Medicinal Plants used in the Traditional Treatment of Cancer in the District of Bamako, Mali.

ABSTRACT

Aims: This study goaled to enhance the value of traditional medicinal plants used in cancer treatment.
Place and Duration of Study: An ethnobotanical survey was conducted in fifteen markets of Bamako district's, from February to August 2023.
Methodology: The surveys involved the traditional medicine practitioners in Bamako based on a well semi-structured questionnaire. The information about the cancer and the plant species used to manage the it, the mode of use and preparation in addition to the social characteristic of respondents were gathered.
Results: In this study area, a total of 172 traditional health practitioners were questioned in this study with a predominance of female (72.7%). Among the types of cancer known by the respondents, the breast cancer topped the list with 63.48%, followed by the cervical (21.34%) and prostate (8.42%) cancer. Twenty-seven (27) plant species belonged to 19 botanical families were used by these people to treat the cancer. *Ximenia americana* Linn, *Cola acuminata* F and *Strychnos spinosa* Lam were the most frequently cited species, with a frequency of 51.85%. The most represented botanical families were Fabaceae and Acanthaceae. The leaves (34%) were the most widely used medicinal plant parts, followed by leafy branches (20%) and roots (16%). For the preparation of medicinal recipes, 44.44% of the respondents recommended mainly the decoction (44.44%) and spraying (41.70%). These recipes are generally administered by oral route (32.69%) and the specific bath (30.76%).
Conclusion: These results constitute a preliminary step to the assessment of the anti-cancer properties of some of these registered plant species.

Keywords: Ethnobotanical surveys, cancer, plant species, Mali.

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1. INTRODUCTION

Over the last few decades, cancer has become a worldwide scourge. According to the data from the Global Cancer Statistics (GLOBOCAN) [1], 19.3 million new cases of cancer were diagnosed in 2020, and almost 10 million people died from the disease. The same reference predicted that the number of cancer cases will rise to 28.4 million by 2040 worldwide, with female breast cancer overtaking lung cancer as the most common cancer (11.7%), followed by lung (11.4%), colorectal cancer (10%), prostate cancer (7.3%) and stomach cancer (5.6%). According to Jacqueline et al. [2], this disease is progressively affecting populations in low- and middle-income countries, where poverty, inadequate healthcare systems and social and cultural prejudices are prevalent. However, Ferlay et al. [3] noted that cancer was long considered to be the preserve of developed countries, but today it is not sparing Africa, where the number of new cases and deaths is rising with an expected increase for almost 100% by 2030. In 2012, the International Agency for Research on Cancer (IARC) [4], estimated that

there would be almost 850,000 new cases and almost 600,000 deaths from cancer in Africa as a whole, and that by 2030 this number would increase by 1.4 million new cases and 1 million deaths. The global cancer statistics [1], reported that 7.2% of African people have died from cancer, whereas the incidence was 5.7%, due to the different distribution of cancer types and higher mortality rates in this region. In Mali, the health authorities registered many types of cancer such as cervical cancer, breast cancer, stomach cancer, liver cancer and colorectal cancer in women; and liver cancer, stomach cancer, prostate cancer, bladder cancer and colorectal cancer in men [5]. In 2020 in Mali, GLOBOCAN [1] reported 14,118 new cases and 10,234 deaths for cervical cancer alone.

To treat various illnesses, local populations turn to local medicinal plants, which are considered much more affordable than modern medical treatments. From the literature, numbers scientific works have been carried out through other countries to list the plant species used in the traditional management of cancer [6, 7]. To the best of our knowledge, this work is the first one carried out in Bamako's city which aimed to highlight the plant species used by the traditional health practitioners to manage the cancer.

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2. MATERIALS AND METHODS

2.1 Study environment

The capital of the Republic of Mali, Bamako is located in the south-western part of the country **(Fig. 1)**. According to the Direction Régionale de la Planification, de la Statistique, de l'Informatique, de l'Aménagement du Territoire et de la Population du District [8], the surface area of Bamako covers approximately 267 km^2 with an estimated population of 2,384,780 inhabitants, i.e. a density of 8,932 inhabitants per Km2. The city of Bamako has a Sudanian climate (hot climate) which is characterized by two alternating seasons: a short cold period (from December to February) and a long hot period (from March to May) with extremes that are sometimes too high (over 38°C) [9].

2.2 Selection of informants

The snowball method was used to select the key traditional healers with the help of local communal authorities, elders, and knowledgeable persons.

2.3 Ethnomedicinal and sociodemographic data collection

The ethnobotanical survey was conducted between February and August 2023, and covered fifteen different markets of Bamako. From each market, the traditional healers or knowledgeable persons were identified and selected based on the information gathered from each local communal authority, and other people in the study area. The objectives of the study were clearly explained by the interviewer and the consent of each interviewee was obtained before administering the questionnaire. The questionnaire focused on the respondents' perceptions and level of knowledge about the cancer (types of cancer, causes, consequences, etc.) and the plants used to treat it, the organs used, and how they are prepared and used. The cost of treatment and the socio-demographic data of the respondents (age, sex, occupation and locality, etc.) were also included.

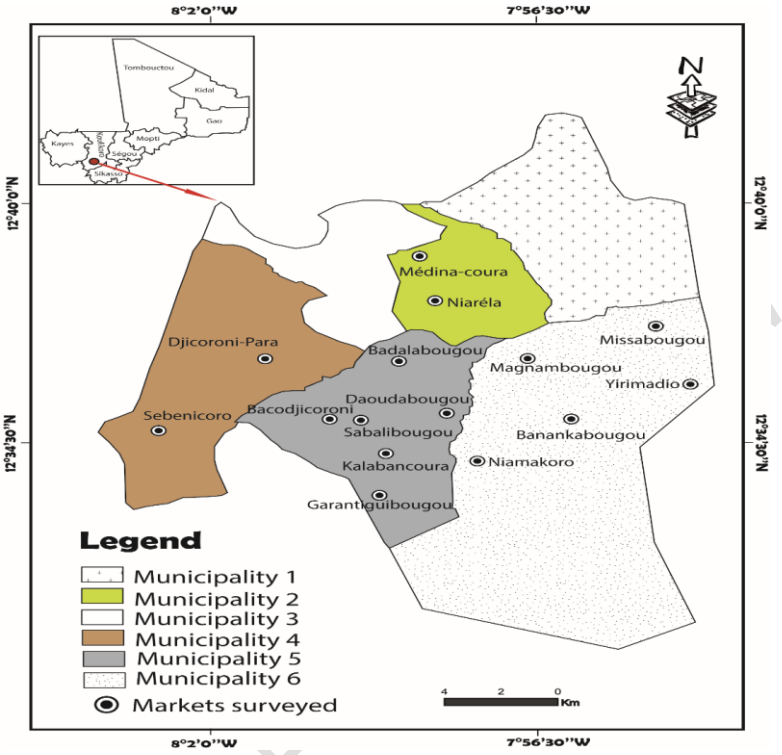

Fig. 1. Map of survey sites in the Bamako district

2.4 Plant identification

A specimen of each plant species mentioned was collected for botanical identification by the team of the Laboratoire de Botanique et d'Ecotoxicologie (Labotec) at the Université des Sciences des Techniques et des Technologies de Bamako (USTTB).

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2.5 Data processing

The ethnobotanical data was summarized using a descriptive statistical method (percentage and/or frequency). Moreover, the informant consensus factor was computed. Microsoft Excel spreadsheet software (Microsoft Corporation®, 2010) and IBM® SPSS® (statistics version 25.0) were employed to organize and analyze the data. The Shapiro-Wilk and Chi2 tests were used to validate the normality and interdependence of the qualitative data, respectively.

3. RESULTS

3.1 Sociodemographic profile of traditional health practitioners

The **Table 1** showed the results of sociodemographic characteristic of respondents.

These surveys were carried out among 172 traditional health practitioners, 39% of whom were traditherapists and 61% herbalists. The majority of them were women (72.7%) compared to men 27.3%. The age of the people surveyed ranged from 19 to 73 years, with an average of around 44 years in the 15 investigated markets.

Table 1. Repartition of respondents by gender, age and activity.

Variables	Category	Frequency	Percentages (%)
Gender	Men	47	27.30
	Women	125	72.70
Age	[19-26[	7	4.10
	[26-33[	27	15.70
	[33-40[	33	19.20
	[40-47[	31	18.00
	[47-54[	34	19.80
	[54-61[	18	10.50
	[61-68[	18	10.50
	[68-75[	4	2.30
Status of respondents	Traditherapists	65	39
	Herbalists	105	61

The Shapiro-Wilk test showed an asymmetrical or abnormal distribution ($p = 0.0001 < .05$) of respondents according to sex, status (herbalist or traditional practitioner), perception and locality. The Chi-square test showed that there is no correlation between perception and the sex of respondents ($p = 0.295 > .05$) **Table 2**. The results of the Shapiro-Wilk test are shown in **Table 2**.

Table 2. Shapiro-Wilk normality test.

	Shapiro-Wilk		
Characteristics	**Statistics**	**Degree of freedom**	**P-value**
Respondent's perception	0.454	172	0.0001
Gender of respondent	0.663	172	0.0001
Status of respondent (herbalist/tradipratician)	0.485	172	0.0001
Location surveyed	0.447	172	0.0002

3.2 Perception and level of knowledge about cancer

3.2.1 Perception of cancer by these traditional healers

The perception of cancer varied according to the questioned people and most of them perceived cancer as a disease under the following local names: "bon", "so bon" or "coungo bon" and "canabagani". The majority of respondents (77.9%) perceived the cancer as a disease, but 22.1% did not know anything about it. Among the interviewed traditional health practitioners, only 36% believed in the curability of this pathology.

3.2.2 Types of cancer

The **Figure 2** shows the types of cancer known by the interviewees with their frequencies in percentage (%). This figure reveals that a total of eight (8) types of cancer was registered from

these traditional healers, leaded by the breast cancer (63.48%), cervical cancer (21.34%) and prostate cancer (8.42%) were the most frequently cited.

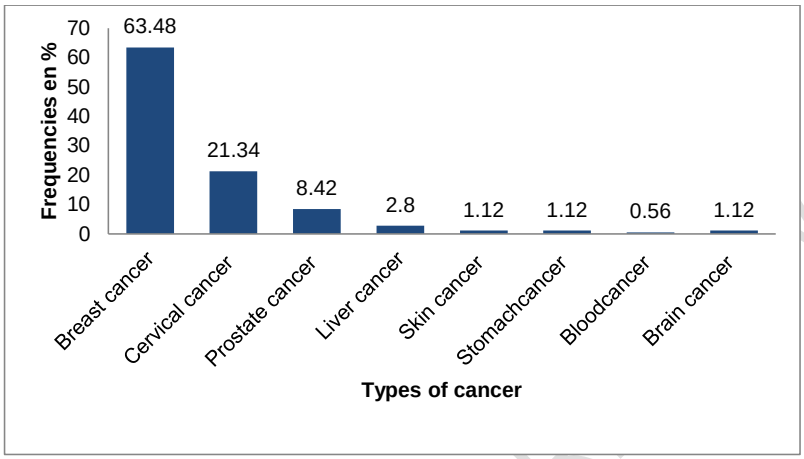

Fig. 2. Frequencies of known types of cancer from the respondents

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Most of the surveyed people (77.9%) knew that cancer is a disease, but only 18% were able to suggest plant species, i.e. 31 people for these three types of cancer: cervical, breast and prostate cancer.

3.2.3 Traditional knowledge about cancer

From the level of people's knowledge, the cancer is locally called "bôn" by the *Bamanan* ethnic group. The traditional healers and herbalists generally recognized the breast cancer by looking for signs such as swelling of the breast (38.43%), intense pain in the breast (36.56%), lump in the breast (11.19%), sore in the breast (5.22%), disgusting milk for the child (4.47%) and swelling of the testicles (4.1%) for prostate cancer.

3.3 Causes of cancer according to traditionalists

According to these traditional health specialists, the breast cancer was caused by the child burping (28.33%) when taking breast milk, placing the telephone (16.66%), money on the breast (16.66%), lack of hygiene (16.66%) and the bra (5%). According to them, poor hygiene was also responsible for cervical cancer. the prostate cancer was linked to the consumption of bouillon maggies (6.66%), bitter products (substances) (6.66%) were responsible for liver cancer, and the burning of plastic waste (1.66%) and cosmetic products (1.66%) were at the root of skin cancer. The origins of other types of cancer were unknown to these traditional healers.

3.4 Anti-cancer plant species

A total of twenty-seven plant species were cited by these traditional healers. The **Figure 3** shows the most frequently cited plant species in the treatment of cancer. The species *Ximenia americana* Linn 29.63% was the most cited in the treatment of cancer. Among these plant

species *Cola acuminata F* (13.79%) and *Ximenia americana Linn* (10.34%) were the most cited for breast cancer; *Ximenia americana* Linn (27.27%) and *Strychnos spinosa Lam* (18.18%) for prostate cancer and *Ximenia americana* Linn (66.66%) and *Parkia biglobosa (Jacq) Benth* (33.33%) for cervical cancer.

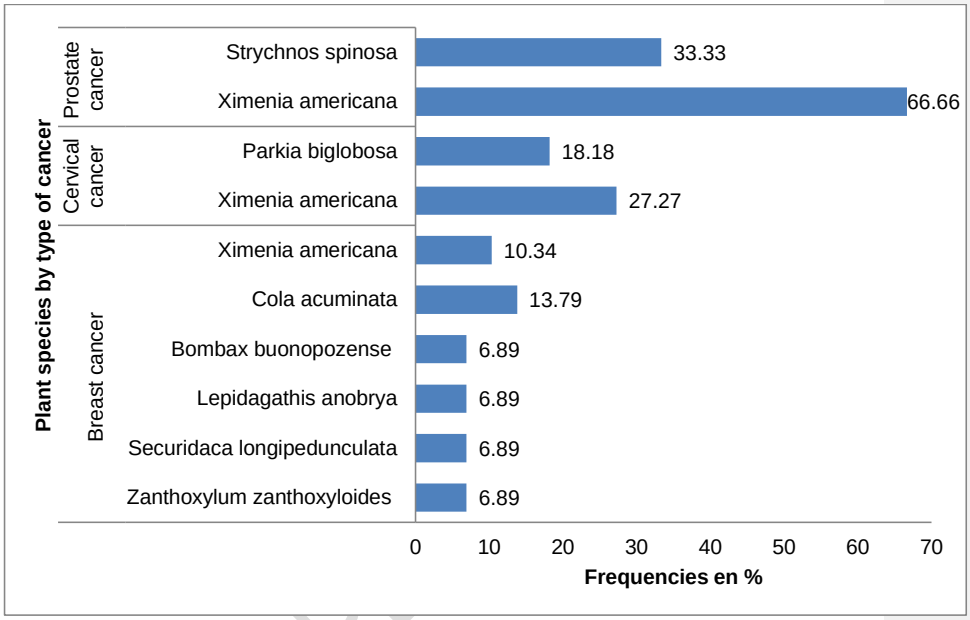

Fig. 3. Frequency of most cited plant species by type of cancer

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3.5 Organs used

The **Figure 4** shows the organs used and their frequencies in the preparation of recipes, with foliage remaining the most used at 34%, followed by leafy branches (20%), roots (16%) and barks (12%).

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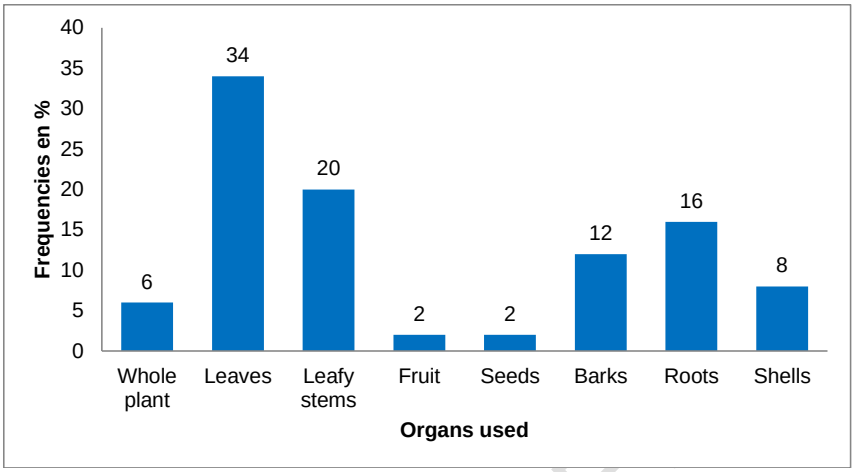

Fig. 4. Frequencies of the different organs used

3.6 Methods of preparation and administration

The modes of preparation and administration of the different organs and their frequencies are illustrated in the **Figures 5** and **6** respectively. The **Figure 5** shows that decoction (44%) and powdering (42%) were the main methods used to prepare the remedies of the different plant species. The oral route (32.69%) was the main route of administration, followed by the specific baths (30.76%) (**Figure 6**).

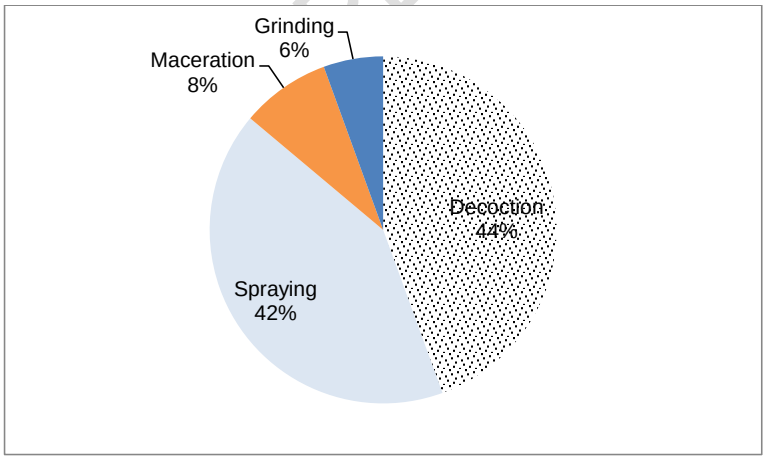

Fig. 5. Frequencies of preparation methods

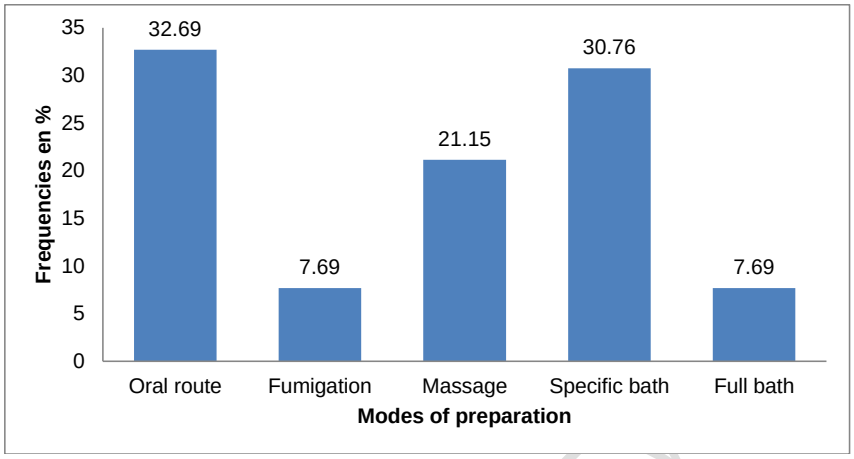

Fig. 6. Methods of use of plant parts

3.7 Different plant species families

The **Figure 7** shows the ethnobotanical families and frequencies of plant species. The most represented were the Fabaceae and Acanthaceae, each with 11.11%, and the Amaryllidaceae, Euphorbiaceae, Apocynaceae and Rhamnaceae, each with 7.4%.

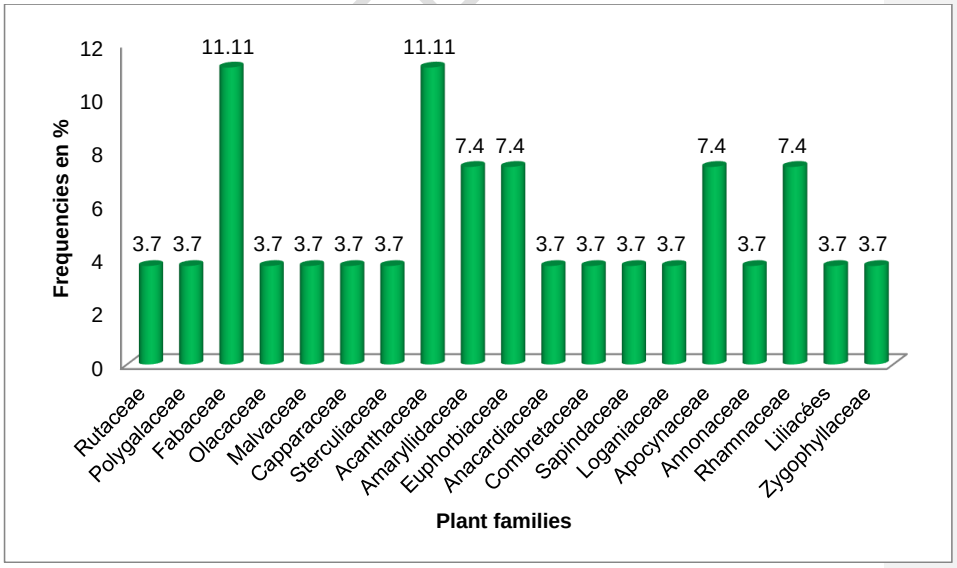

Fig. 7. Family frequencies of different plant species

3.8 Plant species listed

The **Table 3** shows the entire list of plant species registered from the respondents during the survey.
The most coveted species used in the traditional management of cancer were *Ximenia americana* Linn, *Cola acuminata F, Zanthoxylum zanthoxyloides Lam, Securidaca longipedunculata Fresen, Bombax buonopozense, Lepidagathis anobrya Necs, Strychnos spinosa Lam and Flueggea virosa* (Roxb. Ex Willd).

Table 3: List of plant species with their families, scientific names, methods of preparation and use of organs according to the three types of cancer

N°	Families	Scientific name	Bambara name	Breast cancer	Cervical cancer	Prostate cancer	Organ used	Preparation methods	Dosage
1	Rutaceae	*Zanthoxylum zanthoxyloides Lam.*	Wo	2	0	0	Leaves & Tl	Decoction	Oral & Fumigation
2	Polygalaceae	*Securidaca longipedunculata Fresen.*	Dioro	2	0	0	Leaves & Tl	Decoction	Oral & Fumigation
3	Fabaceae	*Acacia nilotica Del.*	Buana	1	0	0	Fruits	Reduced to powder	Oral
4	Fabaceae	*Parkia biglobosa (Jacq) Benth.*	Néré	0	1	0	Bark	Maceration	Oral
5	Fabaceae	*Pterocarpus lucens*	N'Garayiri	1	0	0	Leaves & Tl	Decoction	Oral
6	Malvaceae	*Bombax buonopozense*	Bumbum	2	0	0	Leaves & Tl	Decoction	Specific bath
7	Capparaceae	*Boscia senegalensis (Pers) Lam.*	Béré	1	0	0	Leaves & Tl	Reduced to powder	Massage
8	Sterculiaceae	*Cola acuminata F.*	Worosun	4	0	0	Shells	Reduced to powder	Massage
9	Olacaceae	*Ximenia americana Linn.*	Tonguè	3	2	3	Leaves & Roots	Reduced to powder (4); Maceration (2); Decoction (1); Grinding (1)	Oral
10	Acanthaceae	*Lepidagathis anobrya Necs*	Gontèkè	2	0	0	Leaves & Tl	Decoction	Specific bath Oral, & Fumigation
11	Acanthaceae	*Peristrophe bicalyculata (Retz.)*	Barakala	1	0	0	Leaves & Tl	Decoction	Whole & specific bath
12	Acanthaceae	*Hydrophila senegalensis (Nees)*	Zamuzamu	1	0	0	Grindings	Decoction	whole bath

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13	Amaryllidaceae	*Allium tricoccum Ait.*	Oignon sauvage	1	0	0	Whole plant	Grinding	Massage
14	Amaryllidaceae	*Allium cepa L.*	Oignon	0	0	1	Leaves	Maceration	Oral
15	Euphorbiaceae	*Bridelia ferruginea Benth.*	Sagan	1	0	0	Whole plant	Decoction	Oral
16	Euphorbiaceae	*Flueggea virosa (Roxb. Ex Willd)*	Suruku gnègnè	1	0	1	Leaves, Tl & Roots	Decoction	Oral
17	Combretaceae	*Combretum glutinosum Perr. ex DC*	Tiangara	1	0	0	Leaves	Decoction	Specific bath
18	Sapindaceae	*Blighia sapida K.D.Koenig*	Finsan	1	0	0	Leaves	Decoction	Fumigation
19	Loganiaceae	*Strychnos spinosa Lam.*	Gangoro	0	0	2	Leaves & Tl	Decoction	Oral
20	Apocynaceae	*Calotropis procera (Action) W.T.Action*	Pôopopogolo	1	0	0	Leaves	Decoction	Oral
21	Apocynaceae	*Leptadenia hastata (Pers.) Decne.*	Zognè	0	0	1	Whole plant	Reduced to powder	Oral
22	Annonaceae	*Annona senegalensis Perss.*	Mande sunsun	1	0	0	Leaves	Decoction	Oral
23	Rhamnaceae	*Ziziphus mucromata Willd.*	Suruku n'tomolo	1	0	0	Roots	Decoction	Oral
24	Rhamnaceae	*Ziziphus mauritiana Lam.*	N'Tomolo	0	0	1	Leaves	Reduced to powder	Oral
25	Anacardiaceae	*Lannca acida A. Rich*	Bembe	1	0	0	Bark	Reduced to powder	Massage
26	Liliacées	*Asparagus*	Sogobakenèci	0	0	1	Leaves	Reduced to powder	Oral
27	Zygophyllaceae	*Balanites aegyptiaca (L.) Delile*	Zèguènè	0	0	1	Bark	Reduced to powder	Oral

Abbreviations: Tl: twigs leaves

4. DISCUSSION

In this study, we conducted an ethnobotanical survey to document the existing traditional knowledge and practices related to the treatment of cancer using medicinal plants by the traditional health therapists in Bamako. The results of our study showed that the respondents who had experienced cancer as an illness had an average age of around 44 years. About 16% of these questioned people were aged between 47 and 54, followed by 13% aged between 33 and 40. In Africa, the acquisition of traditional knowledge requires a certain age of maturity. The same age groups of respondents involved in the ethnomedicinal investigations were reported by many authors [6, 10, 11].

The high citation frequency registered for breast (63.48%), cervical (21.34%) and prostate (8.42%) cancer are in line with the conclusions of previous studies which highlighted these categories of cancer as the most encountered in Africa [12-14]. Misonge et al. [15] showed that data from the Kenyan cancer registry revealed an increase in cancer cases, particularly the breast cancer and prostate cancer. Likewise, these cancers are among the most common in Mali [1, 14, 16]. The Chi-square test showed that while the frequency of the type of cancer mentioned was independent of the localities surveyed (p value $> .05$), it was sex-dependent. For instance, the cervical cancer was cited mainly by women ($p = 0.008 < .05$) and the prostate cancer by men ($p = 0.0001 < .05$). There was also a high correlation between the prostate cancer ($p = 0.001 < .05$) and the liver cancer ($p = 0.014 < .05$) with the category of people surveyed (TPS or herbalists).

To the question, how do you recognize cancer? The traditional health practitioners reported the recognizing breast cancer by different signs such as swelling of the breast (38.43%), intense pain in the breast (36.56%), lump in the breast (11.19%), sore in the breast (5.22%), breast milk disgusting to the child (4.47%) and swelling of the testicles (4.1%) for prostate cancer. Lutoti et al. [7] reported the same signs for breast cancer according to the traditional healers in Uganda.

This study identified 27 plant species divided into 19 botanical families. The most represented families were the Fabaceae (11.11%) and Acanthaceae (11.11%), followed by the Euphorbiaceae, Rhamnaceae, Amaryllidaceae and Apocynaceae, each accounting for 7.4%. Most of these botanical families, such as Fabaceae, had been mentioned by other authors in the traditional management of cancer [7, 12]. Most of the traditional anticancer recipes were made from the leaves (34%), the leafy stems (20%) and the roots (16%). The statistical analysis revealed that the use of leaves ($p = 0.001 < .05$), leafy stems ($p = 0.038 < .05$) and roots ($p = 0.030 < .05$) varied according to the respondent category. According to Lutoti et al. [7], the leaves (46%) were the most commonly used plant part followed by the roots (13%) by traditional healers against cancer. Also, Omara et al. [12] reported that anticancer extracts are generally prepared from the leaves (29%), bark (24%), roots (21%) and fruit (13%). The preparation methods most frequently mentioned were the decoction (44.44%) and the spraying (41.67%). Based on other studies, the decoction remains the main method for preparing medicinal plant recipes [7, 11, 12]. Kouchadé et al. [17] reported that the decoction yields the most active ingredients and decontaminates the raw material.

These recipes are mainly administrated by the investigated populations in the form of oral route (32.69%), and specific bath (30.76%). The Chi2 test showed that this route was mainly recommended by herbalists ($p = 0.001 < .05$). These findings corroborate those of many authors who have shown that the main route of administration of phytomedicines remained the oral one [11, 17, 18]. The results of this study show that traditional medicinal plants are used in the treatment of cancer in Mali, so further research is needed on the plants most frequently mentioned by the population.

5. CONCLUSION

This study identified twenty-seven plant species used in the treatment of cancer by the traditional health practitioners in the district of Bamako. The breast, cervical and prostate cancer were the most known and treated by these traditional health practitioners. Since plants are sources of immense bioactive molecules with various virtues (nutrition, health, etc.), they can help to improve the living conditions of local populations. In-depth research into the anti-cancer activities, phytochemical composition and toxicity of these plant species is needed if they are to be put to better use.

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