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Understanding the Pharmacognosy of Plants Used in Malaria Treatment

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ABSTRACT

Malaria remains a major global health challenge, particularly in tropical and subtropical regions. The search for effective treatments has led to a renewed interest in pharmacognosy—the study of medicinal plants and their bioactive compounds. This paper explores the historical and contemporary role of plant-based remedies in malaria treatment, emphasizing key botanical sources, phytochemical constituents, and their mechanisms of action. Traditional knowledge has long recognized the efficacy of plants such as *Cinchona* and *Artemisia annua*, which later contributed to the development of quinine and artemisinin-based therapies. However, issues related to safety, efficacy, and standardization remain. Ethnobotanical perspectives provide crucial insights into integrating traditional and modern medicine. Addressing regulatory challenges and enhancing scientific validation can pave the way for the responsible use of herbal antimalarials, ensuring both safety and efficacy.

Keywords: Pharmacognosy, Malaria Treatment, Medicinal Plants, Antimalarial Compounds, Ethnobotany, Herbal Medicine, Quinine.

INTRODUCTION

Pharmacognosy deals with medicinal drugs of natural origin particularly those derived from plants. Recently, there has been a resurgence of public interest and utilization of so-called alternative medicines, much of which is plant based. This revival is partly due to the shortcomings of modern allopathic medicine, which despite remarkable advances in surgery, diagnosis, and chemotherapeutic agents, does not have a cure for all ailments. Traditional medicines have long been used in developing countries and are prominent in the management of certain diseases. Alternatively, the interest has been generated and reinforced by the historic and ethnobotanical studies of medicinal plant remedies. The roles that pharmacognosy has played from its inception until the present day in relation to different historical periods have been discussed. Interestingly, the direction of pharmacognostic research and the techniques used have not changed greatly over that time. During the "Renaissance" period (mid 16th – 18th Centuries) where physicians were frequently also apothecaries, pharmacopoeias were first produced in different countries. These works were divided into two main sections, posological information (dose, formulation) and botanical data (identification, description). Characterization was described later and then generally in separate books. Since the advent of powerful, modern analytical techniques, there has been growing interest in the identification and characterization of natural products. Following this, the relationship between pharmacognosy and the pharmaceutical industry and the impact of natural product research upon the incidence of disease and drug cost are discussed. The treatment of bilateral diseases presents a major threat to world health. Malaria ranks among the most important of these, especially where it is holoendemic and where populations are infected more or less constantly. In recent years, there has been a resurgence of research activities aimed at discovering novel agents to combat plasmodia. The antimalarial properties of a great many plant species have been described in the literature [1, 2].

Historical Overview of Malaria Treatment

Malaria has been treated in traditional medicine for centuries using mainly herbal remedies and to a very small extent, minerals and animal products. Although synthetic drugs like quinine have been formally

used medicinally already in ancient Egypt and a variety of other cultures for centuries, its general acceptance in conventional medicine as treatment for malaria really only began in the 19th century. So even in the relatively recent history of medicine, traditional herbal medicine has been used for far longer to treat this disease than conventional synthetic drugs have been known. Also of interest is that until the discovery of quinine, nearly all the different herbal remedies for malaria were derived from unrelated plants known only to specific tribes, villages or regions which contributed to the success of various traditional treatments in different parts of the world, from both Western as well as indigenous healers. Native Americans, Chinese, Indian, Indonesian, Filipino, African, Transylvanian, Polynesian, Sami, and Australian aboriginal traditional healers have all treated malaria with various practices prior to the advent of modern mass market drugs. Flooded with cheap jungle-fever drugs, like the gift of quinine World War II Axis forces made to its African troops, plasmodium falciparum developed levels of resistance to most available conventional drugs assorted of nearly 100 years of 'normal' use, within a matter of 10-15 years. Currently, chloroquine - the cheapest and most deployed synthetic anti-malaria drug - is useless in most affected parts of the world, effectively condemning millions to piperaquine, quinine or the ridiculously expensive artemether, all of which are destined for the same epic fate of resistance to which falciparum parasites develop in line with any anti-malaria drug used against them. Even if resistance did not develop, profit-motive driven factors ensure that only a small spread of malaria drugs remain in usage, currently programmed for rapid expiration in the face of drug resistance. Neither of these options is stable or promise a lasting victory, and in some respects, the sole incontestable victory relates to resources: the pharmaceutical approach is breathtakingly expensive. In contrast, traditional remedies are both diverse and cheap in comparison to proprietary alternatives, widening the scope of future research. The picture painted by the anthropological, historical and medical data is paradoxically one of a potentially effective array of treatment options shackled by prejudices, a lack of rigorous scientific research, and the influence of sociopolitical forces affecting the incorporation of ancient methods with modern treatment systems. Yet within this complexity lie the keys to the profitability of both ethnomedicine and allopathy in a combined, evidence-based approach in the global struggle against malaria [3, 4].

Botanical Sources of Antimalarial Compounds

Malaria is an infectious disease that affects hundreds of millions of people every year, causing significant morbidity and mortality. African children have a notable risk of dying from malaria. The development of resistance in malarial parasites to currently used antimalarial drugs has led researchers to look for new drugs from various sources, including plants. Traditionally, a number of plants have been used in the folk medicine of local communities to treat malaria and fever. In sub-Saharan Africa, the treatment and management of malaria is to a large extent based on herbs. Considerable information is thus available about plants used in the treatment of malaria. Here, the proposed mechanisms of action of the various known phytochemical classes of antimalarial compounds have been described. It is vital to better understand these mechanisms to aid the search for improved antimalarials of both plant and synthetic sources. Malaria parasites resistant to most currently used drugs have been documented, thereby limiting the efficacy of drugs using these compounds. Therefore, it is a good idea to search for new anti-malarial drugs in African medicinal plants. There is vast literature documenting the pharmacology of various classes of compounds derived from plants reported to have antimalarial activity. Leak information, however, seems to be rare or absent for many of the commercially interesting malaria-related metabolites. The importance of using local plants as the primary drugs in non-industrialized areas around the world, particularly for combatting infections with protozoal and helminthic parasites, prompted a pilot project on the pharmacognosy of plants with reported, or perfectly possible, antiprotozal and anthelminthic properties. The project was run at the University of Copenhagen in Denmark. African, South-East Asian, and South American plants, respectively, were compiled and extracted. From these extractables, the simplest metabolites were isolated yielding a tentative inventory of both known and new natural antimalarials. Plasmodium is responsible for malaria, which is one of the most devastating and deadly parasitic diseases (especially in regions with lower socio-economic standards). The parasites are transmitted via the salivary glands of Anopheles mosquitoes. It has been found that compounds of plant origin possess antimalarial activity. Current antimalarial drugs are derived from traditional medicine. In particular, the bark of the Cinchona tree has been used by indigenous people in Peru to treat malaria. Antimalarial activity has mainly been correlated to the quinine alkaloids. It has been suggested that malaria parasites resistant to quinine may have had a selective advantage leading to a strong epidemics of resistant strains [5, 6].

Phytochemistry of Antimalarial Plants

Medicinal plants traditionally employed in the treatment of malaria encompass a number of species. Four protozoan species of the genus Plasmodium are responsible for this infection, although the majority of fatal cases are caused by Plasmodium falciparum. Therefore, the search for more potent and safe remedies continues. Phytochemical investigations have been carried out on dozens of plant species in this context, leading to the identification of secondary metabolites with antimalarial potential. Alkaloids, flavonoids, terpenoids, and several other classes of phytochemicals that have been isolated from antimalarial plants are discussed here. The biosynthesis of these compounds is described, highlighting its biological significance. The four biochemical classes of phytochemicals most commonly associated with antimalarial activity are reviewed, but the goal is to paint a broader picture of the state of research by incorporating findings beyond this particular subset of compounds. Alkaloids may be the most biologically significant class of phytochemical, as they are well known for their relatively broad spectrum of pharmacological activities, including anti-inflammatory, antipyretic, and analgesic effects. In addition, many of the alkaloid compounds isolated from medicinal plants are recognized for their notable antimalarial properties. The interactions between alkaloid secondary metabolites and the Plasmodium parasites are thus well studied. They have become a model system for investigating the biosynthesis of nitrogen compounds in plants, a group of phytochemical compounds that serve essential functions in plant metabolism and, according to an increasing number of studies, play key ecological and developmental roles as well. Alkaloids feature a variety of different ring systems and functional groups. Peculiar characteristics endow these compounds with a vast spectrum of pharmacological activities [7, 8].

Mechanisms of Action of Antimalarial Compounds

Infection with Plasmodium species starts with sporozoites invading hepatocytes, leading to merozoites released upon host cell rupture, and subsequent invasion of RBCs. This progress involves stages like trophozoite, schizont, and gametocyte. Some antimalarial compounds halt the parasite at specific developmental stages, causing atypical RBC forms and uneven hemozoin distribution. Infection leads to physical capture of RBCs during their egress, allowing for observation of various antimalarial agents including antibiotics, antifolates, and plant-based compounds. Antibiotics impact the interaction between parasites and RBCs, halt the intraerythrocytic phase, and reduce parasitemia, with in vitro tests conducted on treated infected blood. Electron microscopy reveals that malaria parasites occupy RBCs without altering membrane shape, though infected RBCs develop spiky projections. Antimalarials can also influence biochemical factors in host and parasite cells, with interactions varying based on parasite life cycle stages, primarily targeting schizont and trophozoites. A biochemical model has been developed to explain enzyme-cell interactions across compartments like cytoplasm and mitoribosomes. Additionally, a mathematical model simulates hemozoin formation at the merozoite stage, while the activation mechanism of artemisinin's peroxide bridge is proposed. Furthermore, ampicillin enhances merozoite inhibition by naphthoquine, which has a biochemical model developed to demonstrate protein inhibition in merozoites [9, 10].

Traditional Uses of Medicinal Plants in Malaria

Every culture around the world has its own way of curing diseases. Nowadays, diseases are treated with prescriptions containing a variety of chemicals. However, long before modern medicine was introduced, the flu was cured with a mixture of honey and lemon, traditional herbs were consumed for diabetes (although the effectiveness of the medicine was still not proven), and traditional herbs also played an important role in curing malaria. Local wisdom about plants as traditional medicine was passed down from generation to generation for thousands of years. These plants besides being able to create immunity also have remarkable properties for curing diseases, in this case malaria. Plants are chosen as medicines is often associated with culture. It could be that in the past there were traditional healers who chose certain plants as medicines for diseases that are often suffered by their people and the knowledge they have is passed down through stories that are believed by the public. Indonesia has a large variety of flora, which is approximately 30 thousand species of flora that spread evenly in several regions, such as Sumatera, Kalimantan, Papua, and Java. In Uganda, prepared from three to six mixed barks and roots. The extract is taken as herbal tea. The only human trial with single species of plant against monoinfected malaria is done in Tanzania (eight adult). These patients had reported to have shown resistance to major antimalarial drugs. After a load of very bitter herb tea, majority of patients could not tolerate the drug since from the beginning they had vomiting and stomach cramps. In addition to these common methods of treatment, there are populations who are known to take tub-bath steam of leaves frequently, smear themselves with the decoction of opposite stems, drink the extract of leaves or knife ground roots. It is known that the tribal herbal healers use more than one species of plants in combination in the form of

concoction, or else in the form of powder or simple rubbing of raw materials, and at other times just smeared burnt seeds or parts [11, 12].

Key Plant Species Used in Malaria Treatment

Malaria is a severe febrile illness caused by protozoal parasites of the Plasmodium genus, frequently observed in tropical regions. The use of plants in the treatment of malaria is a widespread phenomenon. The classic example of an herbal medicine with antimalarial properties is the decoction of Cinchona barks, which was introduced to Europe in the XVII century from South America and used effectively to treat malaria. The efficacy of this therapy, and its remarkable success in Europe, further fueled the interest in the botany of medicinal plant sources in general and plants with antimalarial properties in particular. The search for other sources of antimalarial plants accelerated in the XIX century, when the principal causal agent of malaria, P. vivax, became resistant to quinine. A systematic search for other plants with similar therapeutic potential was undertaken, which led to the discovery of many new species, among which Artemisia annua is the most well-known to date. Native to China, this traditionally used antimalarial species has played an exceptional role in antimalarial therapy by providing the lead compound for the most modern group of antimalarial drugs – the artemisinins. Officially recognized in 2015 with the Nobel Prize, this is the only example of a medicinal milestone being awarded to a plant compound. The worldwide antimalarial campaign with synthetic antimalarial drugs soon treated these and many subsequent findings as the main weapon against malaria while the knowledge of other traditional antimalarial plants subsequently fell into oblivion in scientific circles. This was unfortunate as the long-term use of most modern antimalarials sooner or later resulted in drug resistance. The problem of antimalarial drug resistance became critical in the late XX and early XXI centuries, prompted by the emergence of resistance to artemisinin combination therapy drugs in Southeast Asia. Following a randomised clinical trial with the herbal medicine Cryptolepis sanguinolenta, data are presented as a basis for a discussion on the potential value of other antimalarial plants that are already known or could be empirically tested in the treatment of malaria. Along with the ongoing search for new antimalarial plants, there is a growing interest in other 'old knowledge' from which modern drug discovery could benefit [13, 14].

Extraction Techniques for Antimalarial Compounds

Many plants used as antimalarials contain active principles in lipophilic compounds, requiring complex extraction procedures. The preparation of plant materials and extraction methodologies significantly influence the quality and purity of the isolated compounds. Various extraction techniques exist for this purpose, including solvent extraction through maceration, which can be done cold, hot, or under reflux. Maceration, performed without thermal or hydraulic aids, closely resembles traditional methods and involves skilled technical operations. Another traditional method, digestion, involves steeping dried, powdered plant material in a refrigerant overnight before filtering the residues. Steam distillation focuses on isolating volatile compounds, primarily essential oils, utilizing specialized apparatus to enhance yield and purity. This method is effective for extracting water-soluble volatiles, though many antimalarial plants also contain water-soluble alkaloids, flavonoids, tannins, and polyphenols. A significant challenge in extracting tough samples is the lengthy process, which risks degrading thermo-labile compounds. However, steam distillation can be conducted at lower temperatures, reducing processing time. Supercritical fluid extraction has been utilized for over 30 years, allowing substances to flow like gas while efficiently penetrating solids. This method, ideal for isolating light-sensitive ingredients and avoiding solvent toxicity, is also environmentally friendly. Due to existing regulations, producers in phytomedicine must be adept in this technique; however, many developing regions face technical limitations in its application. Consequently, the ease and familiarity of traditional methods may influence the adoption of supercritical fluid extraction in these facilities [15, 16].

Pharmacological Studies of Antimalarial Plants

The recent surge in scientific validation of plant-derived therapies has been prompted by increased interest in traditional medicine. A detailed critical review of the in vitro and in vivo pharmacological studies of various plants used in the treatment of malaria in different countries, including India, Thailand, Kenya, Venezuela, Ghana and Australia, and home to Amazonian traditional healers has been conducted. The aim was to affirm the traditional use of medicinal plants as effective and safe antimalarial drugs by comprehensively discussing both in vitro studies on the biological activities of extracts and isolated compounds and in vivo studies undertaken to determine cytotoxicity, safety, and the efficacy of traditional preparations. Six case studies of successful identification of potent antimalarial compounds from everyday culinary or medicinal plants have been provided, illustrating the contributions of traditional knowledge, and antimalarial home remedies given by Brazilian urban traditional healers have been documented. Any

in vitro studies describing side effects, toxicity on non-parasitological cells, or significant contraindications were also documented, and species were reported for which there are published reports of toxic effects. It is important to validate traditional uses by careful pharmacological evaluation, and no doubt there will be a continuing role for plant pharmacology as the global search for new medicines advances. The challenge is to ensure the scientific standards of bioassay techniques and pharmacological evaluation are maintained and that resulting information is used to support the development of new guidelines for the treatment of malaria. Many traditional medicines may prove to be of significant benefit in the treatment of malaria, though a need for quality research and assembly of good evidence before policy-based recommendations can be advanced [17, 18].

Safety and Efficacy of Herbal Antimalarials

While many plants are believed to possess anti-malaria properties and some studies indicate that herbal antimalarials might benefit the immune system and memory, rigorous testing is essential to ascertain their effectiveness. Numerous reports highlight their use not only for treating malaria but also for improving cardiovascular health and overall well-being. However, certain herbal treatments have led to neurological and haematological changes resulting in psychosis. Typically, these remedies are consumed as teas, but dosages from freshly prepared or dried materials are often unclear. Other forms include tinctures and infusions, which often lack standardization. A study on the treatment of Plasmodium falciparum in mice with fresh plant material showed no anti-malaria effect. In vitro studies indicate that whole plant material might have an effect, but data supporting herbal antimalarials is rarely available publicly. Rigorous testing of herbal medicines has often suggested minimal effectiveness. Remedies from various origins, including Chinese and West African, have raised concerns. While some advocate for careful evaluation, others believe individuals should make their own choices. Case reports indicate beneficial hematology as a potential risk. While some herbal treatments show effectiveness, there are risks of health impairment. Emphasis is placed on finding the ideal remedy for individual patients. Herbal antimalarials should be approached skeptically, given the historical context of many treatments potentially inhibiting curable diseases. Most studies focus on the positives, and advocacy may obscure important issues. Thus, caution is advised regarding herbal antimalarials, as they could complicate modern malaria treatments and necessitate careful regulation to avoid adverse effects [19, 20].

Ethnobotanical Perspectives on Malaria Treatment

The investigation and validation of the traditional knowledge concerning a great variety of medicinal plant use could help in the development and understanding of ancestral medical practices, and in this case, antisystemic forms existing all over the planet. Such information could also be useful for improving current treatment strategies to alleviate diseases of social concern. In this context, among others, the treatment of patients suffering from tropical diseases, such as malaria, considers ethnomedical perspectives and the way cultural beliefs determine why and how this or that plant is or should be used. An increasing number of studies have highlighted the way local knowledge influences the choice of some of the plants used by affected communities. More generally, the place of ethnobotanical research has been proven to be essential for conservation purposes, i.e. safeguarding traditional healing practices that are tenfold more likely to disappear than their pharmacopoeia. In the so-called developing world, several case studies have shown the importance of a good understanding of the way this or that culture treats its severely ill people. The variety of plant uses and methods of treatment in different cultures appear to be directly associated with the philosophy of healing. From Yangambi neocolonial plantists to the diagnosis and treatment of Cofán shamans, from the concept of "hot-cold" and imbalanced humoral conditions, at the basis of the traditional health treatment of Highland Maya, to popular medicine in Kenya and beyond, the interplaying effect of cultural beliefs on the many possible therapeutic uses of plants is fundamental in its fundamental dimension. It best illustrates how the choice of which plant is supposed to act upon the imbalance is tightly associated with idiosyncratic cultural facts and the vicious circle of the perpetuation of suffering related to the unilateral way people get treated in some specific cultural contexts. This is why it is now essential to include a "receptive" approach in any attempt to discover while healing takes place. Therefore, there is also a need to involve the population concerned in the priority bases often close enough to the scenario of empirical healing interplays while also enhancing the understanding of their own medicinal system/s. Thus, a more precise observation of traditional practices of plant remedies would suggest respect of an investigative methodology and helps to find the most appropriate complement in the treatment of inaugural healers and their patients [21, 22].

Challenges in the Use of Herbal Medicines

The use of herbal medicines for the treatment of malaria and other diseases is widely practiced in many regions of the world and dates back centuries. Recent studies have shown that despite the adoption of

artemisinin-based combination therapy, which is the recommended contemporary way to manage malaria, some people still turn to herbs to treat the disease since herbal medicines offer a cheaper alternative. However, if adequate care is not exercised in the selection, handling, and usage of herbs, the medicine might end up damaging the health of the individual [23, 24, 25, 26, 27, 28]. Assorted evidence has exposed the lack of safety of some forms of herbal medications either due to toxic reactions generated from contaminated herbs, the adulteration of the products with undeclared pharmaceuticals, or the application of inappropriate pharmaceutical treatment approaches. Every year, over 300 million acute cases of malaria are reported globally [29, 30, 31, 32, 33, 34]. The ailment is the leading cause of morbidity and mortality in many sub-Saharan African countries, posing significant threats to the pregnant woman and the under-five child. Extravagant drug resistance against malaria poses complications in executing management tasks. The high patronage for off-the-book OTC, unregistered, and unregulated herbal antimalarial concoctions on the Ghanaian market, though cheap and easily accessible like illicit antimalarials, solicit the evaluation of their packaging, labels, and some physicochemical properties for quality effects that could influence patient welfare [35, 36, 37, 38, 39, 40]. Herbal antimalarial products on the Ghanaian market need to be screened for heavy metals, microbial contaminants and chemical compounds that can be developed into quality control standards. Results from this study show that herbal packaging is substandard, there are concerns with the powder application, and samples do not comply with identity, strength, quality, and purity. Viewing the higher patronage rates, manufacturers should be held accountable for proper packaging, anticipated labels, and quality control-monitoring approaches before their products are allowed into the open market [41, 42, 43, 44, 45, 46, 47].

Regulatory Aspects of Herbal Antimalarial Products

Regulatory Aspects of Herbal Antimalarial Products Compliance with internationally accepted standards must be ensured for the quality of finished pharmaceutical products. The importance of compliance with these standards is clearer in the case of herbal antimalarial products, as these are not as strictly regulated compared to pharmaceutical antimalarial products [48, 49, 50, 51, 52]. Adherence to current guidelines for the good agricultural and collection practices (GACP) on cultivation, collection, and processing of medicinal plants; good extraction processes on the manufacture of herbal starting materials; good manufacturing practices (GMP) on the manufacture of herbal medicinal products; and good clinical practices (GCP) during any clinical trials, strengthens the belief that the manufacturers, processors, packers, and/or importers are able to produce herbal antimalarial products of suitable quality that will be safe and effective for the claimed use [45, 46, 47, 48, 49, 50]. Finished products should be submitted to pharmacopoeial or equivalent methods of assay to determine their quality, for example in respect to identification, content, and comparison of the finished product with standard materials. This is of particular importance in the case of herbal antimalarial products when those are used to self-medicate or in an unsupervised manner. There is little information on the interaction between herbal antimalarial products and pharmaceutical antimalarial products [51,52]. This is of importance particularly in the case of incomplete or sub-therapeutic courses of pharmaceutical antimalarial treatment when those are combined with self-medication using antimalarial herbs. Regulatory requirements, often focussing on the potential hazards for consumers from food-borne pathogens, pesticides, contamination, or residues, have direct implications for the growing, harvesting, and manufacturing of plant material. Supply of standardized, high-quality bulk raw material, however, remains a major problem, and poses challenges for the international and many national regulatory and scientific bodies [30, 31, 32, 33, 34].

Integrating Traditional and Modern Medicine

Traditional and modern medicine have long been regarded as opposites, with one labeled as "old" and the other "new." However, there is a growing recognition of the value both systems hold, prompting efforts to integrate their beneficial aspects [35, 36, 37, 38, 39, 40]. Traditional medicine often involves plant-based remedies and is gradually gaining acceptance within modern science. Herbal treatments are increasingly embraced by the public and are endorsed by the World Health Organization, despite concerns about interactions between herbal phytochemicals and pharmaceuticals. A key concern arises from the interaction of copper ions in tannin compounds found in some herbs, which may affect drug efficacy. These compounds share structural similarities with minerals and can create coordination complexes in human serum albumin. [41, 42, 43]. Research utilizing electric, spectral, and crystallographic methods has confirmed these antagonistic mechanisms, suggesting the potential for integrated therapies to address various diseases. However, the integration of traditional and modern practices presents challenges. Modern healthcare adopts a biomedical model focusing on physical, emotional, and social wellness, while traditional healers view health as harmony within oneself, family, and community, untainted by social disruptions or spiritual issues [44, 45, 46, 47, 48, 49]. Discontent can

arise when mutual respect is lacking; for example, traditional healers' beliefs in illness stemming from witchcraft may be dismissed by conventional practitioners. In many developing nations, these beliefs coexist with traditional healthcare practices. Ultimately, both holistic traditional methods and modern medical systems agree on the imperative to cure the sick, with no preference for the healing approach taken [50, 51, 52].

Case Studies of Successful Herbal Treatments

Herbal treatments have been used historically in malaria therapy and some case reports and evidence-based discussions of these indications and of the plants used have been published. Folk herbalism is a knowledge base developed, persistent and transmitted through generations. The most common way of transmitting such knowledge is culturally valuable customs or rituals. The practice of health treatments is most often an important part of them and in some cultures traditional plant remedies are widely used. 15 representative case studies are presented, used and documented in the practice of magical healing ART for malaria in Europe, Africa, America and Asia. The 15 discussions are supported by reports that document significant anamnestic or anthropological data about such remedies. The most valued plants are listed. The reports document remedies from different plant material, being combinations of different plants or mixtures of plants and other elements. Concerns are also expressed regarding the using of by unqualified and misbehaving partners leading to negative practices and outcomes. Natural treatments represent the plurality of ART practices, they give a player status to healers as experienced partners and that these healers are found in populations with different economies and levels of social development. An underlying philosophy of interrelation is perceived to account for explanations of natural magical therapeutic practices. It is important that in the practice of diagnosis / treatment / prevention that the patient comply with the healing requirements otherwise the results of natural treatments will be compromised. Furthermore, it is important to observe the remedies within the placebo/nocebo context. It is noticed that in some traditional communities there are complex traditional protection and healing panaceas which are shared in case of a malaria epidemic in the community. The knowledge of traditional treatments provides a valuable scientific archive which complements the records of the colonial doctors of the 17th to 20th centuries. Such visual proofs could stimulate ethnobotanists in malaria treatment practices in medical ethnobotany and the research about the ethnopharmacology. Such knowledge is important for the management of Malaria, developing further strategies to cope with the resistance of the parasite to the synthetic antimalarial drugs. On the other hand, such an overview of causes used for Malaria treatment practices would impact local and global health policies and Malaria control programs. There should be a negotiated dialogue between all stakeholders in the management of Malaria. These stakeholders include the World Health Organization and national health departments, Traditional Healers Organizations [31, 32, 33, 34].

CONCLUSION

The role of medicinal plants in malaria treatment underscores the importance of pharmacognosy in drug discovery. While traditional herbal remedies have provided the foundation for modern antimalarial drugs, further research and regulatory frameworks are needed to ensure their safety, efficacy, and standardization. Scientific validation through rigorous pharmacological studies can enhance the credibility of plant-based treatments. Moreover, integrating ethnobotanical knowledge with modern medical approaches offers a promising avenue for addressing drug resistance and expanding treatment options. Strengthening collaborations between traditional healers and biomedical researchers can foster innovative solutions in malaria management

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