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Indigenous Knowledge and folk use of a polyherbal antimalarial by the Bayang Community, South West Region of Cameroon.

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ABSTRACT

Nefang is a polyherbal preparation constituted of the leaves of six plants and the bark of one of these, used traditionally for the treatment of malaria by the Bayang community, South West Region of Cameroon. Since no ethnopharmacological survey has been carried out on this preparation, this study aims at obtaining indigenous and folkloric information on the optimal methods for harvesting of constituent plants, preparation and administration of Nefang in the treatment of malaria. The study design was an exploratory survey. Semi-structured questionnaires were administered randomly to 20 respondents after obtaining their informed consent with the assistance of a medical practitioner. Review of literature of constituent plants was also undertaken. This study revealed that the respondents had a good knowledge of malaria and its causes. Various compositions for the preparation by decoction was obtained and administration was ascertained to be by oral route or by enema. The brief scientific review also validated the pharmacological actions of the constituent plants. The diverse indigenous knowledge and folk use of this preparation in the treatment of malaria are a pre-requisite for the optimization of its composition for efficacy and pharmacological screening.

Key Words: Malaria, traditional medicine Africa, ethics, multidrug resistance, synergy.

INTRODUCTION

Malaria affects millions of people in sub-Saharan Africa with an estimated annual mortality rate of between one and two million, most of who are children under the age of five years [53].

In Cameroon, malaria remains the leading cause of death. The disease is mesoendemic but hyperendemicity occurs in remote areas located in the forest zone. In urban areas malaria is hypoendemic. Cameroon presents the main African prototypes of malaria epidemiology. In the forest and forest fringe in the south, transmission is perennial. In the northern zone which experiences sudanian and sahelian climate, transmission is seasonal; exceptions to this statement are found rice irrigation schemes. Resistance to antimalarial drugs is highly prevalent with most strains

showing resistance to chloroquine (50%) and sulfadoxine-pyrimethamine (12%). Cameroon is thus classified as a group IV region, which denotes countries where multidrug resistance is common [3].

Recent statistics show that 35 to forty percent of deaths occur in hospitals and fifty percent of these deaths are children below five years of age. Forty percent of a family's annual expenditure is on malaria treatment [60]. These numbers do not necessarily reflect the reality, since the most vulnerable are the poor with little or no access to modern medical facilities and as such most deaths are not registered. Such people make up the bulk of the estimated eighty percent of the world's population that rely on medicinal plants in managing diseases due to the lack of access to effective, cheap, safe and user-friendly medicines [36]. There is a belief that the use of these herbs for therapy is safe because they are natural. This belief, however, has hampered the development of phytomedicines in Disease Endemic Countries (DECs). Some of the major factors responsible for this include lack of information and appropriate resources, neglect and inexperience in this area on the part of scientists working in DECs.

With the emergence of multi-drug resistant forms of *Plasmodium falciparum* [54] and the rapidly increasing population in highly endemic areas, the malaria situation might become compounded with an even higher mortality rate in the years ahead. There is the growing consensus that drug combinations are essential to the optimal control of malaria, since they offer improved efficacy through synergistic activity [13].

The need for alternative antimalarial that are not only effective against resistant forms of *P. falciparum* but also relatively affordable is on the rise. One area that offers hope is the use of medicinal plants in diverse forms for the treatment and management of malaria [36] with the view to producing improved traditional antimalarials (phytomedicines). Herbal drugs, singularly and in combinations, contain a myriad of compounds in complex matrices in which no single active constituent is responsible for the overall efficacy.

A large number of plant species have been identified through ethnobotanical and ethnopharmacological studies as potential sources of antimalarial agents. Pure products (phytochemicals) with antimalarial activity have been isolated from some of these plants. Whole plants or parts of them are prepared and administered as oral decoctions, steam baths, infusion or enemas. Most remedies are a concoction of two or more plants species that work in synergy [36], an example being *Nefang*, a polyherbal concoction of six (6) medicinal plants, used locally by the Bayang community in Mamfe Sub-Division, South West Region of Cameroon for the treatment of malaria. The plants that make up this preparation include *Mangifera indica*, *Psidium guajava*, *Carica papaya*, *Cymbopogon citratus*, *Citrus sinensis* and *Ocimum gratissimum*.

The present study aims at obtaining indigenous and folkloric information on the optimal methods for harvesting the constituent plants, preparation and administration of *Nefang*, with the hope of evaluating its safety and optimizing its composition for maximum efficacy.

MATERIALS AND METHODS

2.1 Study Site

This study was carried out in Mamfe Sub-Division, one of the four Sub-Divisions of Manyu Division of the South West Region in Cameroon. It is composed of 11 villages as follows; Bachuo-Ntai, Besong-Abang, Egbekaw, Eshobi, Etemetek, Eyanchang, Eyang-Ntui, Mfairock II (Mile 18), Nchang, Okoyong, Small Mamfe [59]. The inhabitants speak the Bayang language as their mother tongue, called *Kenyang* [21], although English is the official language spoken along with Pidgin, and several other dialects, including Ejagham. Situated in the tropical rain forest zone, Mamfe Sub-Division is in a river valley and its humidity can be over 90% and temperatures sometimes exceed 120 F (49°C) during the Dry Season (February - April). During the rest of the year, temperatures remain around 80-90 F (27 to 37°C) and only drop during the Rainy Season, to approximately 70 F (21°C). Mamfe its capital is located 60 km (37 miles) from the border of Nigeria, on the Manyu River and is known as a centre for traditional religion and traditional medicine, reflecting the use of medicinal plants for the management of many ailments in the villages of this sub-division in particular and the Division at large [22].

In this area, agriculture is primarily the main stay and could be said to be practiced on a two-pronged approach – subsistence and industrial, though there is no clear cut demarcation between the two because most, if not all farmers practice a combination of both. The last three decades, however, have witnessed an explosion in large-scale agricultural production of cash crops like cocoa, coffee, coconuts (tamagha), oranges (nsukuru), palms and palm

produce, bush mangoes (nsenghe), egusi (nkwai), plantains (ekwa), banana (nsurehekwa), etc. thereby getting plants to respond to human rather than natural selection. The proceeds from these endeavors are used to improve the quality of life [5].

Among the plant species of this area, medicinal plants constitute a sector of great importance. The rural population depends solely on this. There is a strong belief of the population in plant medicines reflecting their reliance on this type of treatment. Local knowledge on medicinal plants is not wide because the local herbalists and traditional medicine practitioners usually inherit it [43]. For most treatments, the number of medicinal plants used is great. In fact many villages have been noted for their reliance on traditional medicine and this can be partly attributed to their culture as well as the distance to affordable health facilities.

As in most tropical rain forest, fever is very recurrent in this area due to the presence of many blood-sucking insects like mosquitoes, tsetse flies, midges, and the absence of mosquito nets and other repellents leading to the frequent use of medicinal plants for treatment. Therefore, the traditional health care system is based on significant local knowledge of medicinal plants just like in all major tropical forest areas [10].

The inability of the villagers to distinguish between fevers in the past may have resulted to the death of many, a situation that has changed over time. Presently, most people are aware of at least one plant species used in the treatment of one form of fever.

2.2 Ethical considerations for research involving human subjects:

This was a minimal risk study and was conducted in accordance with the protocol and Good Clinical Practices (GLP) to ensure protection of all aspects of the ethical rights and welfare of research participants. Approval to carry out this study was obtained from Institutional Review Board of the Institute of Medical Research and Medicinal Plants Studies (IMPM), Yaoundé-Cameroon.

Informed consent to participate in the survey was obtained using an appended prior informed consent (PIC) form. All information obtained was treated confidentially.

This PIC form gave details on the objectives of the interview, fair and equitable sharing of benefits, contact of all the researchers concerned and assurance of anonymity and confidentiality, in accordance with the provisions of the United Nations Framework Convention on Biodiversity at the Earth Summit in Rio de Janeiro, Brazil in 1992.

2.3 Study design and data collection

The study design was an exploratory survey. The interviews were conducted at the study site in the months of January and June, 2011. The objectives of this study were explained to traditional leaders of some selected villages due to accessibility. Following their approved consent to carry out this research, open-ended semi-structured questionnaires were administered randomly to traditional medicine practitioners, farmers, herb sellers, mothers, community leaders and elders, by the researcher and a physician. Interviews were considered the best qualitative method of data collection since they provide the best “real-life” experiences. Pre-determined questions with wordings that could be varied were asked from respondents, and extended according to how the interviewee response was perceived [34]. Those who met the following criteria were included in the study:

1. Agreed to participate in the study
2. Have prepared and used *Nefang* for at least one year.
3. Resident in Mamfe Sub-Division

20 respondents were interviewed. Information on their traditional knowledge about malaria and their understanding of the cause was obtained, as well as the parts of these plants used for the treatment, method of collection, preparation, composition, administration and side effects of this antimalarial remedy were obtained.

RESULTS

3.1 Data Generation

Among the 20 people interviewed from 7 villages, were 5 elders/community leaders, 4 herbalists, 5 herb sellers, 3 mothers and 3 traditional medicine practitioners as shown on Table 1 and Table 2 respectively.

Table 1: Distribution of respondents by village

No	VILLAGE/ LOCALITY	NUMBER OF RESPONDENTS	%
1	Bachuo-ntai	3	15
2	Besongabang	2	10
3	Egbekaw	4	20
4	Eyanchang	2	10
5	Mamfe/ Small Mamfe	6	30
6	Nchang	1	5
7	Okoyong	2	10

Table 2: Occupation of respondents

No	POSITION OF RESPONDENT	NUMBER	%
1	Community Leaders/ Village Elders	5	25
2	Herbalists	4	20
3	Herbs Sellers	5	25
4	Mothers	3	15
5	Traditional Medicine Practitioners	3	15

80% of the people interviewed were above fifty years old. All respondents spoke and understood *Kenyang* language spoken by the scientist for easy communication and the pre-determined questions only provided guidelines for the research but further questions naturally arose between interviewer and respondents to provide valuable insights into methods of herbal practice. However, the respect of the wishes of the respondents on sensitive issues was taken into consideration.

3.2 Data Analysis

The guidelines for analysis of the questionnaires were by the inductive and deductive analysis method described by Harrel and Bradley [44]. Questionnaires were read a couple of times to determine different themes and comparisons among the respondents as follows:

- Relationships on their understanding of the causes and physical manifestation of malaria.
- Aspects of herbal antimalarial treatment regarding plant parts used and how they are harvested.
- Aspects on the preparation of *Nefang*, method of administration and side effects.
- Conservation of *Nefang*.

3.3 Traditional Knowledge about the causes and Physical Manifestation of Malaria

The understanding of malaria among the respondents was good and they even recognized the importance of sleeping under impregnated mosquito bed nets. All respondents knew that malaria was caused by mosquito bites, though some mentioned indirect causes like hot weather (more mosquitoes), stagnant water, dirty environment and unhygienic living conditions. They also recognized some of the frequent symptoms of malaria like high body temperature, headache, shivering, weakness, loss of appetite, diarrhea and vomiting as shown in Table 3.

Table 3. Physical manifestation of Malaria mentioned by respondents

No.	Symptom	No of Respondents	%
1	High Body Temperature	20	100
2	Shivering	20	100
3	Headache	19	95
4	Vomiting	18	90
5	Loss of appetite	15	75
6	Weakness	15	75
7	Abdominal Pain	12	60
8	Diarrhea	10	50
9	Blisters on mouth	8	40
10	Dizziness	2	10
11	Sweating	12	60
12	Pale coloured eyes and finger nails (Signs of Aneamia)	4	20
13	Nausea	6	30

3.4 Plant parts used for the preparation of *Nefang*

All respondents could identify the constituent plants of *Nefang* and harvest the plant parts used in its preparation. The plants parts were harvested and identified by species, family, common and vernacular name. Voucher specimens were then deposited at the IMPM herbarium.

A review of the ethnomedical use relevant to malaria and other diseases, biological activity and chemical studies of all the six constituent plants of *Nefang* scientifically identified, revealed their importance in folk medicine as summarised in Table 4. However, the activity of a combination of all the plants is yet to be evaluated.

Table 4. Plants used for the preparation of *Nefang* and their reported use

No.	Plant Family and Species (Voucher specimen number)	Common and Vernacular Name	Plant Part used	Reported relevant ethnomedical uses	Biological Activity/ Chemical constituents
1	Anacardiaceae <i>Mangifera indica</i> Linnaeus (TN6225)	Mango <i>Nsenghe</i> (Kenyang) <i>Endo'o</i> (Bulu)	Bark and Leaves	Malaria [25] [1], [55]; expectorant, dental caries and toothache [39].	Antimalarial; positive effect on hematopoietic system, anti-inflammatory [51]; antidiabetic [8] [67]; hypoglycemic and strong antioxidant: total phenols [48]; diuretic [6][15]; anti-inflammatory [30] [57].
2	Myrtaceae <i>Psidium guajava</i> Linnaeus (TN6226)	Guava <i>Gwava</i> (Kenyang) <i>Afele</i> (Ewondo)	Leaves	Malaria [36] [49], [55]; diarrhea, amoebic dysentery, dermatitis, bleeding gums [30]; wound healing [68].	Amebicide, analgesic, antibacterial, antifungal, antidiarrheal, antimalarial [16] [29]; broad spectrum antimicrobial [31].
3	Caricaceae <i>Carica papaya</i> L. papaya (TN6227)	Paw-paw <i>Popo</i> (Kenyang) <i>Fofo'o</i> , <i>Fofuo</i> (Ewondo)	Leaves	Malaria [36] [28] [1] [63] [55]; diarrhea [27]; jaundice [38] [66]; wound healing [68].	Antimalarial [28]; antimicrobial [33]; immunomodulatory [50]; high ascaricidal effect; alkaloids, tannins, saponins, glycosides [56]; antidiabetic [67].
4	Poaceae <i>Cymbopogon citratus</i> (DC. Ex Nees) Stapf (TN6228)	Fever Grass or Lemon Grass <i>Fiva Grass</i> (Kenyang) <i>Osanga</i> (Ewondo)	Leaves	Influenza [41]; malaria [25] [2] [23][4] [55]; mosquito repellent [7]; jaundice [66]; snake bites [69].	Antiplasmodial [25]; antibacterial [52]; antileishmanial, essential oils: citral, geraniol, neral and beta-myrcene [47]; anti-snake venom [69].
5	Rutaceae <i>Citrus sinensis</i> (Linnaeus) Osbeck (pro sp.) [maxima reticula] (TN6229)	Sweet Orange <i>Nsukuru</i> (Kenyang)	Leaves	Kill mosquito larva, treat neurological disorders and facilitate digestion [26] [65]; paediatric sickle cell [66].	Anti-inflammatory, diuretic, hypolipidemic: hesperidin, diosmin [35] [19]; antioxidant: alkaloids, phenols, flavonoids, tannins [14]; antidiabetic [67].
6	Lamiaceae <i>Ocimum gratissimum</i> Linnaeus (TN6230)	Wild Basil or Mosquito Plant <i>Berem</i> (Kenyang) <i>Messep</i> (Bulu) <i>Masepo</i> (Bakweri)	Leaves	Abdominal pain [20]; mosquito repellent [18]; malaria [46] [23]; cholera, typhoid, dysentery [61].	Antifungal, antimicrobial [37]; antimalarial [23]; strong antioxidant and free radical scavenger: phenolic acids, rosmarinic acid, lipoic acid [24]; antidiabetic [67].

All respondents recognized the importance of harvesting these plants species from their natural habitat or from well-kept nurseries or botanical gardens. The plant parts to be used were either harvested in the evening or early in the morning and the method of harvest was in accordance with the preservation of biodiversity as handed down to them through folklore. The harvested plant parts were either used immediately or dried either by air or sun and then conserved in a cool dry place separately for eventual use. The role of each plant was not ascertained but all respondents confirmed the fact that the plants acted together for maximum efficacy. 80% of the respondents confirmed that the method of administration was either by enema or oral while 20% confirm oral administration only.

3.5 Method of preparation and use of *Nefang*

The method of mixing, preparation and use of *Nefang* was handed down to users through folklore as ascertained by the respondents. The respondents gave us their various proportions of mixing the plant parts as shown in Table 5.

Table 5. Composition of *Nefang*

No.	Constituent Plant Proportion in <i>Nefang</i> [<i>Mangifera</i> indica (B): <i>Mangifera</i> indica (L): <i>Psidium</i> guajava (L): <i>Carica</i> papaya (L); <i>Cymbopogon</i> citratus (L): <i>Citrus</i> sinensis (L): <i>Ocimum</i> gratissimum (L) w/w]	No. of Respondents	%
1	4:2:2:1:1:1:1	1	5
2	3:1:1:1:1:1:1	2	10
3	2:2:1:1:1:1:1	7	35
4	2:1:1:1:1:1:1	5	25
5	1:1:1:1:1:1:1	5	25

Key: (B) - Bark; (L) - Leaves

Freshly harvested tree bark was cut into small pieces while freshly harvested leaves were sliced into equal sizes and mixed in their given proportions, whereas the dried plant parts were crushed before mixing in same proportions. From the method of preparation given by the respondents, we estimated that approximately 2kg of a mixture of the freshly harvested plants or 500g of the crushed dried plants was boiled in 4litres of water for 5-10 minutes and taken orally or administered through enema. 4 respondents (20%) reported administration by enema alone while 16 (80%) reported both by oral route and enema. There was however, no difference in efficacy between using freshly harvested plant parts and dried plants, apart from the fact that freshly harvested plant parts were used immediately after harvest whereas crushed dried plant parts could be preserved in a cool dry place for eventual use. The administration of this product did not involve any rituals and there were no taboos in relation to its preparation.

Oral administration required taking one glass full (0.33 litre) daily before eating for 6 days for adults and half a glass for children, whereas administration by enema required taking mild warm enema early in the morning before eating at a unique dose of 1litre \times 3 for adults and 0.5litre \times 2 for children, once in 3-6 months. The product was immediately disposed of after use in the case of enema. After the administration of enema, patients could only eat after 2-3 hours. When taken orally, the period of conservation of this product within which it remained active was reported to be one week, after which it had to be disposed of and a new product prepared.

Reported side effects included dizziness, over sleeping and nausea, though 11 respondents (55%) reported no side effects.

DISCUSSION

With respect to the plants parts, the leaves of all the six constituent plants and the bark of only one of the plants were used, hence leaves were the most frequently used plant part in preparing *Nefang*. The common use of leaves in the preparation of remedies is reported by Muthuet *al.* [9] and Kala [11]. These plant parts, especially the leaves were harvested either very early in the morning or in the evening when there is low irradiance and hence low photosynthesis rate leading to increased production of carbon-based secondary metabolites (CBSM), followed by enhancement in the production of total non-structural carbohydrates (TNC), H₂O₂ and malondialdehyde, which are related to increased secondary metabolites production [58] [45].

80% of the respondents interviewed during the study were aged above 50 years. Thus, the majority of healers from whom a great deal of ethno-medical knowledge is derived are elderly. This puts the art of herbal medicine and indigenous health care knowledge at risk because as the older people die, so does their legacy of the use of traditional medicines to manage malaria and related diseases [40] [17]. There is the urgent need for the documentation of this invaluable knowledge, since there is a persistent gap in knowledge of herbal practice between the younger and older generations. However, there is the belief that the older people are more competent in providing healthcare using plants and other natural substances, based on the social and cultural background of the society [62].

Most of the plants used in traditional healthcare are collected from the wild, and only a few have been domesticated. However, field observations in this study revealed that four of the six constituent plants of *Nefang*, are fruit plants, while two are spices and as such are now being domesticated because over exploitation and urbanization have led to decline in resources.

Respondents recognized the need for proper harvesting of these constituent plants, as well as other plant resources. They are also interested in the domestication of these plants as well as other plants of interest, in order to ensure sustainable availability of the plants, enhance food security, improve income, health and nutritional status of the rural communities while safeguarding biodiversity and protection of the environment as earlier reported by Mbwambo [42]. However, they lack the means and relevant technology for maximum yield.

From the various compositions of the plants given by the respondents, an average composition could be arrived at with the view to evaluating its safety and optimize this composition for maximum efficacy. This is in line with the tradition of combining a large number of plants to create synergy, reduce toxicity and increase bioavailability and efficacy [40] [41].

Method of administration of *Nefang* is either through the conventional oral route or by enema, a rare method of rectal administration of aqueous or oily solutions or suspensions. The benefits and hazards of this rectal route has earlier been reported by Doyle [12] and Smith *et al.* [32], hence the need for special formulation techniques are required and for rectal administration to be carried out by well trained personnel.

Side effects were not well defined because there was no prescribed dose as is required for each drug. All drugs to be administered to humans must be safe, efficient and of good quality [64].

CONCLUSION

The review on the constituent plants of *Nefang* clearly validates the effectiveness and reliability of ethno-medical knowledge and traditional uses of these plant species in managing malaria and other opportunistic infections. This requires mobilizing indigenous healthcare knowledge, empowering traditional healers, and fostering the cooperation between traditional and modern healthcare systems. There is therefore a strong need for the documentation of indigenous knowledge and folk use of this polyherbal and other medicinal plant preparations.

The inhabitants of the area are very poor and have no or insufficient knowledge about proper preservation and storage techniques of medicinal plants. There is no proper storage facility and so dried plant parts may get contaminated, which leaves the local inhabitants with the only option of harvesting the plants each time it is needed leading to depletion and deforestation. Due to the extinction of some of the plants, there is dire need for awareness and application of conservation strategies, to educate and train the local inhabitants regarding the proper use and cultivation of available medicinal resources. In-situ and ex-situ conservation methods can be practiced to avoid further depletion of rare plants.

The rectal method of administration known as enema has proven to be very delicate, hence the need for the proper training of traditional health personnel on the use of this method.

Most of the indigenous knowledge on the use of medicinal plants is held by the elderly, hence the need for the mobilization of herbal practitioners to form conservation groups for the transmission of their wealth of traditional knowledge. The training of herbal practitioners to empower other indigenous users will be very important towards the integration of traditional medicine into modern medicine.

Dosage forms, side effects and efficacy were not clearly defined, even from literature review, hence the need for collaboration between herbal practitioners and research scientists to conduct pre-clinical and clinical studies on the safety, efficacy and synergistic relationship of the constituent plants of this polyherbal product with the view to developing affordable improved traditional medicines (ITM).

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