anti-malaria	Make a juice with fresh one or drink it with coffee	leaves	(Angupale et al., 2023)
Lagenaria siceraria	Duque hahaha (O)	Anti-malaria	Put it in cold water and drink one glass at noon.	fruits	(Angupale et al., 2023)
Croton macrostachyus	Bisana (A)	Anti-malaria	cook it with aquatic then take it orally either with tea or milk	leaves	(Angupale et al., 2023)

Dracaena reflexa Lamk	Hasina Pleomele, Song of India	Anti-malaria	Get fresh and grading then boil it and drink it twice for five days	Leaves and bark	(Angupale et al., 2023)
Euphorbia abyssinica	Kukuak (A)	Anti-malaria	New fluid of Euphorbia abyssinica consume roast using Eragrostis tef dough	Latex	(Angupale et al., 2023)
Sesamum indium	Eshkulubia (Ku)	Anti-malaria	Get a fresh root then mix it with cooked milk and half a cup in the morning as well as at night time.	Roots	(Angupale et al., 2023)
Tephrosia gracilipes	Atotoka (Ku)	Anti-malaria	Devastating the roots, combine it with water then drink it in the morning time with an empty stomach	Roots	(Angupale et al., 2023)
Acacia Seyal	Tundukiyac (O	Anti-malaria	Chew the bark	barks	(Angupale et al., 2023)
Albizia amara	Ondoddee (O)	Anti-malaria	Chewing the barks	barks	(Angupale et al., 2023)
Tamarindus indica	Mala (B)	Anti-malaria	Cut it into pieces mix it with water and drink it	fruits	(Angupale et al., 2023)
Cicer arietinum	Shinbira (A)	Anti-malaria	Dried it and consume with allium sativum bulb	seeds	(Angupale et al., 2023) (Badoni et al., 2018)
Entada abyssinica	Ambalta (O)	Anti-malaria	Barks mix with rhizome of zingiber and bulb album and drink	barks	(Angupale et al., 2023) (Hashim EL-Kamali, 2009)
Duranta repens L	Kata-mehandi, Kata-mehendhe	Anti-malaria	Eat the plant	Whole plants	(Angupale et al., 2023)

Lantana camara L	Chaturaangi, Jangoli-janglog	Anti-malaria and tuberculosis	Chewing with salt, blend it mix it with salt, and drink it.	Leaves, roots, and flowers	(Angupale et al., 2023)
Nyctanthes arbor tristis L	Shefali, Sheuli, Sheuly-phang	Anti-malaria	Blend it and mix it with water and consume it	leaves	(Angupale et al., 2023)

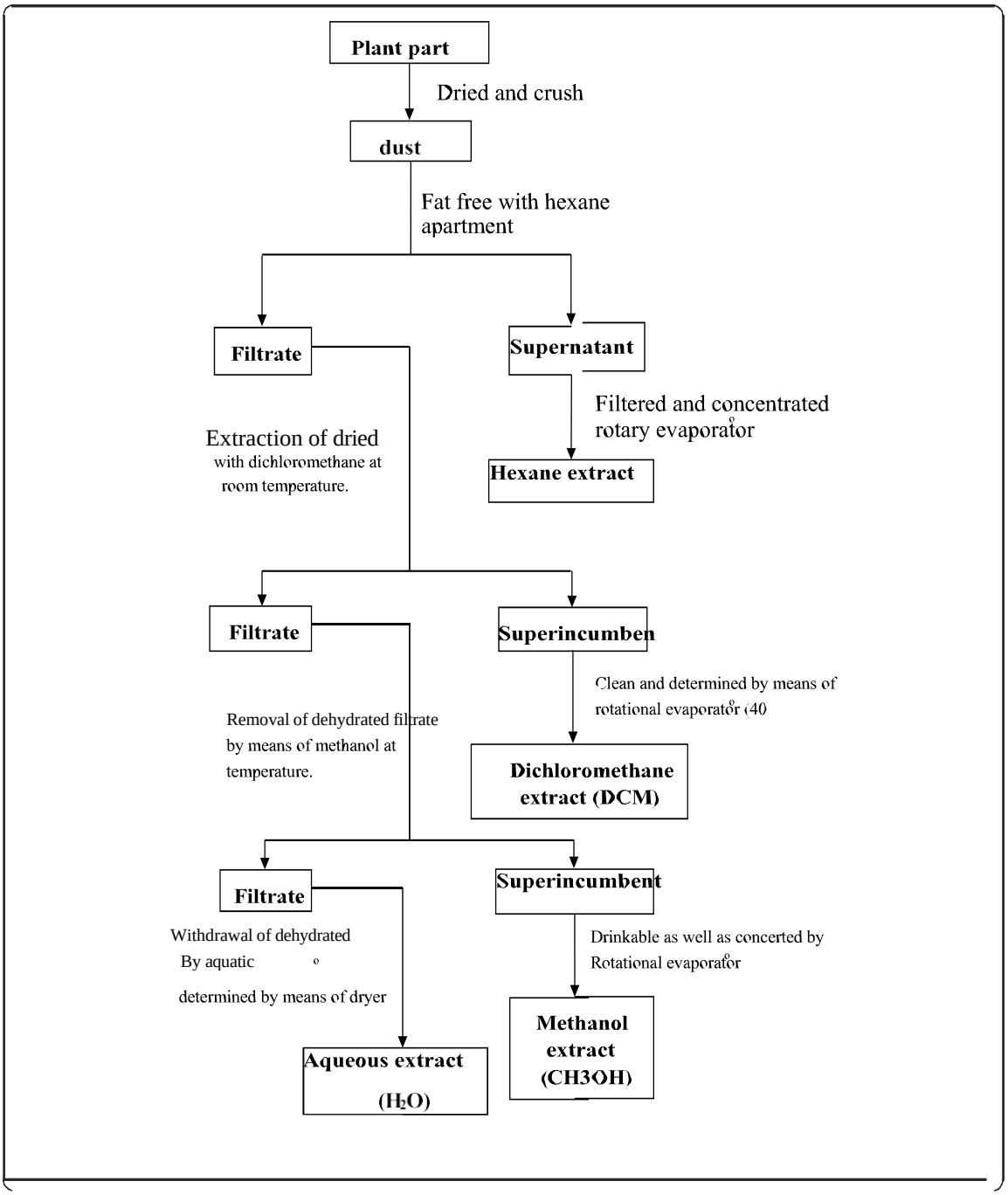


Fig 3, The process of extraction of plant parts by using chemicals

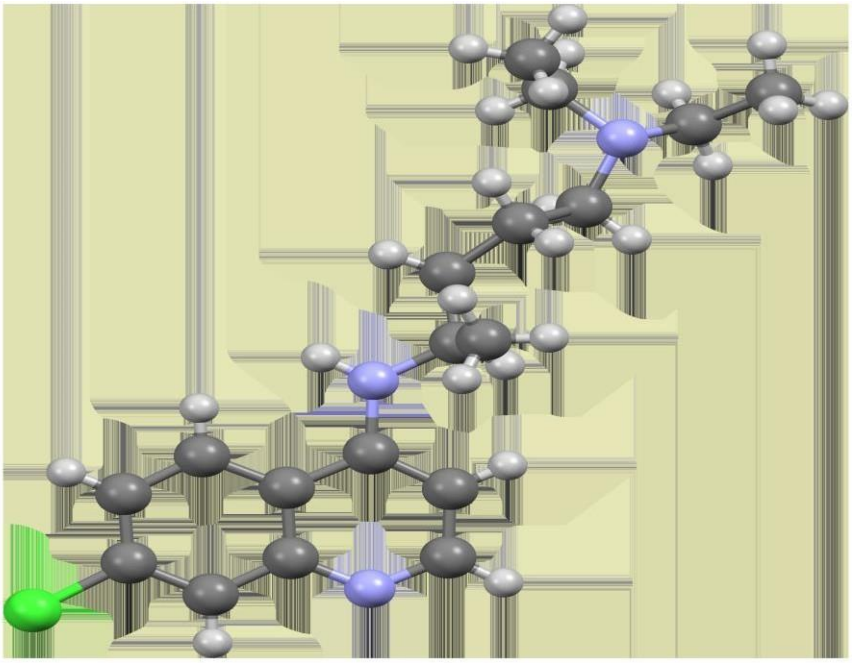


Fig 4, Chloroquine formula

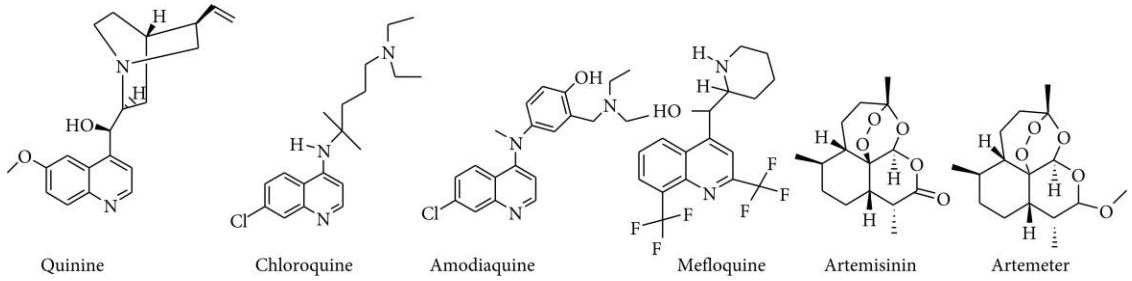
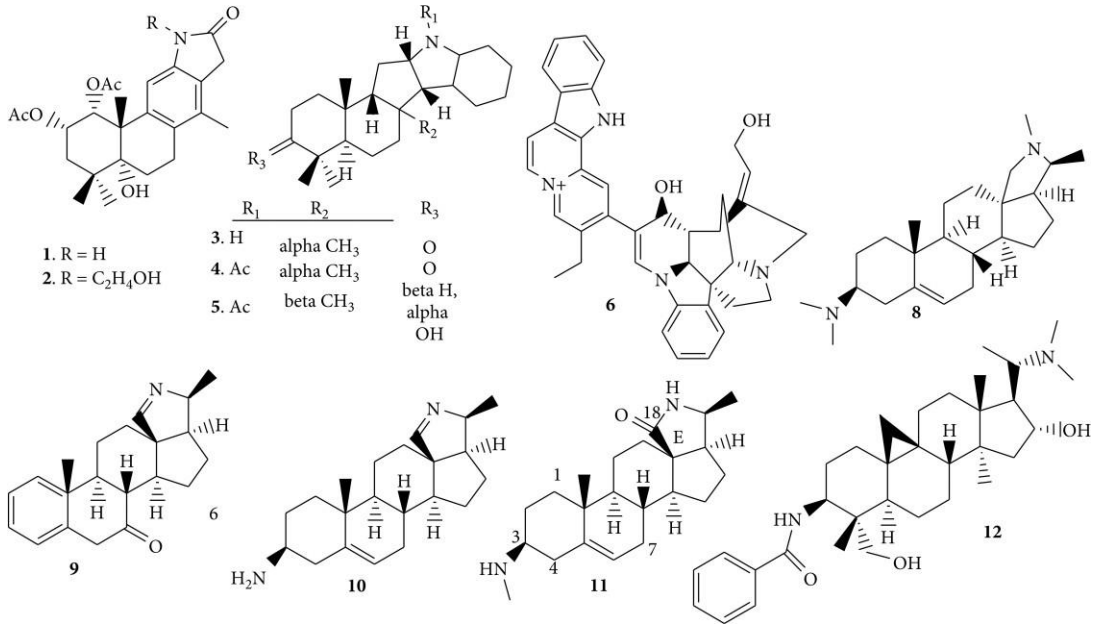
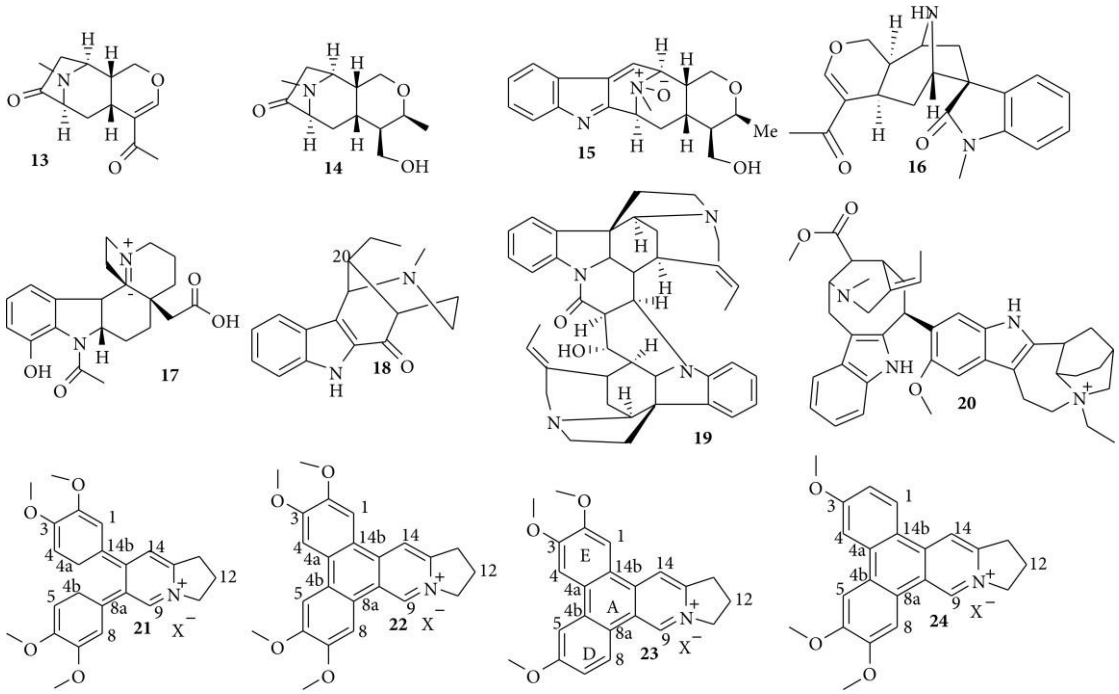


Fig 5; Quinine, Chloroquine, Amodiaquine, Mefloquine, Artemisinin and Artemeter



Fi, 6; Structures of *terpenoidal* and *steroidal alkaloids*.(Uzor, 2020)



Fig, 5; Structures of *indole* and related *alkaloids* with promising anti-malarial activity

Vaccination (add more information in a timeline manner)

A viable solution to combat malaria lies in the development of a vaccine. Given the parasite's resistance to antimalarial drugs and the associated toxicity of chemoprophylaxis, an effective malaria vaccine is imperative. Currently, researchers are actively engaged in vaccine development, with only one candidate progressing to a significant Phase III investigation as of World Malaria Day 2023. Additional investigations are underway for other deserving candidates.

The three main classifications for malaria vaccines correspond to different phases of the parasite's lifecycle: pre-erythrocytic, erythrocytic, and transmission-blocking. AS01, a candidate vaccine, has completed rigorous trials, demonstrating positive results in preventing *p. falciparum* sporozoite.

1. RTS, a monovalent recombinant protein vaccine, kickstarts the immune system's response against the circumsporozoite protein (PfCSP), coating sporozoites. This triggers a robust T-cell (CD4+) and immunoglobulin G (IgG) antibody reaction targeting the citrate synthase (CS) protein region, supported by studies (Laurens MB et al., 2019).
2. Despite these strides, the World Health Organization (WHO) currently cautions against administering RTS, S/AS01 to young ones in sub-Saharan Africa and other regions with moderate to high P. falciparum transmission. For children starting at 5 months, a four-dose schedule is recommended. Ongoing trials in countries like Malawi, Kenya, and Ghana aim to shed light on the benefits of the fourth dose and its long-term impact on child mortality (WHO, 2023).
3. PAMAVAC, another promising malaria vaccine in development for the blood stage, holds the potential to revolutionize malaria prevention strategies, with ongoing research paving the way for a breakthrough.

Alternative approach

Biological, physical, chemical, and mechanical control of mosquitoes

1. **Biological Control** is a method that involves the use of natural predators, parasites, or pathogens to target and reduce mosquito populations, e.g., introducing mosquito larvae-eating fish into stagnant water bodies to control mosquito breeding.
2. **Mechanical Control** is an approach involves the manipulation of the mosquito's environment to prevent its breeding or limit its access to humans, such as implementing proper waste management and eliminate potential breeding sites like discarded tires or containers that collect water.
3. **Chemical Control** is use of chemical substances to kill or repel mosquitoes, either on a large scale or through personal protection measures. Like Spraying insecticides in mosquito-prone areas or using insecticide-treated bed nets and indoor residual spraying.
4. **Physical Control** is a method involves using physical barriers or modifications to prevent mosquitoes from reaching or biting humans. Such as installing screens on windows and doors to prevent mosquito entry, or using protective clothing such as long sleeves and pants to reduce exposure.

Anyone of the above methods has its advantages and limitations. A comprehensive malaria control program often integrates a combination of these approaches to effectively target different stages of the mosquito life cycle and minimize the risk of disease transmission.

SUMMARY

This study appears to be thorough in its analysis of malaria in Ghana, emphasizing the application of homeopathic remedies. It's interesting to observe how Ghanaian people, particularly in rural regions, rely on herbal treatments because of their perceived efficacy and affordability. The goals of the study, which include determining which herbs were utilized, rating their scientific validity, and determining whether or not they complied with FDA regulations, offer a comprehensive approach.

The World Health Assembly's summary of worldwide efforts to control malaria reflects the continued difficulties and the need for creative solutions. The topic gains depth with the consideration of the challenges presented by drug resistance to anti-malarial and the investigation of plant-based remedies.

The comprehensive list of Ghanaian medicinal plants and the preparation and application techniques for each, provide important insights. It's important that the study recognizes the need for more investigation to fully comprehend herbal remedies and their function in the battle against malaria.

The material is presented more visually when figures describing the chemical structures of antimalarial medications and possible vaccinations are included. All in all, it's a comprehensive examination of the topic, stressing the complexity of malaria and the significance of taking traditional herbal knowledge into account when looking for remedies.

Conclusion

Unique of the greatest established plus effortlessly avoidable roots of bereavement universal is malaria. Some plants contain high toxicity in their nature while some contain low toxicity; more research is needed to curtail their circumstances and then find some suitable plants for the treatment of malaria. There is a need to educate people concerning first aid treatment of malaria, and the prevention of mosquito bites, such as the use of treated mosquito bed nets, repellent oil and soap, and vaccination against pathogens. Granting the frequency of malaria and the number of malaria-related losses have been diminishing for eras, movement seems to be slowing down. Malaria suitcases have improved in the number of seats since 2014 up to date (2023).

Since Laveran in Algeria, Ghana, Nigeria, and India identified the etiology of malaria and the Plasmodium parasite in the nighttime 1800s, several methods have been tried with variable degrees of success to control and eradicate malaria off the face of the earth. We are still a long way from eradicating malaria, despite some significant breakthroughs in its control. There has been a recent emergence of resistance to the conventional front-line artemisinin-based combination therapy.

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