

Plants used to treat anaemia, in traditional medicine, by Abbey and Krobou populations, in the South of Côte-d'Ivoire

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Abstract: Anaemia appears as frequent pathology in the tropical world. In the search of means of fighting, man used the medicinal properties of many plants. During an inventory of medicinal plants in 12 villages of Agboville Department (Côte-d'Ivoire), we discovered that 27 traditional healers used 20 species of plants to develop 19 medicamentous receipts for purpose anti-anaemic. The monospecific receipts, 18 of them (94.73 %), are mainly used. Like drugs, in fact leaves (50 %) are requested. The preparation of the medicamentous receipts utilizes mainly decoctions (35 %). The majority of the remedies are employed by oral way, particularly out of drink (75 %). To cure anaemia, the healers use often natural resources (plants, animals). A comprehensive literature review shows that the anti-anaemic effect would be the fact of the following active constituents: alkaloids, ascorbic acid, calcium, flavonoides, iron, saponosides, solasonine (glycoalkaloid), tannins, vitamin C, vitamin K and zinc.

Key Words: Agboville, Ethnopharmacology, Medicinal plants, Traditional Healers

INTRODUCTION

Anaemia, a haemolytic affection, characterized by an insufficiency in quality and quantity of the red globules, is frequent in the tropical countries ^[1]. In Africa, the prevalence is higher for the children (30 to 40 %) like among women in pregnancy or nursing. This high prevalence rate makes that anaemia is dreaded among the populations ^[2].

In Africa and in most of the developing countries, plants' properties are empirically appreciated. In connection with the cure's techniques, they require plants and mystic practices. Despite these traditional health care methods, African medicine is used by 80 % of the rural populations and appears like a sure mean of eradication of diseases ^[3]. The reason is that traditional medicine is a medicine of proximity, less constraining and non expensive ^[4,5]. In the search of fighting means against this cardiovascular disorder, ethnopharmacological investigations were conducted in Africa and in most of the developing countries ^[6,7,8,9,10,11,12]. Abbey and Krobou people recognized the medicinal virtues of several species of plants they use to treat anaemia. This study aims at finding new affordable therapies, easily accessible, non expensive, able to treat anaemia and provide scientific evidence of the effectiveness of the traditional use of plants having anti-anaemic effect.

MATERIAL AND METHODS

Vegetable and technical material: The vegetable material is represented by all the plants that are subject of this study. As technical equipment, we used a classic material that allowed us to have access to the plants and take some samples to build up a collection of dried plants.

Ethnopharmacological survey: Ethnopharmacological investigations on the traditional uses of plants were conducted among native villages in the Department of Agboville in South of Côte-d'Ivoire ^[11]. As approach, we met the healers and organized semi-structured interviews. During this study, we collected informations relating to the plants used to treat anaemia, the different parts used as drugs, their methods of collection and the modes of preparation and administration of the medicamentous receipts. From the collected samples and specimens of the herbarium of the National Floristic Center, we identified the plants, by their scientific name and we determined their botanical characteristics.

Non experimental validation for the medicinal activity of plants using phytochemical / pharmacological literature: According to the literature, we performed a validation of the traditional medical

practices, by looking for the chemical constituents that explain the anti-anaemic effect for the studied plants.

RESULTS AND DISCUSSION

Botanical Characteristics of the Studied Plants: The ethnopharmacological investigations that we conducted in the Abbey and Krobou areas, with several traditional doctors from villages located in the Department of Agboville in Côte-d'Ivoire, made it possible to identify 20 species of plants used in traditional medicine to treat anaemia. These species of plants (table 1) belong to 19 genera and 15 families. There are 14 orders, 06 sub-classes, 02 classes (Monocots and Dicots), 01 subphylum (Angiosperms) and 01 phylum (Spermaphytes). The 17 Dicots, representing 85 %, have the highest number of plants. The family of Solanaceae, with 03 individuals, is the best represented. From the viewpoint of Morphological Types, we divided the taxons we identified in 4 groups (table 2): trees, shrubs, lianas and herbs. The shrubs (35 %) are mainly used. Concerning the Biological Types, the Phanerophytes are in the majority (80 %). Among them, the Nanophanerophytes (35 %) are the best represented. Twelve (12) cultivated plants are mainly used. There are 08 Spontaneous wild plants (40 %); this does not represent the majority.

Ethnopharmacological Characteristics of Identified Plants: During this ethnopharmacological study conducted in the Department of Agboville (Côte-d'Ivoire), we met 27 traditional healers, native of 12 villages who agreed to collaborate with us by providing informations on anti-anaemic plants. They were 16 men and 11 women. The oldest person of these healers is a man who is about 70 years and the youngest one is 30 years old. We met a lot of traditional healers who treat anaemia (06, or 22.22 %) in Aboudé-Mandéké village. The ethnopharmacological characteristics of the plants, the different parts used as drugs, the methods of preparation and administration of medicamentous receipts, are consigned in table 3. For making diagnosis about anaemia, the healers proceed by questioning the patient, general observation, examination of eyes, palms. We note that 19 medicamentous receipts are developed to treat anaemia. The monospecific receipts (18), representing 94.73 %, are mainly used. The following organs are used as drugs: leaf, flower (petal), fruit, tuberous root and stem barks. The leaves (50 %) are the most used. The decoction (35 %) is the most widespread method of preparation of medicamentous receipts. The majority of the remedies are employed by oral way, particularly out of drink (75 %).

There are different methods of sampling. For the underground system (roots), the sampling is made with

a hoe. Easily accessible specimens (leaves) are usually picked by hand. The fruits are harvested when they are completely ripe, by using hands or with a billhook. Concerning the stems and roots of woody specimens the barking is done with machetes. For rather high specimens, people loop the branches off, thanks to special tools (billhooks); the ax is used for the cutting down of large, high and inaccessible specimen.

Mortar, flat stone, pebble, canary, saucepan, gourd are used to prepare medicines. There are different modes of preparation: decoction, infusion, chewing, cooking, crushing, expression, kneading, maceration and pulverization. Gourds, goblets, jugs, ladles, spoons, glasses (liqueur or beer), cups are used to administer the medicines by oral routes.

Discussion:

Botanical Characteristics of the Studied Plants: We obtained 20 anti-anaemic plants which represent 5.54 % of the plants identified during the ethnopharmacological study we conducted in Agboville Department in South of Côte-d'Ivoire^[11]. This representation was not also observed during ethnopharmacological investigations in other areas of Côte-d'Ivoire and in Africa, concerning the plants exerting anti-anaemic properties. Comparing our results to other works show variability in the number of individuals listed from one study to another. In Ouattara's study^[12], 03 plants species representing 1.78 % of the plants identified during the ethnopharmacological study conducted in the area of Divo with the Dida people (South of Côte-d'Ivoire), have anti-anaemic effect. The Spermaphytes constitute the greater part of the anti-anaemic therapeutic means in this study as well in Ouattara's^[12]. In his study related to the populations of Issia (Mid-West of Côte-d'Ivoire), Zirihé^[13] did not mention the use of any plant having anti-anaemic effect. Tra Bi^[14] does not mention any plant with the anti-anaemic effects, in its study relating to the census of the plants used by the man, in the classified forests of Haut-Sassandra and of SCIO, in Côte-d'Ivoire. Adjanohoun and Aké-Assi^[15] undertook a significant study on the medicinal plants of Côte-d'Ivoire. However any plant was mentioned like exerting anti-anaemic effects. In his study devoted to the medicinal plants in the North of Côte-d'Ivoire Koné^[16] reports that only 01 species of plant is employed in the combat of anaemia.

This variability in number of plants with anti-anaemic effect would be due to the variations in the methods of investigation; it could also be explained by the differences of locality or habits.

The shrubs (35 %) are mainly used. The massive use of shrubs is due to the fact that these plants can be found everywhere, in the immediate environment of the

users and their different organs are easily accessible. Twelve introduced plants are mainly used. There are 08 Spontaneous wild plants that's to say 40 %; this does not represent the majority. This is because human beings do harm to their immediate environment, and these harms obviously result in the disappearance of original structures. Therefore, there is a regression of spontaneous wild species^[17]. Another reason that could explain why these spontaneous wild plants are not in the majority is the long distance people have to make in order to get these medicinal products, when they need them.

Ethnopharmacological Characteristics of Identified

Plants: We note that 19 medicamentous receipts are developed to treat anaemia. The monospecific receipts (18), representing 94.73 %, are mainly used. This result is similar to that of Ouattara^[12] who indicated that all the medicinal formulas are monospecific. The monospecific formulas are in the majority in the two studies in question. This preponderance of monospecific receipts is in the patients' interest. Combining ill-matched plants is sometimes dangerous. In Africa, about 30 % of fatal accidents are caused by mixtures^[18]. The leaves (50 %) are the most used. This result is in the line with Ouattara's^[12]; the author showed that the leaves are mostly used in 66.66 % of the cases. Therefore, there is an important sampling of the leaves. This sampling is not harmful to the plant, according to Poffenberger et al.^[19] who said that sampling 50 % of the leaves of a plant does not significantly affect its survival. The decoction (35 %) is the most widespread method of preparation. This result is similar to Ouattara's^[12] who showed that the decoction is applied in 66.66 % of cases in the Department of Divo. The drink (75 %) is the most used method of administration. This result tallies with that of Ouattara^[12] who indicated that drink is the only method of administration of medicines.

There are different methods of sampling. The uprooting, the looping off of branches, the cutting down, the barking, are harvesting methods reported by Ouattara^[12] in his study on medicinal plants in Divo (Southern forest of Côte-d'Ivoire). The author stated that, most of the times, the barking leaves huge scars through which these plants are, later on, attacked by fungi, birds and caterpillar's infestation. The uprooting, the looping of branches, the cutting down, the barking, prove to be harmful because these methods of sampling prevent the plant from blooming, induce infections and are the source of the threat of species extinction^[17].

By intuition, people think that there is a relationship between the morphology of the plant organ and that of the human organ affected by the disease. This way of thinking, also called similarity theory or theory of signatures, consists in attributing a biological property to a vegetable organ because of its look

elements such as shape, color, appearance. According to that doctrine of signatures, the Abbey and Krobou people think that petals of *Hibiscus sabdariffa*, producing a decoction that echoes the color of blood, could cure anaemia which is considered as a disease of the blood.

According to some studies, we notice interesting similarities with some plants exerting anti-anaemic properties; their effect is recognized by other ethnic groups. The decoction of stem barks of *Mangifera indica* is used to fight anaemia by the Dida people in the area of Divo in Côte-d'Ivoire^[12]. In the Honduras, people use the decoction of *Momordica charantia* (Cucurbitaceae) leaves in the treatment of anaemia^[6]. In the Caribbean, people use the paste from fruit of *Solanum lycopersicum* (Solanaceae) to treat anaemia^[6]. In Burkina Faso, one uses leaves decoction of *Adansonia digitata* (Bombacaceae) for their anti-anaemic effect^[8].

Non Experimental Validation for the Medicinal Activity of Plants Using Phytochemical / Pharmacological Literature:

According to the literature, we present below, the pharmacological activity and the phytochemical composition that confirm the traditional use of the anti-anaemic plants of this study (table 4). We note that the anti-anaemic effect results from several chemical elements: alkaloids, ascorbic acid, calcium, iron, saponosides, solasonine (glycoalkaloid), tannins, vitamin C, vitamin K and zinc. This phytochemical composition provides scientific evidence of the effectiveness of the traditional use of plants having anti-anaemic effect.

Conclusion: The ethnopharmacological investigations conducted in the Department of Agboville (Côte-d'Ivoire) show that 20 species of plants are used by Abbey and Krobou people for the treatment of anaemia. The different drugs are used to develop many medicinal preparations by braised cooking, chewing, cooking, crushing, decoction, expression, infusion, kneading, maceration and pulverization. The decoction is the method often used by healers. There are 2 modes of administration: drinking and eating. The drinking is the most widespread mode of administration. The treatment of anaemia is a matter for traditional healers using only natural resources, essentially plants.

According to some studies, we found similarities with many species of plants which anti-anaemic effect is recognized by other ethnic groups. The anti-anaemic effect would results from several chemical constituents: alkaloids, ascorbic acid, calcium, iron, flavonoids, saponosides, solasonine, tannins, vitamin C, vitamin K and zinc. The phytochemical and pharmacological informations indicate the rightfulness of the traditional use of the studied plants as anti-anaemics.

Table 1: Systematic groups of studied plants

Plants species used	Family	Order	S/C	Classes
<i>Adansonia digitata</i>	Bombacaceae	Malvales	Dilliniidae	Dicots
<i>Alchornea cordifolia</i>	Euphorbiaceae	Euphorbiales	Rosidae	Dicots
<i>Brassica oleracea</i>	Brassicaceae	Capparales	Dilliniidae	Dicots
<i>Capsicum annuum</i>	Solanaceae	Solanales	Asteridae	Dicots
<i>Citrus sinensis</i>	Rutaceae	Sapindales	Rosidae	Dicots
<i>Cocos nucifera</i>	Arecaceae	Arecales	Arecidae	Monocots
<i>Daucus carota</i> var. <i>sativa</i>	Apiaceae	Apiales	Rosidae	Dicots
<i>Ficus sur</i>	Moraceae	Urticales	Hamamelidae	Dicots
<i>Gossypium hirsutum</i>	Malvaceae	Malvales	Dilliniidae	Dicots
<i>Hibiscus sabdariffa</i>	Malvaceae	Malvales	Dilliniidae	Dicots
<i>Justicia secunda</i>	Acanthaceae	Scrophulariales	Asteridae	Dicots
<i>Momordica charantia</i>	Cucurbitaceae	Violales	Dilliniidae	Dicots
<i>Parinari excelsa</i>	Chrysobalanaceae	Rosales	Rosidae	Dicots
<i>Saccharum officinarum</i>	Poaceae	Cyperales	Commelinidae	Monocots
<i>Solanum lycopersicum</i>	Solanaceae	Solanales	Asteridae	Dicots
<i>Solanum torvum</i>	Solanaceae	Solanales	Asteridae	Dicots
<i>Tectona grandis</i>	Verbenaceae	Lamiales	Asteridae	Dicots
<i>Treculia africana</i>	Moraceae	Urticales	Hamamelidae	Dicots
<i>Uapaca esculenta</i>	Euphorbiaceae	Euphorbiales	Rosidae	Dicots
<i>Xanthosoma mafaffa</i>	Araceae	Arales	Arecidae	Monocots
Total: 20 Species	15 Families	14 Orders	06 S/Classes	02 Classes

Table 2: Morpho-Biological Types and Chorological Affinities of the listed plants Signification of symbols: I: Introduced; GC: Guineo-Congolais; SZ: Soudano-Zambesienne GC-SZ: Guineo-Congolais and Soudano-Zambesienne

Plants species used	Morphological Types	Biological Types	Chorological affinities	Status
<i>Adansonia digitata</i>	Tree	Mesophanerophyte	SZ	Wild
<i>Alchornea cordifolia</i>	Liana	Microphanerophyte	GC-SZ	Wild
<i>Brassica oleracea</i>	Herb	Therophyte	I	Cultivated
<i>Capsicum annuum</i>	Shrub	Therophyte	I	Cultivated
<i>Citrus sinensis</i>	Shrub	Microphanerophyte	I	Cultivated
<i>Cocos nucifera</i>	Tree	Mesophanerophyte	I	Cultivated
<i>Daucus carota</i> var. <i>sativa</i>	Herb	NanophanerophyteI	I	Cultivated
<i>Ficus sur</i>	Shrub	Microphanerophyte	GC-SZ	Wild
<i>Gossypium hirsutum</i>	Shrub	Nanophanerophyte	GC-SZ	Cultivated
<i>Hibiscus sabdariffa</i>	Shrub	Nanophanerophyte	I	Cultivated

Table 2: Continue

<i>Justicia secunda</i>	Shrub	Nanophanerophyte	I	Cultivated
<i>Momordica charantia</i>	Liana	Nanophanerophyte	GC	Wild
<i>Parinari excelsa</i>	Tree	Megaphanerophyte	GC	Wild
<i>Saccharum officinarum</i>	Herb	Nanophanerophyte	I	Cultivated
<i>Solanum lycopersicum</i>	Herb	Therophyte	GC-SZ	Cultivated
<i>Solanum torvum</i>	Shrub	Nanophanerophyte	GC	Wild
<i>Tectona grandis</i>	Tree	Mesophanerophyte	I	Cultivated
<i>Treulia africana</i>	Tree	Mesophanerophyte	GC	Wild
<i>Uapaca esculenta</i>	Tree	Mesophanerophyte	GC	Wild
<i>Xanthosoma mafaffa</i>	Herb	Hemicryptophyte	I	Cultivated

Table 3: Indications on the methods of preparation and administration of medicines

Plants species	Part used	Mode of Preparation	Medicamentous Form	Mode of Administration
<i>Adansonia digitata</i>	Leaves	Decoction	Decocte	Drink
<i>Alchornea cordifolia</i>	Leaves	Decoction	Decocte	Drink
<i>Brassica oleracea</i>	Leaves	Chew directly	Paste	Eating
<i>Capsicum annum</i>	Stem bark	Pulverization	Powder + water	Drink
<i>Citrus sinensis</i>	Fruit	Expresion: juice + egg white:	Mixture	Drink
<i>Cocos nucifera</i>	Fruit (milk)	Any preparation	Milk	Drink
<i>Daucus carota</i> var. <i>sativa</i>	Tuber of root	Crushing, expression	Juice	Drink
<i>Ficus sur</i>	Leaves	Cooking and kneading	Soup	Eat
<i>Gossypium hirsutum</i>	Leaves	Decoction	Decocte	Drink
* <i>Hibiscus sabdariffa</i>	Flower (petal)	Maceration in bangui	Macerate	Drink
<i>Justicia secunda</i>	Leaves	Infusion	Infusate	Drink
<i>Momordica charantia</i>	Leaves	Decoction	Decocte	Drink
<i>Parinari excelsa</i>	Stem bark	Decoction	Decocte	Drink
* <i>Saccharum officinarum</i>	Leaves	Maceration in bangui	Macerate	Drink
<i>Solanum lycopersicum</i>	Fruit	Chew directly	Paste	Eat
<i>Solanum torvum</i>	Fruit	Cooking and kneading	Soup	Eat
<i>Tectona grandis</i>	Leaves	Decoction	Decocte	Drink
<i>Treulia africana</i>	Fruit	Decoction	Decocte	Drink
<i>Uapaca esculenta</i>	Stem bark	Crushing: paste + water	Mixture	Drink
<i>Xanthosoma mafaffa</i>	Leaves	Cooking and kneading	Spinach	Eat

Significance of symbol

* Bispecific receipt: Association *Hibiscus sabdariffa* and *Saccharum officinarum*

Table 4: Non experimental validation for the medicinal activity of plants using phytochemical or pharmacological literature

Plants species	Phytochemistry/ Pharmacology	Literature
<i>Adansonia digitata</i>	Calcium: Essential to coagulation	Nacoulma, 1996 ^[8]
<i>Alchornea cordifolia</i>	Tannins: anti-haemorrhagic property	Kerharo et Adam, 1974 ^[20]
<i>Brassica oleracea</i>	Calcium: Essential to coagulation	Anonyme, 1997 ^[21]
<i>Capsicum annuum</i>	Ascorbic acid: Essential to coagulation	Pinkas et al., 1986 ^[22]
<i>Citrus sinensis</i>	Vitamin C: Fights disorders of coagulation	A.C.C.T., 1989 ^[6]
<i>Cocos nucifera</i>	Iron: anti haemorrhagic properties	A.C.C.T., 1989 ^[6]
<i>Daucus carota</i> var. <i>sativa</i>	Calcium: Essential to coagulation	Nacoulma, 1996 ^[8]
<i>Ficus sur</i>	Tannins: anti-haemorrhagic property	Kerharo et Adam, 1974 ^[20]
<i>Gossypium hirsutum</i>	Saponosides: Anti-haemorrhagic effect	Nacoulma, 1996 ^[8]
<i>Hibiscus sabdariffa</i>	Calcium: Essential to coagulation	Kerharo et Adam, 1974 ^[20]
<i>Justicia secunda</i>	Alcaloïdes pyrrolidiniques: Depressors	Bouquet et Debray, 1974
<i>Momordica charantia</i>	Zinc: Essential to red globules formation	Nacoulma, 1996 ^[8]
<i>Parinari excelsa</i>	Flavonoids: Anti-haemorrhagic effect	Bouquet et Debray, 1974 ^[23]
<i>Saccharum officinarum</i>	Tannins: Effective against haemorrhages	A.C.C.T., 1989
<i>Solanum lycopersicum</i>	Vitamin K or haemorrhagic vitamin	Nacoulma, 1996 ^[8]
<i>Solanum torvum</i>	Solasonine: Depressive effect	Neuwinger, 1996 ^[8]
<i>Tectona grandis</i>	Tannins: Anti-haemorrhagic properties	Nacoulma, 1996 ^[8]
<i>Treulia africana</i>	Tannins: Anti-haemorrhagic action	Bouquet et Debray, 1974 ^[23]
<i>Uapaca esculenta</i>	Flavonoids: Anti-haemorrhagic effect	Bouquet et Debray, 1974 ^[23]
<i>Xanthosoma mafaffa</i>	Iron: anti haemorrhagic properties	Bouquet et Debray, 1974 ^[23]

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