



(RESEARCH ARTICLE)



Antimalarial and antianemic medicinal plants used by traditional medicine practitioners and the populations of the Korhogo 1 health district (Poro Region, Ivory Coast)

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Abstract

The purpose of this study is to identify a list of medicinal plants used by Traditional Medicine Practitioners and the populations to treat malaria and anemia in the health district of Korhogo1. The ethnobotanical survey carried out among 251 people, including 51 practitioners of traditional medicine and 200 people from the general population identified 49 species for the treatment of malaria. Individuals cited *Azadirachta indica* 54 times, *Carica papaya* 51 times and *Nauclea latifolia*. For the treatment of anemia, 36 species have been identified, of which the most cited are: *Hibiscus sabdariffa* (38 citations), *Tectona grandis* (27 citations) and *Justicia secunda* (27 citations). The predominantly methods of preparation of remedies are decoction (63.84%), maceration (11.15%). The remedies are administered in the majority of cases orally in the form of 64.04% drink. The leaves represented 51.26% of the organs used in the preparation of herbal remedies. As part of this survey, nearly 85 plant species were listed for their antimalarial and anti-anemic properties. These species constitute potential resources that can lead to the isolation of phytochemicals of therapeutic interest. Also, given the strong use of medicinal plants by the communities, at around 90%, the ivoirien government, through the Ministry of Health, has integrated into its health policy and its strategy for the development and promotion of health. Traditional medicine the research and promotion component of the traditional African pharmacopoeia. This, with the aim of making available to the populations effective Improved Traditional Medicines, of guaranteed quality and harmlessness.

Keywords: Malaria; Anemia; Traditional Healers; Korhogo; Policy; Development; National Health System

1. Introduction

Malaria is a febrile and hemolyzing erythrocytopathy due to the presence and development in the liver and then in the red blood cells of a protozoan of the genus *Plasmodium* transmitted to man by the bite of an infected female *Anopheles* [37], [44], [45]. Over 91% of malaria deaths occur in Sub-Saharan Africa, malaria is one of the leading causes of death [38]. These malaria-related deaths are mainly due to the onset of severe anemia [39], [40]. The epidemiological studies carried out in the health district of Korhogo 1 for the year 2019 made it possible to notify the most commonly encountered pathologies, in particular: malaria, anemia, acute respiratory infections (ARI), diarrheal diseases and

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Dermatoses. The Korhogo 1 health district has, in a register, all the pathologies identified and the number of cases. These data come from different public and private health establishments, at different levels. Among these pathologies, malaria and anemia remain by far those with the highest mortality rate [36], [38]. Out of a population of 141,330 people, we have 28,979 confirmed cases. Malaria, 7,022 confirmed cases in children under 5 with an incidence of 205 ‰ [12].

Faced with the extent of these pathologies in the study area, a large majority of the population uses medicinal plants for treatment for reasons of great accessibility to herbal remedies and for socio-cultural considerations [30]. The area of Korhogo is known to be an area straddling tradition as evidenced by the figures relating to the number of traditional medicine practitioners in the city with more than 166 Traditional medicine practitioners identified and trained by the National Program for the Promotion of Medicine. Traditional [11]. These traditional practices in the treatment of certain pathologies need to be documented in order to preserve the know-how of the populations in the management of recurrent pathologies in the area. Because the current sector policy of the government is to integrate traditional medicine and pharmacopoeia into the national health system in order to improve the health coverage of the health needs of the populations. The present study aims to inventory the antimalarial and antianemic plant species used in the composition of herbal remedies offered to patients from a survey of practitioners and users.

2. Material and methods

2.1. Framework

The geographic scope of the study was the Korhogo Health District 1. This District is one of two (2) health districts of the Korhogo health region in the Poro region. It brings together the city of Korhogo and the sub-prefectures of Napieolodougou, Tioro, Lataha, Karakoro, Komborodougou, Kiémou, Sohouo, Dassoungbo, Kombolokoura and Koni.

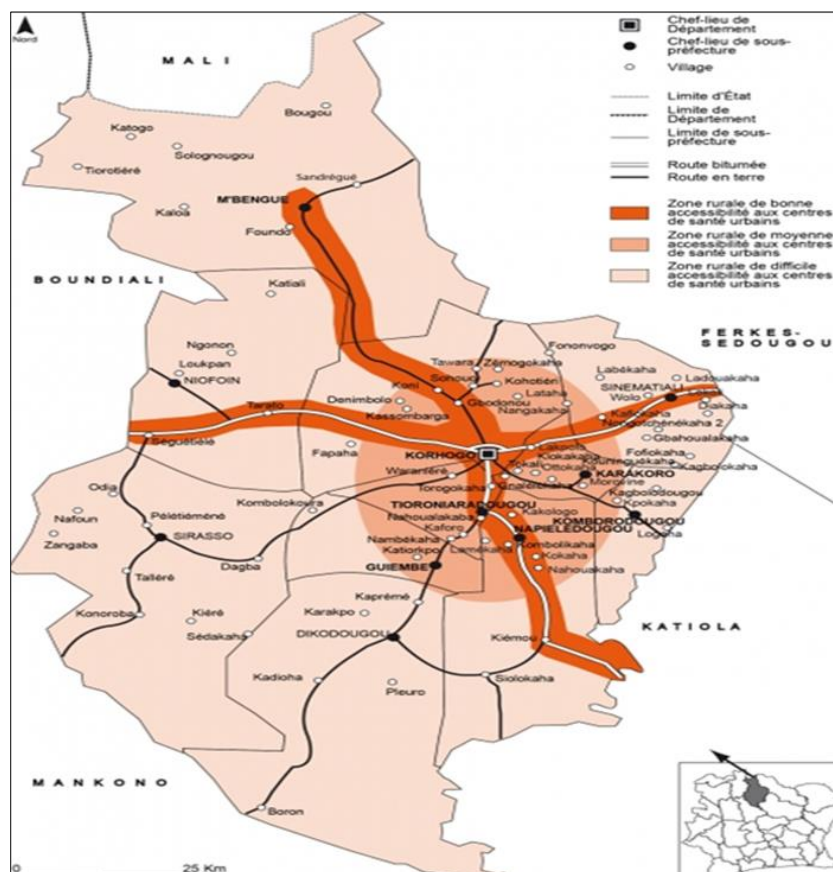


Figure 1 Health district map

2.2. Choice of study area

Korhogo was chosen for its richness in cultural heritage and traditions. It is also full of many Traditional Medicine Practitioners (PMT) recognized and renowned for their expertise.

Korhogo 1 was selected because of the high frequency of these pathologies, in particular malaria and anemia in this health district, the purpose of which is to identify the medicinal plants commonly used for the management of these endemics

2.3. Type and duration of the study

This is a prospective cross-sectional study with a descriptive and analytical aim. It lasted three (3) months (from March 13 to June 15, 2020). The target populations consisted of 51 traditional medicine practitioners and 200 people from the population.

2.4. Target populations and inclusion criteria

To collect a large amount of information on medicinal plants, part of the survey was carried out among PMTs and the other among populations made up of traditional medicine practitioners and residents of the Korhogo health district 1.

- PMTs installed in the health district of Korhogo 1 and recognized by the National Program for the Promotion of Traditional Medicine (PNPMT).
- PMT members of the Association of Healers and Traditional Healers of Korhogo (AGTK);
- Adults residing in the Korhogo 1 health district and having given their consent or informed consent to participate in the survey.

51 Traditional Medicine Practitioners and 200 people from the population were surveyed (Table 1 and 2)

Table 1 Breakdown of PMT's according to survey locations

Workplace	Effective	Percentage (%)
Korhogo town	35	68,6
Karakoro S/P	1	2
Komborodougou S/P	2	3,9
Klofohakaha	2	3,9
Lélékaha S/P	1	2
Napié S/P	7	13,7
Tioro S/P	3	5,9
TOTAL	51	100

Table 2 Distribution of the population according to the survey sites

Workplace	Effective (N)	Percentage (%)
Korhogo town	133	66,5
Village of Klofohakaha	14	7
S/P Karakoro	9	4,5
S/P Napiéolodougou	16	8
S/P Kiémou	8	4
S/P Komborodougou	2	1
S/P Lataha	18	9
TOTAL	200	100

The average age of the people surveyed is 54.84 years with a minimum of 34 years and a maximum of 82 years and the standard deviation is 10.15. The most represented age group is [55-65] with 43.1%.

3. Method of collecting information

3.1. Ethnobotanical survey

The study was carried out using a structured method following the previously developed questionnaire. It was carried out with PMTs at their various workplaces and with the population through home and market visits in the Korhogo 1 health district, respecting criteria.

3.2. Collection of medicinal plants

Using the vernacular names given by PMTs and the people, the various medicinal plants were harvested either by gathering in the wild or by purchasing bundles of leaves at the medicinal plant supply market.

3.3. Botanical identification

Each different medicinal plant has been identified by the National Program for the Promotion of Traditional Medicine (PNPMT and confirmed at the National Floristic Center (CNF) of Felix Houphouët Boigny University in Abidjan.

3.4. Data processing

The survey data were entered using Word and Excel 2010 software. Tables and figures were produced with EXCEL 2010 software to better assess and explain the level of knowledge about malaria, anemia and the plants used for support.

4. Results

4.1. Distribution of PMTs by age

The average age is 54.84 years; the minimum age is 34 and the maximum age is 82. The most represented age group is [55-65] [with 43.1%. It is followed by that of [35-45] [with 21.6% of PMT (figure 2)

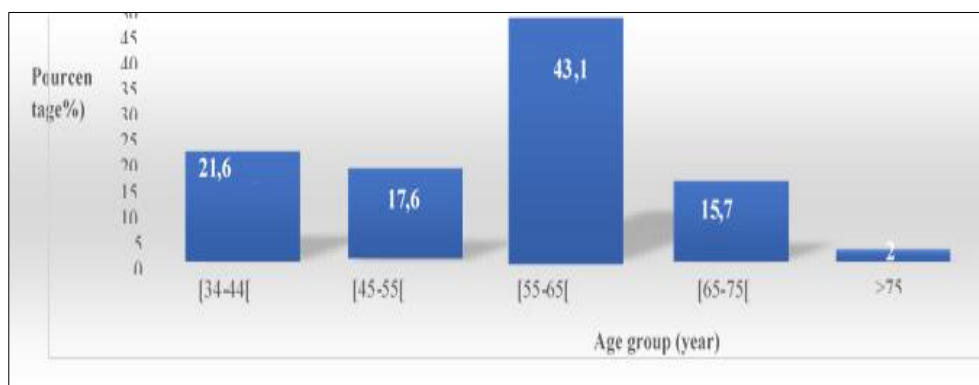


Figure 2 Distribution of PMT by age

4.2. Distribution of PMT's by gender

Most of the PMT's questioned are men (80.4%). The sex ratio is 4.1 (M / F)

4.3. Distribution of PMT's by place of work

The workplace of the majority of PMT surveyed is the town of Korhogo (Table 3).

Table 3 Breakdown by workplace

Workplace	Effective	Percentage (%)
Korhogo town	35	68.6
Karakoro S/P	1	2
Komborodougou S/P	2	3.9
Klofohakaha	2	3.9
Lélékaha S/P	1	2
Napié S/P	7	13.7
Tioro S/P	3	5.9
TOTAL	51	100

4.4. Distribution of PMTs according to level of study

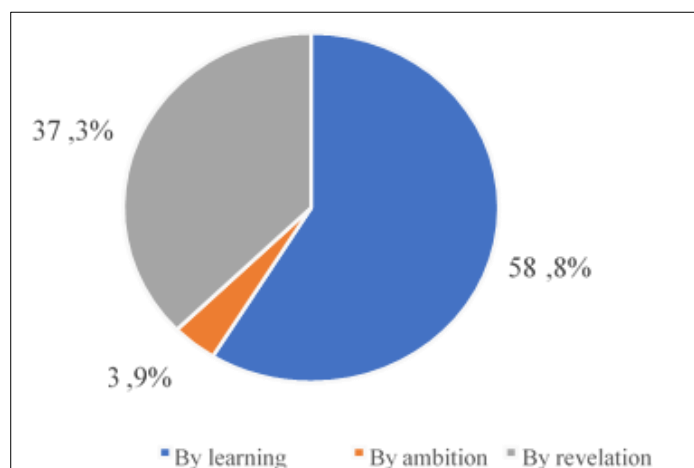
Only 11.8% of PMT questioned have primary and secondary education. Also, 66.7% of them have not been to school (Table 4).

Table 4 Distribution of PMTs by level of study

Level Of Study	Effective	Percentage (%)
Primary	6	11.8
Secondary	6	11.8
University	3	5.9
Koranic school	2	3.9
Illiterate	34	66.7
TOTAL	51	100

4.5. Distribution of PMTs according to the mode of acquisition of traditional knowledge

The majority of LMPs surveyed (58.8%) acquired their traditional knowledge through apprenticeship. Only 3.9% became PMT by ambition (Figure 3)

**Figure 3** Distribution of PMTs according to the mode of acquisition of traditional knowledge

4.6. Distribution of PMT according to seniority

PMTs with a seniority of 10 to 20 years are the most represented (47.06%) (Table 5)

Table 5 Distribution of PMTs according to seniority

Year	Effective	Percentage (%)
[10 ; 20[years	24	47.06
[20 ; 40[years	17	33.33
≥40 years	10	19.61
TOTAL	51	100

4.7. Distribution of PMT according to the number of patients received per month

The majority of PMT surveyed (86.3%) receive less than 100 patients per month. Only 5.9% receive at least 200 patients per month.

4.8. Directory of medicinal plants used by PMTs

Medicinal plants used in the treatment of malaria 49 species of medicinal plants have been identified as part of the treatment of malaria. *Azadirachta indica* (54 citations) is the most cited, followed by *Carica papaya* (51 citations) and *Nauclea latifolia* (51 citations) (Table 6).

Table 6 List of antimalarial plants identified in Korhogo health district 1

N°	Latin binomials	Families	Vernacular names	NC	Parts used	Method of preparation	Fashion administration
1	<i>Azadirachta indica</i> A. Juss	Meliaceae	Neem (French)	54	Sheets ; bark; seeds	Grinding; decoction; infusion	Oral route; bath ; steam bath
2	<i>Vernonia colorata</i> (DC.) C. Jeffrey	Arecaceae	Kossafinin (Dioula)	34	Sheets	Grinding	Oral route; bath
3	<i>Carica papaya</i> L.	Caricaceae	Papayer (French)	51	Sheets ; roots	Grinding ; decoction; maceration; infusion	Oral route; bath ; steam bath
4	<i>Mangifera indica</i> L.	Anacardiaceae	Manguier (French)	44	Sheets ; bark; roots	Broyage ; décoction ; macération ; hydrolysats	Oral route; bath with black soap + ash
5	<i>Nauclea latifolia</i> Sm.	Rubiaceae	Bati (Dioula) ; Zanvalm (Senoufo) ; Bitter yellow (French)	51	Sheets ; roots; bark	Decoction; maceration	Oral route; purge
6	<i>Bambusa vulgaris</i> Schrad. Ex J.C. Wendl	Poaceae	Chinese bamboo (French); Bobourou (Dioula)	26	Sheets	Decoction	Oral route; purge

7	<i>Anogeissus leiocarpus</i> (DC.) Guill&Perr	Combretaceae	Kèrèkètè (Dioula) Nanganam (Senoufo)	29	Sheets ; bark; roots	Decoction; infusion	Oral route; bath ; purge
8	<i>Cassia alata</i> L.	Caesalpiaceae	Acacia (French)	23	Sheets	Decoction	Oral route; bath ; steam bath
9	<i>Cordia myxa</i> L.	Boraginaceae	Dolma (Senoufo)	18	Sheets	Decoction	Oral route; bath
10	<i>Citrus aurantifolia</i> (Christm.) Swingle	Rutaceae	Citronnier (French)	18	Sheets ; fruits	Decoction; grinding ; maceration in alcohol	Oral route; bath
11	<i>Olax Subscorpioidea</i> Oliv.	Olacaceae	Gangbélem (Senoufo) ; Ninbossi (Dioula)	17	Sheets	Decoction	Oral route; bath
12	<i>Flueggea virosa</i> (Roxb. Ex Wild.) Voigt	Euphorbiaceae	Balan balan (Dioula) ; Galandiène (Senoufo)	17	Sheets ; roots	Decoction	Oral route; bath
13	<i>Moringa oleifera</i> Lam.	Moringaceae	Moringa (French)	12	Sheets	Decoction; infusion	Oral route
14	<i>Tectona grandis</i> L. f.	Lamiaceae	Teck (French)	12	Buds; sheets	Decoction	Oral route; bath
15	<i>Acanthus guineensis</i> Heine & P. Taylor	Acanthaceae	Solouvoung (Senoufo)	11	Sheets ; roots	Grinding ; decoction	Oral route; bath
16	<i>Guiera senegalensis</i> J. F. Gmel.	Combretaceae	Ganivig (Senoufo) ; Koumbè (Dioula)	14	Sheets	Decoction	Oral route; bath
17	<i>Musa paradisiaca</i> L.	Musaceae	Bananier (French)	8	Sheets	Decoction	Oral route; bath
18	<i>Tamarindus indica</i> L.	Caesalpiaceae	Tamarin (French)	8	Sheets ; fruits	Decoction	Oral route
19	<i>Combretum micranthum</i> G. Don	Combretaceae	Kinkeliba (Dioula)	6	Sheets	Grinding ; decoction	Oral route; purge
20	<i>Khaya senegalensis</i> (Desr.) A. Juss.	Meliaceae	Djala (Dioula) ; Cailcedra (French)	8	Bark; sheets ; roots	Decoction	Oral route; bath ; purge
21	<i>Alchornea cordifolia</i> (Schumach. &Thonn.) Müll. Arg.	Euphorbiaceae	Djéka (Baoulé)	12	Sheets ; roots	Decoction; maceration	Oral route; purge
22	<i>Acacia nilotica</i> subsp, adstringens	Mimosaceae	Bagana (Dioula)	6	Sheets ; bark; fruits	Decoction	Oral route; bath

23	<i>Aloe vera</i> (L.) Burm.f.	Liliaceae	Aloes (French)	4	Sheets	Decoction; maceration	Oral route
24	<i>Ananas comosus</i> (L.) Merr.	Bromeliaceae	Ananas (French)	3	Peeling of fruit	Decoction	Oral route
25	<i>Cymbopogon citratus</i> (DC) Stapf	Poaceae	Citronnelle (French)	3	Sheets	Decoction; infusion	Oral route
26	<i>Leptadenia lanceolata</i> (Poir.) Goyder	Apocynaceae	Djrime (Senoufo)	3	Sheets	Decoction	Oral route; bath
27	<i>Piliostigma thonningii</i> (Schumach.) Milne-Redh.	Fabaceae	Gnanman (Dioula) ; Tchanhanm (Senoufo)	5	Sheets ; fruit; roots	Decoction	Oral route; bath
28	<i>Pericopsis laxiflora</i> (Benth.) Meeuwen	Fabaceae	KoloKolo (Dioula)	3	Sheets ; roots	Decoction	Oral route; bath ; steam bath
29	<i>Zizyphus mauritiana</i> Lam.	Rhamnaceae	Tomonon (Dioula) ; Jujubier (French)	3	Sheets ; roots	Decoction	Oral route; bath
30	<i>Spondias mombin</i> L.	Anacardiaceae	Trowan (Agni)	3	Sheets; bark	Grinding ; maceration	Bath
31	<i>Ocimum basilicum</i> L.	Lamiaceae	Basilic (French)	2	Sheets	Grinding	Purge
32	<i>Psidium guajava</i> L.	Myrtaceae	Goyavier (French)	2	Sheets	Decoction	Oral route; bath
33	<i>Prunus domestica</i> L.	Rosaceae	Mirabelle (French)	2	Sheets	Decoction	Steam bath
34	<i>Parkia biglobosa</i> (Jacq.) R. Br. Ex G. Don	Mimosaceae	Néré (French)	4	Bark	Decoction; maceration	Oral route
35	<i>Garcinia kola</i> Heckel	Clusiaceae	Small cola (French)	2	Fruit	To chew	Oral route
36	<i>Alstonia boonei</i> De Wild.	Apocynaceae	Aimian (Agni)	1	Bark	Maceration	Oral route; bath ; purge
37	<i>Annona senegalensis</i> Pers.	Annonaceae	Damourou (Senoufo) ; Madessoussou (Dioula)	1	Buds	Maceration	Oral route
38	<i>Entada africana</i> Guill. & Perr.	Fabaceae	Samanèrè (Dioula)	1	Roots	Decoction	Oral route; bath
39	<i>Cassia sieberiana</i> DC.	Fabaceae	Sidjanfi (Dioula) ; Zangob (Senoufo)	8	Roots; sheets ; bark	Decoction; maceration	Oral route; bath

40	<i>Scoparia dulcis</i> L.	Scorpariaceae	Timitimini (Dioula)	1	Sheets	Decoction	Oral route
41	<i>Cochlospermum tinctorium</i> Perr. Ex A. Rich.	Bixaceae	Tourougba (Dioula)	2	Roots	Decoction	Oral route; bath
42	<i>Argemone mexicana</i> L.	Papaveraceae	Wènigbè (Dioula)	1	Sheets	Decoction	Oral route
43	<i>Ficus umbellata</i> Vahl	Moraceae	Fertaladèbè (Dioula)	2	Roots	Decoction; maceration	Oral route; bath
44	<i>Anacardium occidentale</i> L.	Anacardiaceae	Cashew (French); Sonmon (Dioula)	1	Sheets ; bark	Decoction	Oral route
45	<i>Alternanthera purgens</i> Kunth	Amaranthaceae	Kaméléssamara (Dioula)	1	Sheets	Decoction	Oral route
46	<i>Lannea nigritiana</i> (Scott-Elliot) Key	Anacardiaceae	Bembé (Dioula)	1	Bark	Decoction	Oral route
47	<i>Saba senegalensis</i> (A.DC.)Pichon	Apocynaceae	Maad (Wolof) ; N'zaba (Dioula)	1	Sheets	Decoction	Oral route; bath
48	<i>Detarium microcarpum</i> Guill. & Perr.	Fabaceae	N'tabacoumba (Dioula)	1	Sheets	Decoction	Oral route
49	<i>Terminalia macroptera</i> Guill. & Perr.	Combretaceae	Wolo (Dioula)	1	Bark	Decoction	Oral route

The parts of plants most used in the treatment of malaria are the leaves, bark and roots

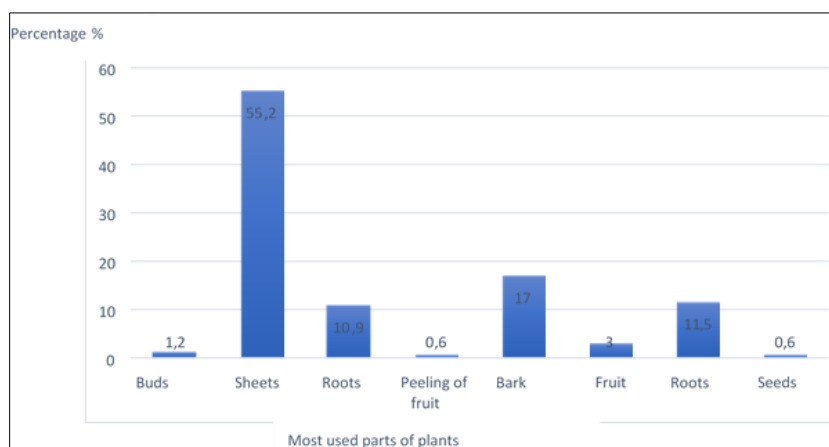


Figure 4 Parts of plants most used in the treatment of malaria

4.9. Distribution of drugs used in the treatment of malaria

The decoction is the most used method of preparation in the treatment of malaria

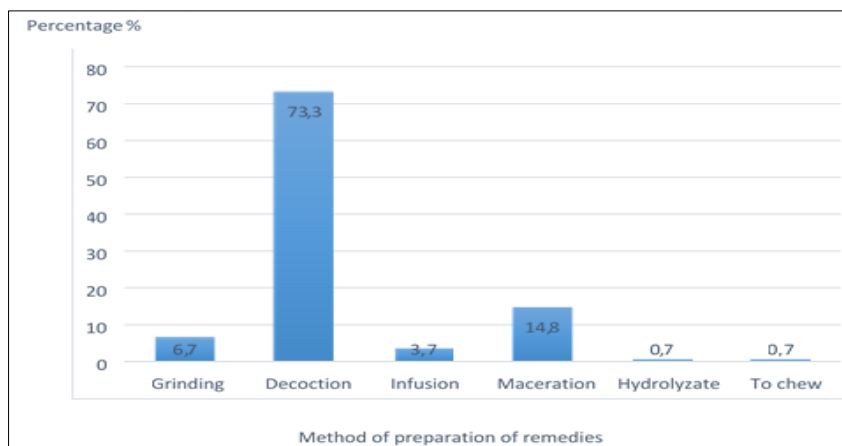


Figure 5 Method of preparation most used in the treatment of malaria

The most widely used route of administration in the treatment of malaria is by mouth.

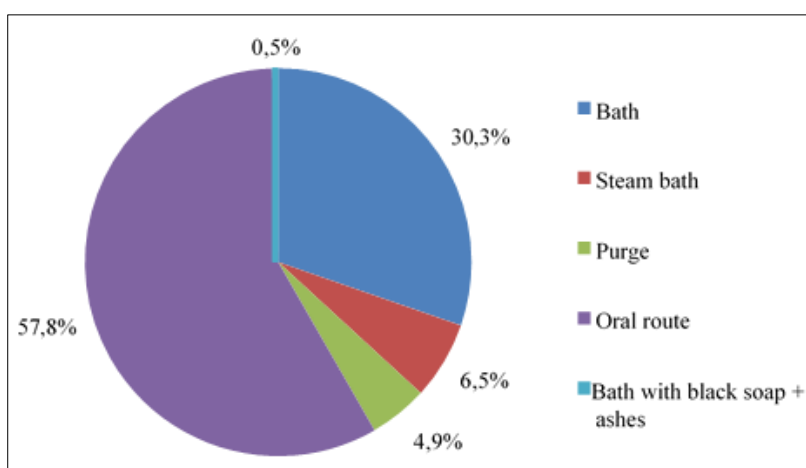


Figure 6 Most commonly used route of administration for the treatment of malaria

4.10. Medicinal plants used in the treatment of anemia

For the treatment of anemia, 36 species of medicinal plants have been identified. Among them, *Hibiscus sabdariffa* (38 citations) is the most cited, followed by *Tectona grandis* (27 citations) and *Justicia secunda* (27 citations). (Table 7).

Table 7 List of anti-anemic plants identified in Korhogo health district 1

N°	Latin binomials	Families	Vernacular names	NC	Parts used	Method of preparation	Route of administration
1	<i>Hibiscus sabdariffa</i> L.	(Malvaceae)	Guinea Sorrel (French); Dah (Dioula)	38	Sheets ; flowers	Decoction	Oral route
2	<i>Tectona grandis</i> L. f.	(Lamiaceae)	Teck (French)	27	Buds; sheets	Decoction	Oral route; bath
3	<i>Sorghum bicolor</i> (L.) Moench	(Poaceae)	Bimbiri (Dioula)	24	Rods	Decoction; maceration	Oral route
4	<i>Justicia secunda</i> Vahl.	(Acanthaceae)	Bassifla (Dioula)	27	Sheets	Decoction	Oral route

5	<i>Bambusa vulgaris</i> Schrad. Ex J. C. Wendl. (Poaceae	Chinese bamboo (French); Bobourou (Dioula)	7	Sheets	Decoction	Oral route; bath
6	<i>Lawsonia inermis</i> L.	Lythraceae	Hénné (French)	7	Sheets	Decoction	Oral route
7	<i>Carica papaya</i> L.	Caricaceae	Papayer (French)	7	Sheets	Grinding ; decoction; maceration	Oral route
8	<i>Sorghum halepense</i> (L.) Pers.	Poaceae	Red sorghum (French)	4	Rods	Decoction	Oral route
9	<i>Anacardium occidentale</i> L.	Anacardiaceae	Anacardier (French); Sonmon (Dioula)	2	Sheets ; bark	Decoction	Oral route
10	<i>Adansonia digitata</i> L.	Bombacaceae	Baobab (French)	2	Sheets ; bark	Decoction; sauce	Oral route; bath
11	<i>Antidesma venosum</i> E. Mey. Ex Tul.	Euphorbiaceae	Djelikonan (Dioula)	2	Sheets	Decoction	Oral route; bath
12	<i>Pterocarpus erinaceus</i> Poir.	Fabaceae	Goni (Dioula) ; Modjawaka (Baoulé)	2	Sheets ; bark	Decoction	Oral route
13	<i>Lannea nigritiana</i> (Scott-Elliot) Key	Anacardiaceae	Bembé (Dioula)	2	Bark	Decoction	Oral route
14	<i>Manihot esculenta</i> Crantz	Euphorbiaceae	Cassava (French)	2	Sheets	Decoction	Oral route
15	<i>Ipomoea batatas</i> (L.) Lam	Convolvulaceae	Potato (French)	2	Sheets	Decoction	Oral route
16	<i>Ceiba pentandra</i> (L.) Gaertn.	Bombacaceae	Cheese maker (French)	1	Sheets	Sauce	Oral route
17	<i>Opilia amentacea</i> Roxb.	Opiliaceae	Kagbo (Senoufo) ; Korogbéi (Dioula)	1	Bark; roots	Decoction	Oral route
18	<i>Guiera senegalensis</i> J. F. Gmel.	Combretaceae	Koumbè (Dioula) ; Ganivig (Senoufo)	1	Sheets	Decoction	Oral route; bath
19	<i>Alchornea cordifolia</i> (Schumach. &Thonn.) Müll. Arg.	Euphorbiaceae	Koyiran (Dioula) ; Fém (Senoufo)	1	Sheets	Decoction	Oral route

20	<i>Terminalia schimperiana</i> Hochst	Combretaceae	Kpandji (Baoulé)	1	Bark	Decoction	Oral route
21	<i>Ximenia americana</i> L.	Olacaceae	N'tonguè (Malinké)	1	Bark; roots	Decoction	Oral route
22	<i>Anogeissus leiocarpus</i> (DC.) Guill. & Perr.	Combretaceae	Nanganam (Senoufo) ; Kèrèkètè (Dioula)	2	Sheets ; bark; roots	Grinding ; decoction	Oral route; bath
23	<i>Ficus sur</i> Forssk.	Moraceae	Sérétoro (Dioula)	1	Sheets	Decoction	Oral route
24	<i>Daniellia oliveri</i> (Rolfe) Hutch. & Dalziel	Fabaceae	Souroutchiqué (Senoufo)	1	Bark	Maceration	Oral route
25	<i>Colocasia esculenta</i> (L.) Schott	Araceae	Taro (French)	1	Sheets	Decoction	Oral route
26	<i>Cola cordifolia</i> (Cav.) R. Br.	Malvaceae	Wam (Senoufo)	1	Sheets	Decoction	Oral route
27	<i>Piliostigma thonningii</i> (Schumach.) Milne-Redh.	Fabaceae	Gnanman (Dioula) ; Tchanhanm (Senoufo)	2	Roots	Decoction	Oral route
28	<i>Phoenix dactylifera</i> L.	Arecaceae	Date palm (French); Tamaro (Dioula)	1	Fruits	Maceration	Oral route
29	<i>Flueggea virosa</i> (Roxb. ex Wild.) Voigt	Euphorbiaceae	Balan balan (Dioula) ; Galandiène (Senoufo)	1	Sheets	Decoction; maceration	Oral route
30	<i>Alternanthera purgens</i> Kunth	Amaranthaceae	Kaméléssamara (Dioula)	1	Sheets	Decoction	Oral route
31	<i>Moringa oleifera</i> Lam.	Moringaceae	Moringa (French)	1	Sheets	Spraying + infusion	Oral route
32	<i>Annona senegalensis</i> Pers.	Annonaceae	Damourou (Senoufo) ; Madéssoussou (Dioula)	1	Sheets ; bark; roots	Decoction	Oral route
33	<i>Sesamum indicum</i> L.	Pedaliaceae	Sesame (French)	1	Seeds	Spraying + maceration	Oral route
34	<i>Tamarindus indica</i> L.	Caesalpiniaceae	Tamarind (French)	1	Fruits	Decoction	Oral route
35	<i>Bridelia ferruginea</i> Benth.	Phyllanthaceae	Sagba (Dioula)	1	Sheets ; bark	Maceration	Oral route
36	<i>Nauclea latifolia</i> Sm.	Rubiaceae	Bati (Dioula) ; Zanvalm (Senoufo)	1	Roots	Spraying + infusion	Oral route

The parts most used in the treatment of anemia are the leaves

4.11. Distribution of drugs used in the treatment of anemia

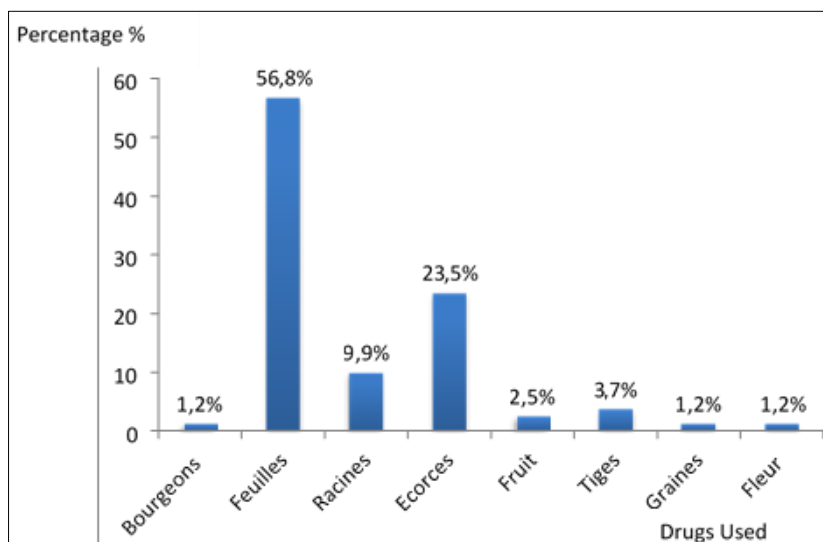


Figure 7 Drugs used in the treatment of anemia

The most popular form of preparation in the treatment of anemia is a decoction

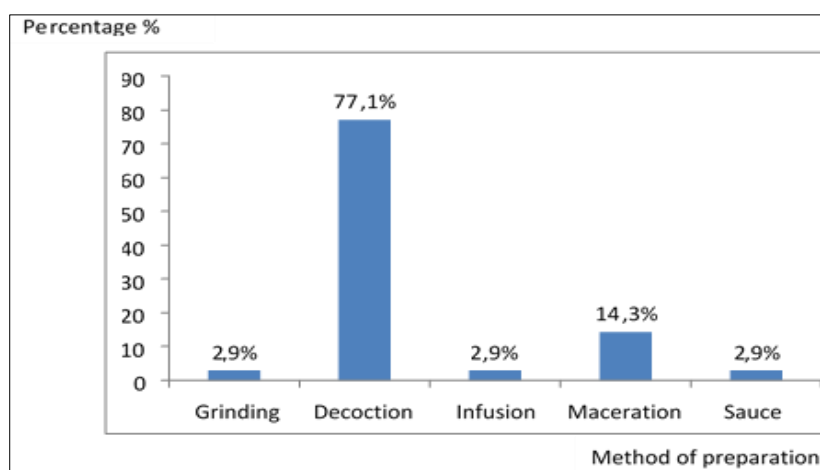


Figure 8 Method of preparation most used in the treatment of anemia

The most common route of administration for the treatment of anemia is by mouth; 84% of users use it against 16% for baths.

4.12. Distribution of medicinal plants identified according to the method of preparation of remedies for malaria and anemia

We note that the decoction is the method of preparation par excellence (63.84%)

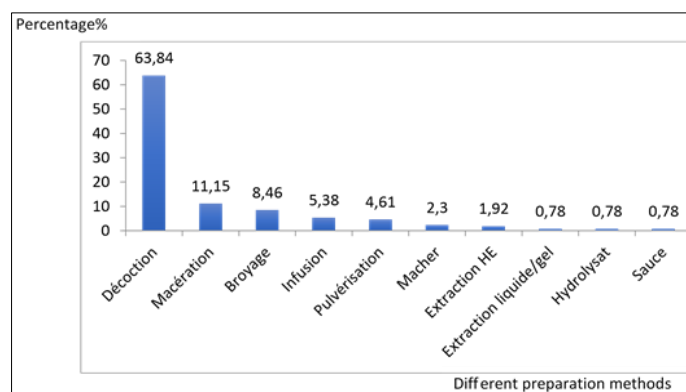


Figure 9 Method of preparation most used in the treatment of malaria and anemia

Different ways of preparing remedies

4.13. Distribution of medicinal plants identified according to the route of administration of the remedies

The majority of remedies are administered orally (64.04%)

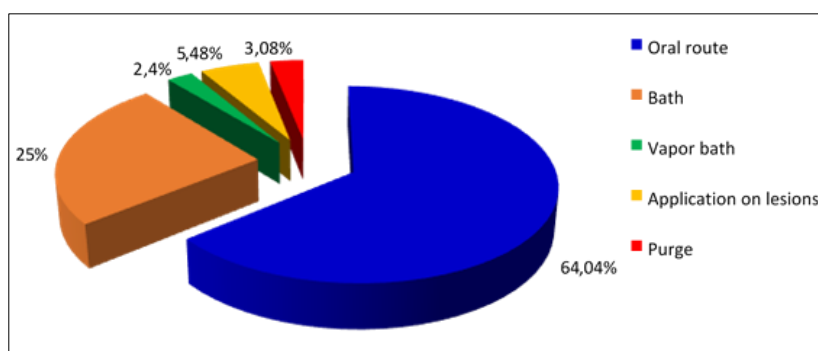


Figure 10 Different routes of administration of the remedies

5. Discussion

5.1. Diseases treated with medicinal plants (Malaria and anemia)

Our study concerned the most frequent pathologies in the Korhogo health district 1. For this, malaria and anemia were chosen on the basis of statistics provided by the Korhogo regional health directorate.

During the survey, we identified 86 species of medicinal plants, divided into 46 botanical families. Some *plants are involved in the treatment of both pathologies at the same time.*

- *For malaria, we have identified 49 species, among which the most cited are: Azadirachta indica (54 citations), Carica papaya (51 citations) and Nauclea latifolia (51 citations).*

The effectiveness of *Azadirachta indica* has been confirmed by several laboratory studies. The chemical constituents responsible for its antimalarial activity are limonoids: nimbolide and guedunine [2]. The leaves and stems of *Nauclea latifolia* contain glucoalkaloids, which have antipyretic activity; also, the leaves contain an active ingredient against *Plasmodium falciparum* [15].

In the south of Côte d'Ivoire, more precisely in the Autonomous District of Abidjan, people are turning to these same plants for the traditional treatment of malaria [2]. In Burkina Faso, populations who use traditional medicine for the treatment of malaria also use *Azadirachta indica* and *Carica papaya*, according to a study carried out by [13].

- For anemia, we have identified 36 species, among which the most cited are: *Hibiscus sabdariffa* (38 citations), *Tectona grandis* (27 citations) and *Justicia secunda* (27 citations).

[49] determined that one of the characteristics of *Hibiscus sabdariffa* is its richness in anthocyanins (red calyxes). They have an antioxidant power that promotes tissue regeneration, decreases the permeability of blood capillaries and strengthens their resistance to hemolysis [27]. This could explain their traditional use in the treatment of anemia. *Tectona grandis* leaves are known to be diuretic, depurative, stimulating, anti-dysenteric and deworming and are used in traditional medicine to treat anemia [2].

In the Moyen-Comoé region, the population of the town of Abengourou uses *Hibiscus sabdariffa* and *Tectona grandis* to treat anemia by plants according to the survey carried out by [24]. Also, the study by [2] revealed that the populations of Abidjan who resort to traditional medicine, also use *Hibiscus sabdariffa*, *Justicia secunda* and *Tectona grandis* to treat anemia.

Also, *Solanum lycopersicum* is said to be used as an antianemic in Côte d'Ivoire, in the town of Abengourou [24].

5.2. Parts of plants used

The leaves are the most used parts in the preparation of remedies with 51.26%. [3], during his ethnobotanical study in the Zuénoula region, also recorded that the leaves were mainly used in the preparation of traditional remedies at 64.7%. Our results also agree with those of [30], which found from its study on the treatment of malaria in the district of Abidjan, that the leaves are 68.89% used in the preparation of traditional medicines.

[5] asserts that the leaves, bark and roots are the site par excellence of the biosynthesis and even of the storage of secondary metabolites responsible for the biological properties of the plant. Also, the choice of leaves could be explained by the ease and speed of their harvest [47]. These results agree with those of [48] with 64.49%, [18] with 73.28%, [4] with 64%, [22] with 43% and Yapo [31] with 44%.

In addition, the intense removal of the leaves does not present any danger for the plant [28]. According to this author, removing 50% of the leaves from a tree does not significantly affect the survival of the tree.

5.3. Method of preparation

The method of preparation of traditional remedies the most used during our study is a decoction with 63.84%, followed by maceration (11.15%). Our results agree with those of [29], who carried out an ethnobotanical survey on Euphorbiaceae in the district of Yamoussoukro, from which it emerged that a decoction, with 34%, is the most frequently used method of preparation for the majority of drug recipes. In Senegal, more precisely in the region of Matam, [50], during his ethnobotanical study on antimalarials, revealed that the decoction was the most used method of preparation with a percentage of 61.11%.

This is explained by the fact that the decoction collects the most active ingredients and attenuates or cancels the toxic effect of certain recipes [4].

5.4. Administration mode

The oral route with 64.04% is the most common method of administration in our study. In the study by [30], 84.09% of preparations are administered orally. The latter was also the most used to administer the remedies, in the study by [29], at 44%.

[6], indicate that the decocted containing bioactive ingredients ingested orally, requires a much faster and more efficient process than other techniques.

6. Conclusion

According to the WHO, more than 80% of the population uses traditional medicine for treatment, especially in Africa. Indeed, in developing countries, faced with a lack of health infrastructure, populations tend to turn to the Traditional Medicine Practitioner, who in addition to being closer to them, is financially accessible. Having realized this reality and the strong potential of traditional medicine, the Ivorian health authorities deemed it necessary to integrate the latter into the National Health Development Plan (PNDS) in 1995.

Since then, studies and research by eminent botanists have identified and identified several species of medicinal plants present in our flora.

However, it should be noted that very few studies have been carried out in the northern part of the country, which also has a rich variety of flora. It is in this context that we tried to make our contribution to the knowledge of the traditional Ivorian pharmacopoeia through a study in the Poro region, located in the north of the Ivory Coast.

To carry out this study, we carried out an ethnobotanical survey in the department of Korhogo, among the populations on the one hand and traditional medicine practitioners on the other.

200 people in the population and 51 traditional medicine practitioners were questioned about pathologies commonly encountered in the Korhogo 1 health district: malaria, anemia.

At the end of the survey, 49 species of medicinal plants were listed against malaria, among the population and PMT. The most cited were *Azadirachta indica*, *Carica papaya* and *Nauclea latifolia*; which are also used by other peoples, in other West African countries where malaria is rife, for its traditional treatment.

Regarding anemia, 36 species of medicinal plants have been identified in total. Among them, the most cited in our two samples are: *Hibiscus sabdariffa*, *Tectona grandis*, and *Justicia secunda*.

At the end of our study, it emerges that traditional medicine occupies a very important place in the department of Korhogo, as evidenced by the high level of satisfaction of practitioners of this medicine. Also, all the species of medicinal plants inventoried among the population and PMTs constitute real solutions to the health problems facing African populations in general. The results of this study will serve as the basis for the development of approved improved traditional medicines.

This has led the ivorian government to integrate medicine and traditional pharmacopoeia into the national health system in order to improve the health coverage of the health needs of the populations.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest related to the publication of the article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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