



ETHNO-PHARMACOLOGICAL INVESTIGATION OF MEDICINAL PLANTS USED FOR TREATMENT OF HUMAN INFERTILITY IN DEPARTMENT OF KORHOGO, NORTH OF IVORY COAST

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ABSTRACT

Infertility in humans, which is a major concern for procreation in a large number of people, has now become a public health problem. Therapeutic failures in treatment of infertility in modern medicine and high cost of most effective treatments lead populations of northern Ivory Coast to resort to plants for management of this pathology. Therefore, the purpose of this study is to list medicinal plants traditionally used by herbalists and native doctors against infertility in department of Korhogo, North of Ivory Coast. An ethnopharmacological survey was carried out using an oral questionnaire addressed to 70 actors of traditional medicine of Korhogo city and these surrounding villages. These investigations have identified 22 species of plant which the most cited are *Heliotropium indicum* (21.60%), *Cassia sieberiana* (14.40%) and *Flueggea virosa* (9.90%). The organs of plants used to prepare various medicinal recipes are leaves (64.44%), roots (23.70%), bark (9.62%), fruit (1.5%) and whole plant (0.74%). To facilitate administration of drugs, main preparation techniques are decoction (69.4%), crushing (23.60%) and maceration (7%). The most used route is the oral route (67.31%) and the dermal route is the least used (7.14%). In addition, some treatments are prescribed only to women (45%) and men (14%) and others to both genders (41%). These data will contribute to the development of natural resources in the fight against human infertility in department of Korhogo.

KEYWORDS: Infertility; medicinal plants, investigation, ethnopharmacology, Korhogo.

1. INTRODUCTION

Infertility is the inability of a couple to procreate after 12 months of regular, unprotected sex without contraception. Worldwide, it is estimated that between 48 million couples and 186 million people are affected by infertility.^[1] It affects 3.3 million people in France, or one couple out of four, and the fertility rate in the United States fell to 1.75 in 2017.^[2,3] Africa is the most affected continent by couple infertility with a rate of 15-30%.^[4] The infertility of the couple is seen as a fatality in Africa, a society where the fundamental reason for marriage always remains procreation.^[5] The causes of this increasing low fertility in the population are diverse. These include age, hormonal dysfunctions, bacterial, viral and fungal infections.^[6] Infertility treatments available today use surgical methods and drugs.^[7]

However, the cost of these treatments is very high and the specialized health facilities in this area are insufficient and inaccessible to the rural population.^[1,8] Moreover, these treatments very often lead to treatment failures. Faced with all these difficulties, couples in distress in developing countries are increasingly using medicinal plants. The richness of the local flora allows us to hope to find effective herbal treatments against this condition. Therefore, this study purpose is to identify the medicinal plants commonly used against infertility and to characterize their mode of use in the department of Korhogo, in North of Ivory Coast.

2. MATERIAL AND METHODS

2.1. Materials

2.1.1. Study zone

This study was carried out in the department of Korhogo, north of Ivory Coast, whose area is 13.400 km² with a very hot and dry climate (Fig1).^[9] The vegetation of this region is that of wooded savannah, characterized by trees and shrubs that have a height between 8 m and 12 m. The riparian population is, mainly, constituted by the Senoufo, a people very attached to ancestral practices and its culture. For health care they use medicinal plants more than modern medicine.^[10]

2.1.2. Technical Equipment

The technical material used was a survey sheet developed to conduct the ethnopharmacological study. This form was sent to the actors of traditional medicine (herbalists and tradipraticians) settled in the city of Korhogo and these surrounding villages.

2.2. Methods

The ethnopharmacological survey was conducted from June 06 to July 05, 2022 among 40 herbalists and 30

tradipraticians from the department of Korhogo (Ivory Coast). Actors using media other than plants in the treatment of infertility were not taken into account. This study was carried out by an oral interrogation using the data sheet containing a questionnaire on the common or vernacular name of the plants. The other information on the plants to be filled in questionnaire are the organs or parts used, the method of preparation of the phytomedicines, the mode of administration and gender of the patient being treated. Plant samples were then collected and identified (family and species), either directly on-site for certain species or through the use of Adjanohoun *et al.* (1979) and Aké-Assi (2011)^[11,12] and also the Department of Plant Biology at Peleforo Gon Coulibaly University in Korhogo. Cronquist's (1981) classification was used for the species classification.^[13]

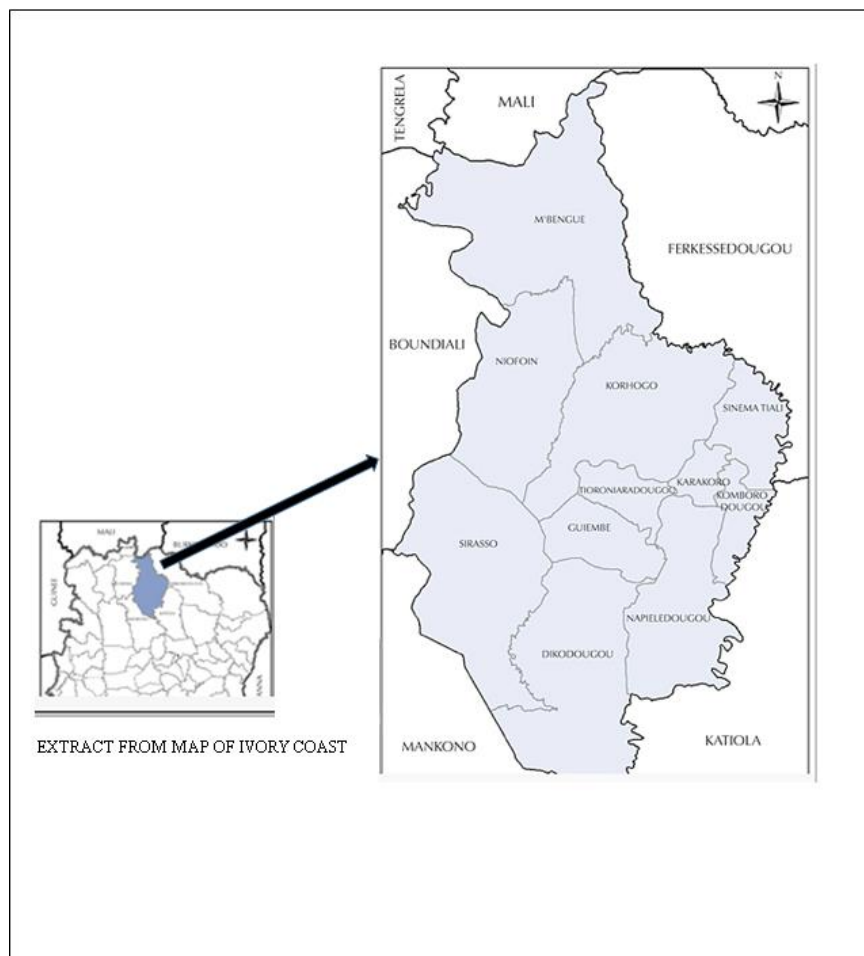


Figure 1. Map of Korhogo department, North of Ivory Coast (Tanoh *et al.*, 2014).^[9]

2.3. Statistical analysis

The statistical tests were carried out exclusively using SPHINX (The Sphinx Plus2) and the data were entered

using Word and Excel 2013. The Khi-2 test (equality of distributions) was used to compare the percentages of plants cited by the actors of traditional medicine, plant

organs, techniques of preparation of phytomedicines and their delivery methods. For this purpose, the significance of the difference in percentages is determined by comparing the probability "p" associated with the Khi-2 test statistic with the theoretical threshold of $\alpha = 0.05$. Thus, when $1-p > 95\%$, we deduce that there is a significant difference. On the other hand, when $1-95\%$, there is no significant difference between the different averages.

3. RESULTS AND DISCUSSION

3.1. Botanical families

The survey results in department of Korhogo revealed 22 species of plants grouped in 15 botanical families used for infertility treatment. The most represented botanical families of these plants are Fabaceae and Euphorbiaceae (Table I). The results of these investigations are in agreement with those found by several authors. Indeed, an similar study conducted in department of Oumé in Midwest of Ivory Coast, the Euphorbiaceae were plants among the majority botanical families use by herbalists to treat infertility.^[14] In addition, the research work of Azonbakin et al. (2021) in Benin revealed that Euphorbiaceae and Fabaceae were the most predominant botanical families of plants use in traditional treatment of male infertility.^[15] Contrary to our results, the study

carried out in department of Dabakala in Center-north of Ivory Coast by Konan et al. (2019) showed that the plants mostly intended for treatment of infertility were in families of Annonaceae and Solanaceae.^[16] The variability between botanical families of plants involved in treatment of infertility from one author to another could be explained by the difference in climate and sol of regions of investigation. Indeed, climate and sol are the key factor in formation of vegetation.^[17]

3.2. Plants identified

In this study, the plant known and cited by the majority of players in traditional medicine is *Heliotropium indicum* (21.60%), followed by *Cassia sieberiana* (14.40%) and *Flueggea virosa* (9.90%) (Table 1). This could be explained by the phytochemical composition of these three plants. Indeed, several studies have shown that the phytochemical compounds of these plants have important biological properties on the reproductive functions of mammals. According to Zahoui et al. (2010).^[18] *H. indicum* contains total polyphenols, saponosides, flavonoids, quinones, alkaloids. As for *C. sieberiana* and *F. virosa*, they have a chemical composition close to that of *H. indicum* with the exception of alkaloids and polyphenols.^[19,20]

Table I: Directory of medicinal plants used in the department of Korhogo to treat infertility in human.

Scientific names	Family	Organs used	Modes of preparation	Routes of administration	Treated genera	Citation Frequency (%)
<i>Heliotropium indicum</i>	Boraginaceae	Leaves; Whole plants	Decoction / Crushing	Oral / Anal	Man and Woman	21.60
<i>Cassia sieberiana</i>	Fabaceae	Leaves; Roots	Decoction	Oral	Man and Woman	14.40
<i>Flueggea virosa</i>	Euphorbiaceae	Leaves	Decoction	Oral	Woman	09.90
<i>Ximania americana</i>	Olaceae	Leaves; Roots	Decoction / Crushing	Oral	Woman	09.90
<i>Gomphrena serrata</i>	Amaranthaceae	Leaves	Decoction / Maceration	Oral / Dermal	Woman	07.20
<i>Annona senegalensis</i>	Annonaceae	Leaves; bark	Decoction	Oral / Dermal	Man and Woman	06.30
<i>Gardenia aqualla</i>	Rubiaceae	Leaves	Decoction	Oral	Man and woman	06.30
<i>Calotropis procera</i>	Asclepiaceae	Leaves	Decoction	Anal / Oral	Woman	05.40
<i>Daniellia oliveri</i>	Fabaceae	Bark	Decoction	Oral	Man and Woman	03.60
<i>Parkia biglobosa</i>	Fabaceae	Bark	Decoction	Oral / Anal	Man and Woman	02.70
<i>Tamarindus indica</i>	Fabaceae	Root	Decoction / Maceration	Oral	Man	01.80
<i>Blighia sapida</i>	Sapindaceae	Root	Decoction	Oral / Anal	Man and Woman	01.80
<i>Kigelia africana</i>	Bignoniaceae	Bark	Decoction	Oral / Dermal	Man and Woman	0.90
<i>Ficus capensis</i>	Maraceae	Leaves; Fruit	Decoction / Crushing	Oral	Woman	0.90
<i>Phyllanthus amarus</i>	Euphorbiaceae	Whole plants	Decoction	Oral / Dermal	Woman	0.90

<i>Vitex doniana</i>	Lamiaceae	Root	Decoction	Oral	Man	0.90
<i>Combretum glutinosum</i>	Combretaceae	Leaves, Fruit	Decoction	Oral	Man and Woman	0.90
<i>Argemone mexicana</i>	Papaveraceae	Leaves	Crushing	Anal	Woman	0.90
<i>Alternanthera pungens</i>	Amaranthaceae	Leaves	Crushing	Anal	Woman	0.90
<i>Moringa oleifera</i>	Moringaceae	Root	Decoction	Oral	Woman	0.90
<i>Ageratum conyzoides</i>	Asteraceae	Leaves	Decoction	Anal	Woman	0.90
<i>Piliostigma thonningii</i>	Fabaceae	Leaves	Decoction	Oral / Dermal	Man	0.90

All of these molecules are known for their roles in improving fertility. Thus, according to Zougrou (2017)^[21], alkaloids, saponins and flavonoids stimulate estrogen secretion and improve fertility. Similarly, according to Erol *et al.* (2009) alkaloids promote spermatogenesis through their beneficial antioxidant effects.^[22]

3.3. Patients treated

The plants listed in the survey are mainly addressed to women (45%) rather than men (14%) (Fig 2). These results are in agreement with those of Adomou *et al.* (2012)^[23] in Benin which showed that female infertility is the third disease treated by herbalists. Indeed, in African society, women have long been considered the only ones responsible for the couple's infertility. A woman without children is a disgrace to her family.^[24] All of this would explain the high rate of women who use plants for treatment. Moreover, it appears from the results that

several traditional practitioners treat the two partners of the couple together showing that infertility concerns both man and woman. These results corroborate those of Moyabi *et al.* (2021)^[14] who showed that 86.91 per cent of care is for both genders, as the causes of couple infertility are shared between women and men.

3.4. Organs used

Analysis of the results revealed that various organs are used with a preference for leaves (64.44%), followed by roots (23.43%) and bark (9.74%) (Fig 3). The difference between the parts used to prepare the drug recipes is statistically significant ($P=0.01\%$). Similar results were noted by Kipre *et al.*, (2017) and Konan *et al.*, (2019) in Ivory Coast and Azonbakin *et al.*, (2021) in Benin, which found high leaf utilization at 49,3%; 35%; 35,77% respectively.^[15,16,25] This great use of leaves could be explained by the fact that they are the place of synthesis of most secondary metabolites.^[26]

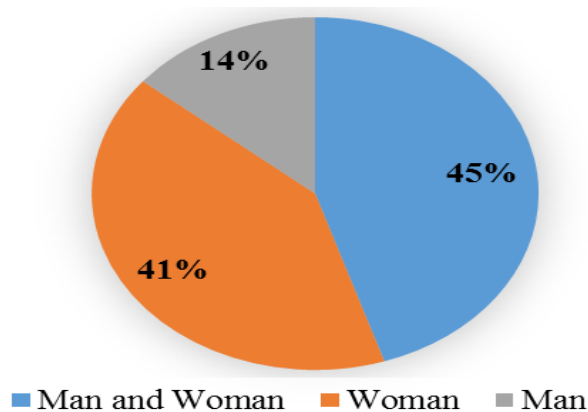
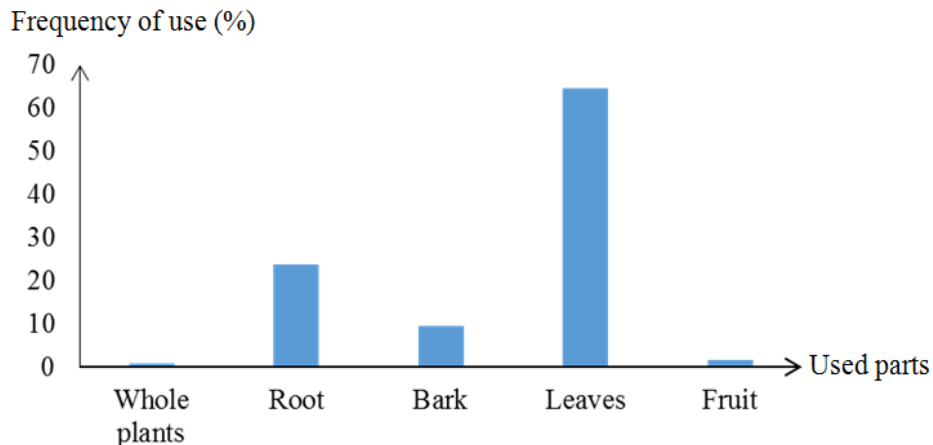


Figure 1: Frequency of administration of medicinal recipes according to the treated gender.



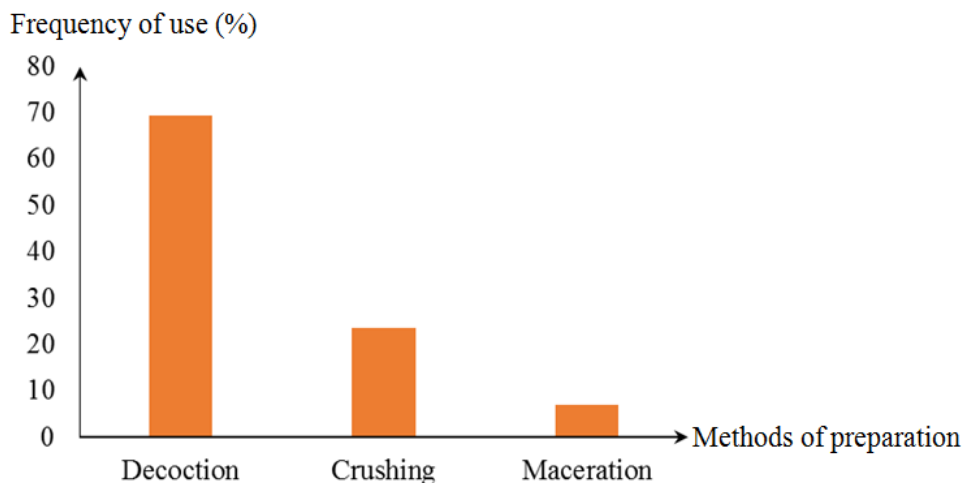
$$Khi-2 = 26.22; dl=6; 1-P = 99.99\%$$

Figure 2: Parts of plants used in recipe preparation.

3.5. Preparations of phytomedicines

Fig. 4 shows the techniques for the preparation of phytomedicines which are, decoction (69.4%), crushing

(23.60%) and maceration (7%). There is a significant difference between the different preparation techniques ($P = 0.01\%$).



$$Khi-2 = 183.66; dl=4; 1-P = 99.99\%$$

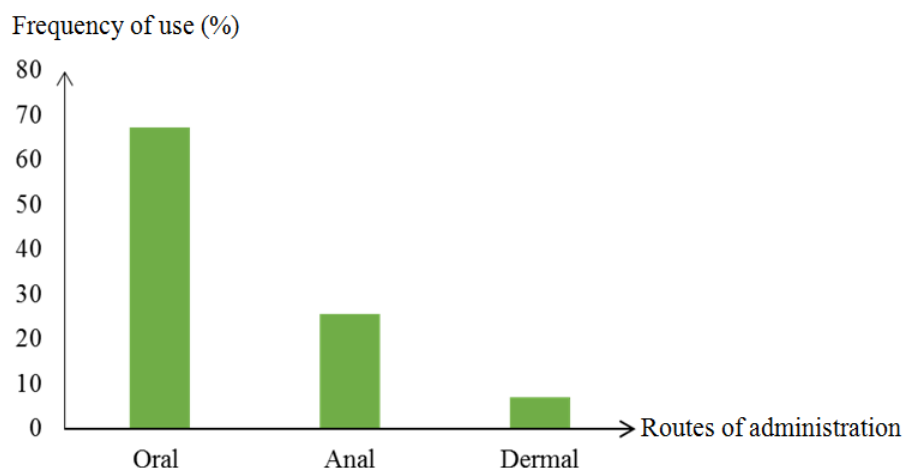
Figure 3: Preparation of phytomedicines.

With regard to the preparation of treatments, decoction is the most used technique. This is consistent with results from Kipre *et al* (2017) in Côte d'Ivoire and Azonbakin *et al* (2021) in Benin, which found that decoction is the most widely used method at 55.1% and 33.55% respectively.^[15,25] This preference for decoction could be justified by the fact that it reduces or cancels the toxicity of certain plants and allows to extract the most active principle.^[27]

3.6. Methods of administration

The results presented in Figure 5 show that treatments is given by the following routes: oral (67.31%), anal (25.64%) and dermal (7.14%). Statistical analysis reveals that the modes of administration used are significantly

different ($P = 0.01\%$). In this study the phytomedicines are given preferentially orally as the anal route. In contrast to Moyabi *et al* (2021) who reported that drug recipes were more administered through the anal route (51.13%) than the oral route (47.89%).^[14] This difference could be explained by the empirical basis of traditional medicine, which varies from tradition to tradition.^[28] Hence the difference between the modes of administration of phytomedicines between the peoples of the North and South-West of Ivory Coast.



$Khi-2 = 165.49$; $dl=4$; $1-P = 99.99\%$

Figure 4: Drug Revenue Route.

4. CONCLUSION

The ethnopharmacological survey carried out among herbalists and tradipraticians allowed to identify 22 medicinal plants that treat infertility in department of Korhogo. In this locality of the Ivory Coast, *Heliotropium indicum* is the most popular plant used in treatment of infertility in humans. The leaves of plants are the organs most used for preparation of remedies. Decoction is the preferred preparation technique and the oral route is the most used to administer phytomedicines. Thus, phytochemical screening and pharmacological testing of aqueous extracts of these plants could be used to evaluate their effects on human fertility.

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