

# Ethnobotanical Knowledge of Medicinal Species in the Beninese Pharmacopoeia Used in the Traditional Treatment of Vaginal Infections in Northwest Benin

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## Abstract :

**Background:** Vaginal infections exhibit high endemicity with severe consequences for women's health in Africa and around the world. In Benin, many medicinal plants are used by therapists in the treatment of female genital infections, however no study has been conducted to list them.

**Aim:** The aim of the study is to document these medicinal species used and the level of knowledge about vaginal diseases.

**Methodology:** A semi-structured ethnobotanical survey related to endogenous knowledge was conducted using pre-established questionnaires on KoboCollect with 81 traditherapists in three municipalities of Atacora and Donga.

**Results:** The results show that 100% of traditherapists from various ethnic groups in northwest Benin have a good knowledge of vaginal infection symptoms and the wide range of medicinal species used to treat them. 93.8% of respondents reported clinical signs such as unusual vaginal discharge, itching, odorous leucorrhoea, lower abdomen pain in women of reproductive age. *Euphorbia hirta* (20.66%), *Allium sativum* (11.57%) and *Ocimum gratissimum* L. (10.74%) are the most cited species for which they testify to their efficacy and accessibility to the population. They are used in the form of decoction (79%), infusion (10%), trituration (6%) and powder (5%) in a variety of ways, including orally (74.07%) and in vaginal baths (25.93%).

**Conclusion and perspectives:** The results provide evidence of the rich knowledge regarding the traditional treatment of vaginal infections in Benin. This preliminary study is crucial before exploring research perspectives on the pharmacological potentials of the specific medicinal species documented.

**Keys words:** Vaginal infections - Ethnobotanical survey - Plant diversity - Northwest Benin.

## INTRODUCTION

Infectious diseases are responsible for over 17 million deaths annually worldwide, and are one of the major causes of death in developing countries accounting for 43% of all deaths [1]. Among these diseases, genital infections are not only highly endemic in the African region but also have severe consequences such as infertility, ectopic pregnancy, miscarriages, and an increased transmission risk of sexually transmitted infections [1]. [2] and [3], had reported that vaginal infections are a global health problem among reproductive-age women. They are among the most common reasons for gynecological consultations in Benin [4]. To address genital infections, synthetic pharmaceutical molecules are commonly used. Thus, modern medicine treatment is primarily based on the administration of synthetic antifungals, which are not always a panacea, sometimes resulting in persistent recurrent complications. Resistance to synthetic molecules, inaccessibility to modern healthcare, the high cost of modern medicine treatment and the manifestation of severe or even toxic side-effects in some cases, are the main causes of dissatisfaction with conventional treatment [5,6,7]. In light of this situation, herbal medicine is an alternative that low-income populations resort to for the treatment of

vaginal infections [8,9]. Despite the advances in modern medicine, plants remain potential natural remedies that can be used for both curative and preventive treatments [10]. According to WHO estimates, 80% of the world's population in developing countries, and 70% of the population of Benin, rely on traditional medicine for the treatment of various ailments [11]. In the sub-region and in Benin in particular, various medicinal plants (*Senna siamea*, *Phyllanthus amarus*, *Uvaria chamae*, *Vachellia sieberiana*, *Crateva adansonii*) are used for their biological properties in the treatment of many infectious diseases [12,13,14,15]. Given that traditional practitioners hold numerous plant-based recipes, it is therefore appropriate to deepen ethnobotanical and pharmacological research on credible plants used in medicine in Benin to validate their more efficient use [16]. Despite several studies on medicinal resources in Benin, no research has documented the plant species used in the treatment of vaginitis. Therefore, ethnobotanical investigations are required for the scientific validation of medicinal plants used in the treatment of vaginal infections in Northwest Benin. The aim of this study was to catalog the credible species used to treat these infections and to preserve this endogenous knowledge.

## MATERIAL AND METHODS

Study data were collected from July to September 2023 in three municipalities of Atacora and Donga. In the Atacora department, the municipalities of Natitingou and Tanguéta, covering the Natitingou-Boukoubé-Toucountouna and Tanguéta-Cobly-Matéri health zones respectively (Figure 1), were considered. Located in the far west of Benin, the Atacora department includes nine municipalities, with Natitingou as the department's capital. With a total area of 20,499 km<sup>2</sup>, Atacora is the third largest department in Benin by size. The population of the Atacora department is relatively young, with approximately 50.6% aged 0-14 years and 44.8% aged 15-60 years. Characterized by a Sudanian-Guinean climate influenced by the Atacora relief, the department has two seasons: a rainy season from mid-April to mid-October and a dry season from mid-October to mid-April. Regarding precipitation, the average height ranges from 900 mm to 1000 mm. The Atacora department hosts all ethnic groups, but the Otamari and related groups (59.3%), the Bariba and related groups (19.0%), and the Fulani or Peuls (12.5%) are predominant. Three types of soil characterize the Atacora department: ferruginous tropical soils in some areas with a relatively adequate arable layer for annual crops; ferrallitic soils, especially in the mountainous regions of Matéri and Tanguéta; and light hydromorphic soils, mainly found in peneplains or lowlands [17].

In the Donga department, the municipality of Djougou, covering the Copargo-Djougou-Ouaké health zone (figure 1), was included in the study. Derived from the former Atacora department, of which it occupied the southern part, the Donga department spans an area of 11,126 km<sup>2</sup>. It encompasses four municipalities, with Djougou as the department's capital. The population of

the Donga department is relatively young, with about 47.4% aged 0-14 years and 47.6% aged 15-60 years. All ethnic groups of Benin are present in the department, with the Yom, Lokpa, and related groups (59.0%) and the Fulani and related groups (15.7%) being the majority. The Donga department has a Sudanian-Guinean climate, characterized by a rainy season (mid-April to mid-October) and a dry season (mid-October to mid-April). Average precipitation ranges from 1200 mm to 1300 mm. The soils are of crude mineral, hardened tropical ferruginous, and hydromorphic types [18].

This study consisted of a semi-structured ethnobotanical survey using pre-established questionnaires on KoboCollect [19], following the approach previously reported by [20], with traditherapists regarding the medicinal species used in the traditional treatment of vaginal infections. Traditherapists were selected based on their reputation within the community and their knowledge of vaginal infections through the symptoms described. This last criterion defined the number of traditherapists per village. The questionnaire was administered in French, with the support of local guides. The collected data included socio-demographic information, the respondents' knowledge of the vaginal infections manifestations, the reasons why people use medicinal plants, patient satisfaction rates, the different plant species involved in treatments and their vernacular names, the different plant parts used, preparation methods, and modes of administration. This was followed by the collection of representative samples of the medicinal species indicated for treatment. These samples were photographed. The cited species were then identified and authenticated by botanist experts and those in charge of phytorecources at the University of Abomey-Calavi in Benin.

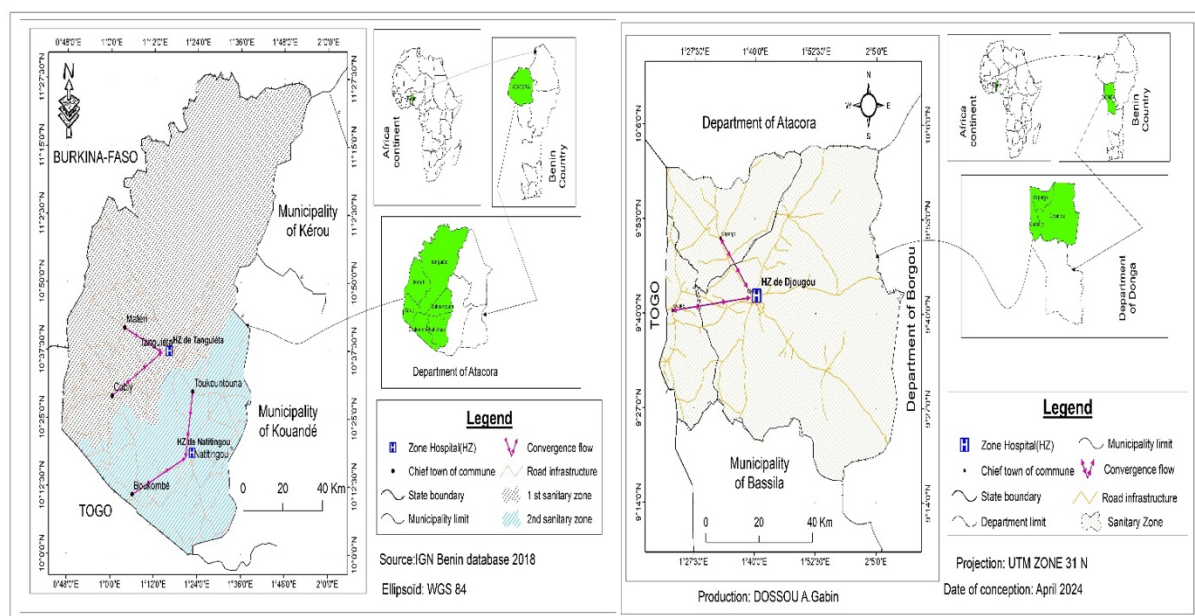


Figure 1: Map showing the geographical location of municipalities in the departments study

### Data Analysis

The parameters considered for data analysis included: the socio-demographic data of the respondents, the citation frequency of plants involved in the vaginal infections' treatment, the confirmation index or informant consensus index. Sociodemographic data were analyzed using a descriptive and quantitative statistical method. Graphical representations and tables were created using GraphPad Prism 8 and Microsoft Excel 2016.

The relative frequency of citation (RFC) was determined for each species using the following formula:

$$RFC = (NP/NT) \times 100$$

where NP is the number of citations for the plant in question, and NT is the total number of citations for all plants.

The confirmation index or informant consensus index (ICs) was determined for each species using the formula applied by Ilumbe *et al.* (2014):

$$ICs = Na/Nt$$

where Na is the number of people who cited the species, and Nt is the total number of people interviewed.

### RESULTS

#### Socio-demographic characteristics of respondents

Table 1 shows the distribution of respondents by age, gender, professional experience and ethnic group. The age ranged from 20 to 75 years, with an average age of  $42 \pm 6$  years. Most respondents were male (59.30% male versus 40.70% female). Professional experience among respondents ranged from 5 to 30 years, with the majority (50.60%) having 15 to 25 years of experience. They were distributed among the different ethnic groups in the study area.

The information collected on the educational level of respondents showed that the majority had a primary education level (55.50%), followed by those with no formal education (24.60%), secondary education (16.04%), and finally, a very small proportion with higher education (3.70%).

#### Knowledge of tradional therapists about vaginal infections

A total of 81 traditherapists were investigated. It revealed that vaginal infections were described by traditherapists as diseases manifested by unusual vaginal discharge, itching, odorous leucorrhoea and pain in the lower abdomen. Figure 2 below shows the

proportions of different vaginal infection symptoms cited by traditherapists.

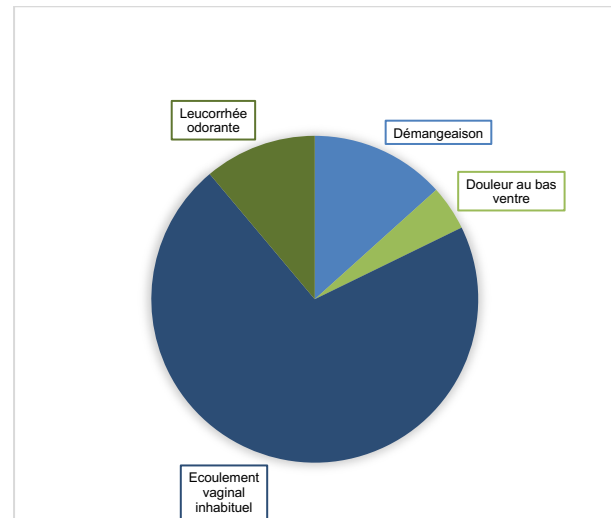


Figure 2 : Vaginal infection symptoms

Vaginal infections affected women of childbearing age, especially those between 20 and 40 years old (93.80%), regardless of their educational level (Table 2).

The reasons for using medicinal plants in the treatment of vaginal infections were essentially availability (9%), financial affordability (15%) to the population, and above all their efficacy (57%) (Figure 3).

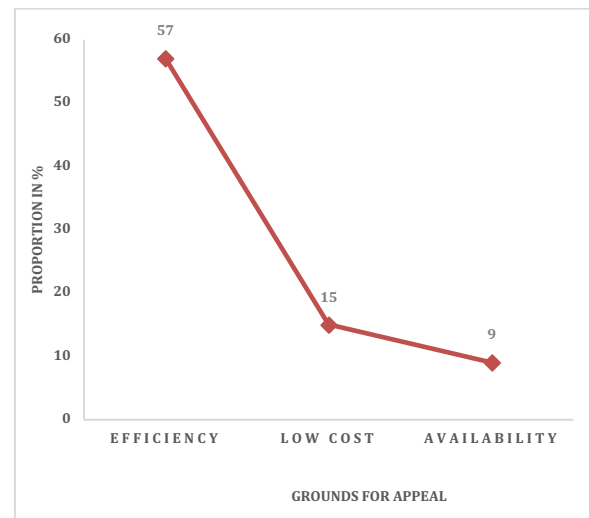


Figure 3 : Variation in the proportion of reasons for using medicinal plants.

Table 2 : Characteristics of patients

	Age of patients (years)			Educational level of patients			
	<20	[20 – 40]	[40 – 60]	NS	P	S	U
Number of patients	2	76	3	64	10	5	2
Percentage (%)	2,4	93,8	3,7	79,01	12,3	6,2	2,4

Notes: NS: Not Specified; P: Primary; S: Secondary; U: University

### Inventory of medicinal plants involved in the treatment of vaginal infections

Table 3 shows the diversity of medicinal plant species cited by traditherapists in the treatment of vaginal infections, with their relative frequency of citation and respective confirmation index. In this survey, 121 medicinal species were cited by a total of 81 respondents.

Twenty-six different species, distributed across twenty families, were mentioned by respondents for the treatment of vaginal infections. *Euphorbia hirta* (20.66%), *Allium sativum* (11.57%), and *Ocimum gratissimum* L. (10.74%) were the most frequently cited. Additionally, these three plants had the highest informant consensus indices.

### Administration modes and preparation modes of traditional medicines.

Figure 4 shows the administration modes of the various species cited in the treatment of vaginal infections in northwest Benin.

It was found that the different species were used in a variety of ways, mainly as decoctions, powders and mainly orally (79% vs. 21% dermally via baths).

They were used alone or in combination with each other or with other plants for greater efficacy, depending on the case.

Table 2 : Socio-demographic characteristics of respondents

Parameter		Workforce	Frequency (%)
Age	[20-40]	12	14,8
	[40-60]	61	75,3
	[60-80]	8	9,8
Gender	M	48	5,20
	F	33	40,7
Study level	NS	20	24,6
	P	45	55,5
	S	13	16
	U	3	3,7
Professional experience	[05-15]	30	37,0
	[15-25]	41	50,60
	[25-35]	10	12,3
Ethnic groups	D	19	23,4
	W	18	22,2
	A	12	14,8
	Y	11	1,5
	Di	6	7,4
	B	4	4,9
	P	6	7,4
	F	5	6,2

Notes: P: Primary; S: Secondary; U: University; NS: No formal education; M: Male; F: Female; D: Dendi; W: Waama; A: Aani; Y: Yom; Di: Ditamari; P: Peulh; F: Fon; B: Berba.

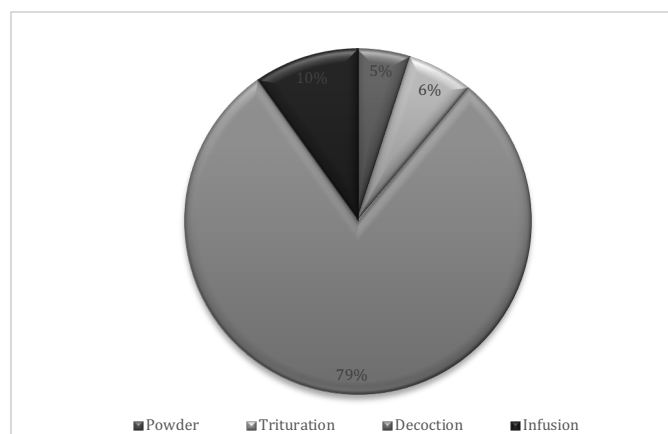


Figure 4 : Administration modes of the various species cited

**Table 3** : Diversity of plants cited with their frequency of citation and respective informant consensus index.

Species	Names in French and local languages	Family	Frequency of citation (%)	Informant consensus index (ICs)
<i>Lantana camara</i> L.	Lantana ou Herbe à plomb (Fr), Hlaciayo (F)	Verbenaceae	2,4	0,03
<i>Ocimum gratissimum</i> L.	Basilic africain (Fr), Winré wassa (D), tchao (F), Simonuwa (Ym)	Lamiaceae	10,7	0,15
<i>Khaya senegalensis</i> (Desr.) A.Juss.	Caïlcédra (Fr), Zunzatin (F), Kahiloumbé (P), Baléléléhi ou Tiinan (B), Fèlè (D), Kouroubou (W)	Meliaceae	7,4	0,1
<i>Euphorbia hirta</i> L.	Herbe d'Australie (Fr), Hundi hundi asu (F), Kpalannawaa (D)	Euphorbiaceae	20,6	0,3
<i>Parkia biglobosa</i> (Jacq.) R.Br. ex Benth.	Néré (Fr), Dorsor (D)	Fabaceae	7,4	0,1
<i>Acacia nilotica</i> L.	Acacia à gomme, gommier rouge (Fr), Gbanni (F)	Fabaceae	9,09	0,13
<i>Annona senegalensis</i> Pers	Pommier cannelle du Sénégal (Fr)	Annonaceae	5,8	0,08
<i>Allium sativum</i> L.	Ail (Fr), Ayo (F),	Alliaceae	11,5	0,17
<i>Seruridaca longipedunculata</i> Fresen.	Arbre à serpent (Fr), Kpéta, Atakpawanlwi (F)	Polygalaceae	2,5	0,03
<i>Piliostigma reticulatum</i> (DC.) Hochst.	Pied de de chameau (Fr), Klon (F)	Fabaceae	1,6	0,02
<i>Carica papaya</i> L.	Papayer (Fr), Kpentin (F), Kaboosituri (D), Papaye (W)	Caricaceae	0,82	0,01
<i>Ceiba pentandra</i> (L.) Gaertn.	Fromager, Kapokier à fleurs blanches (Fr), Guédéhunsou (F), Bantam (D)	Malvaceae (Bombacaceae)	3,3	0,05
<i>Guiera senegalensis</i> J.F. Gmel.	Guiera (Fr), Geloki, gelode (P)	Combretaceae	0,82	0,01
<i>Dyospiros mespiliformis</i> Hochst. ex. A. DC.	Kaki de brousse, Plaquemini (Fr), Kenwi (F), Tokoyi (D)	Ebenaceae	1,65	0,02
<i>Gmelina arborea</i> Roxb., 1814	Arbre à allumette, Gmelina (Fr), Fofitin (F),	Verbenaceae	0,82	0,01
<i>Ficus thonningii</i> Blume	Figuier à pagnes (Fr), klon (F), barkere (P)	Moraceae	0,8	0,01
<i>Ximenia americana</i> L.	Olivier sauvage, citron de mer (Fr), Klikonvwe (F)	Olacaceae	2,5	0,03
<i>Terminalia aviennoides</i> Guill. & Perr.	Framiré (Fr), puuleemi (P)	Combretaceae	0,8	0,01
<i>Combretum glutinosum</i> Perr. ex DC.	kinkéliba coriace (Fr), Dosso (F), Buski, Dooki (P)	Combretaceae	1,6	0,02
<i>Syzygium aromaticum</i> (L.) Merr. & L. M. Perry	Giroflier (Fr), Atiken Gbadota (F)	Myrtaceae	1,6	0,02
<i>Aloe vera</i> (L.) Burm.f.	Aloès (Fr), zogan (F)	Liliaceae	1,6	0,02
<i>Crateva adansonii</i> DC.	Crateva sacré (Fr), Wontonzuzuen (F)	Capparaceae	0,8	0,01
<i>Anacardium occidentale</i> L.	Anarcadier, Cajou (Fr), Acajoutin (F)	Anacardiaceae	0,8	0,01
<i>Senna occidentalis</i> (L.) Link	Faux kinkéliba (Fr), Kinininiba (F)	Fabaceae	0,8	0,01
<i>Laurus nobilis</i> L.	Laurier sauce (Fr),	Lauraceae	0,8	0,01
<i>Xanthoxylum zanthoxyloides</i> (Lam.) Zepern. Timler	Fagara (Fr), Xétin (F), bulebarkele (P), dabo (W), kparouagou (Y)	Rutaceae	0,8	0,01

F : Fon

Fr : French

D : Dendi

W : Waama

P : Peulh

Di : Ditamari

Y : Yom

## DISCUSSION

Vaginal infections are the most common health problem among women [3, 4]. Treatment with antimicrobials for these infections is not always effective, leading the population to turn to the use of medicinal plants. [21]. The aim of the present study was to contribute to the valorization of the phytoresources of the Beninese pharmacopoeia in the treatment of vaginal infections.

In the present study, the ethnobotanical survey showed that traditherapists are the professional holders of endogenous knowledge. In the present study, the ethnobotanical survey showed that traditherapists are the professional holders of endogenous knowledge. They have a thorough knowledge of vaginal infections, whose symptoms they described as unusual vaginal discharge, itching and odorous leucorrhoea. The traditherapists surveyed were mostly male (59.26%), with a primary school education (55.5%) and at least five years' professional experience. These results can be explained by the fact that the study only included traditherapists in a predominantly Muslim area where access to women by outsiders is limited. [13], through an ethnobotanical survey of plants used in the treatment of infections in southern Benin, had justified their similar results to the present findings by stating that traditherapists represent a more restricted class of knowledge on traditional plants, often associated with other sciences such as geomancy, which is reserved for men and intended for the elderly.

The results of the present study revealed that the various species mentioned were used in a variety of forms, mainly as decoctions, and mainly orally (74.07% vs. 25.93% dermally via baths). According to [22], water is used as the main solvent especially in the treatment of mycoses. The decoction, the most frequently used administration mode, not only collects the most active ingredients, but also attenuates or cancels out the toxic effects of some recipes [23]. The results of other ethnobotanical surveys are consistent with the findings of the present survey on the administration and preparation modes of phytoresources in the treatment of infections. Thus, [24] showed that drinks made from the leaves are predominantly used (43.18%), and oral administration is the most frequently employed (60.93%).

*Euphorbia hirta* (20,66%) *Allium sativum* (11,57%) and *Ocimum gratissimum* L. (10,74%) were the most cited. These three species are known for their antimicrobial and anti-inflammatory properties in the treatment of various infectious diseases. Other studies have confirmed the effectiveness of these species in treating various infections. [25] Thus, justified that garlic (*Allium sativum*) is used not only for culinary purposes but also for its therapeutic properties. It is used to combat some infectious skin germs and parasites. [26] demonstrated that *Ocimum gratissimum* L. has notable cytotoxic, antifungal, and antioxidant properties

## CONCLUSION

Vaginal infections are well-known to traditherapists in northwest Benin. Twenty-six different medicinal species, predominantly *Euphorbia hirta*, *Allium sativum*, and *Ocimum gratissimum*, were documented for their treatment in this survey. The medicinal species cited are primarily used in the form of extemporaneous preparations (decoctions) either orally or as vaginal baths. It is therefore important to evaluate the pharmacological properties of the most cited species in relation to their composition and explore their toxicity to better understand their use by the population.

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### Author's contributions:

*This work was carried out in collaboration among all authors. Authors CAV, AGD and TDMA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors CAV, AGD, AA, RF, AHSO and MADT managed the analyses of the study. Authors AGD and RS collected the Field data. Authors CAV, AGD and managed the literature searches.*

*All authors read and approved the final manuscript.*

### Acronym and abbreviations :

NP: number of citations for the plant considered; NT: total number of citations for all plants; Na: the number of people who mentioned this species; Nt: total number of people interviewed.

### Competing interests :

Authors have declared that no competing interests exist.

## BIBLIOGRAPHIC REFERENCES

- [1] Organisation Mondiale de la Santé. Maladies infectieuses en Afrique. Situation et perspectives d'action. 7ème Réunion du forum pour le partenariat avec l'Afrique. Moscou, Russie, 19p OMS, 2017
- [2] Mulu W., Yimer M., Zenebe Y. et Abera B. Common causes of vaginal infections and antibiotic susceptibility of aerobic bacterial isolates in women of reproductive age attending at Felegehiwot referral Hospital, Ethiopia: A cross-sectional study. *BMC Women's Health*, 2015, 15.
- [3] Balkus E., Srinivasan S., Anzala O., Kimani J., Andac C. et Schwebke J. Impact of periodic presumptive treatment for bacterial vaginosis on the vaginal microbiome among women participating in the preventing vaginal infections trial. *Journal of Infectious Diseases*. 2017, 215, 723–731.
- [4] INSAE et ICF. Enquête Démographique et de Santé au Bénin 2017-2018 : Rapport de synthèse. Rockville, Maryland, USA, 2019.



- [5] Superti F. et de Seta F. Warding Off Recurrent Yeast and Bacterial Vaginal Infections: Lactoferrin and Lactobacilli. Review. Microorganisms Journal, 2020, (10) 130
- [6] Organisation Mondiale de la Santé. Résistance aux antimicrobiens. Bureau régional du pacifique occidental, Soixante-dixième session Manille (Philippines), 2019 p.8.
- [7] Organisation Mondiale de la Santé. Campagne mondiale de santé publique de l'OMS, 2017, 24-30.
- [8] Sanogo R., Diallo D., Diarra S., Ekoumou C. et Bougoudogo F. Activité antibactérienne et antalgique de deux recettes traditionnelles utilisées dans le traitement des infections urinaires et la cystite au Mali. Mali Médical, 2006, XXI N° 1.
- [9] Dembélé D., Boubacar D., Mahamane H., Claire K. et Rokia S. Paramètres physicochimiques et activité antibactérienne de trois plantes médicinales utilisées dans la prise en charge des infections urinaires au Mali. Journal de la Société Ouest-Africaine de Chimie, 2022, 051 ; 10 – 16.
- [10] Oullai L. Contribution à l'étude ethnopharmacognosique des plantes médicinales utilisées pour le traitement des affections des appareils digestifs en Kabylie. 2018, Mémoire, Université Mouloud Mammeri, Faculté de médecine
- [11] Organisation Mondiale de la Santé /Ministère de la Santé-Bénin. Stratégie de coopération de l'OMS avec les pays 2009–2013 Bénin. Bureau régional de l'OMS pour l'Afrique, 2009, ISBN : 978 929 031 1249
- [12] Hoekou Y. P., Tchadjobo T., Gbogbo AK., Agban A., Pissang P., Atakpama W., Karou SD., Batawila K. et Akpagana K. Activités antimicrobiennes de *Parquetina nigrescens* (Afzel.) Bullock, une plante utilisée en médecine traditionnelle togolaise dans le traitement des infections microbiennes. Afrique Science, 2016, 12(5), 182 – 188.
- [13] Koudokpon H, Dougnon TV, Bankolé HS, Fah L, Hounmanou YMG, Baba-Moussa L. et Loko F. Enquête ethnobotanique sur les plantes utilisées dans le traitement des infections au Sud-Bénin. Health Sci. Dis, 2017, Vol 18 (2).
- [14] Dougnon V., Legba B., Yadouléon A., Agbankpe J. et Koudokpon H. Utilisation des plantes du Sud-Bénin dans le traitement de la fièvre typhoïde : rôle des herboristes. Ethnopharmacologia, 2018, n°60, 64-70.
- [15] Chabi-Sika K., Sina H., Boya B., Bade F., Hounnou T., Badoussi M. E., Adjatin A. et Baba-Moussa L. *Richardia brasiliensis* collected in Southern-Benin: Phytochemical, Antimicrobial Activity and Toxicity. Asian Journal of Biology, 2021, 13(4):22-23.
- [16] Biswas B., Rogers K., Claughin F., Daniels D. et Yadav A. Antimicrobial Activities of Leaf Extracts of Guava (*Psidium guajava* L.) on Two Gram-Negative and Gram-Positive Bacteria. International Journal of Microbiology, 2013, 746165.
- [17] INSAE and ICF, 2019 ; WHO, 2019 ; Superti and Seta, 2020)INSAE and ICF, 2019 ; WHO, 2019 ; Superti and Seta, Institut National De la Statistique et de l'Analyse Economique. Cahier des villages et quartiers de ville du département de l'Atacora., Superti and 2016.
- [18] Institut National De la Statistique et de l'Analyse Economique. Cahier des villages et quartiers de ville du département de la Donga, 2016.
- [19] Roko O. G., Dougnon V., Hounkpatin A., Klotoé J. R. et Baba-Moussa L. Anti-inflammatory, Analgesic and Antipyretic Properties of Ethanolic Extrats of Three Plants of Beninese's Pharmacopoeia: *Euphorbia hirta*, *Citrus aurantifolia* and *Heterotis rotundifolia*. Asian Journal of Biology, 2019, 8(4) :1-8.
- [20] Agassounon DTM., Missihoun AA., Vodounon AC., Adjagodo A., Djossou F. et Guidi C. Investigation ethnobotanique et profil phytochimique des phyto-ressources crédibles utilisées dans la prise en charge des drépanocytaires dans la Commune d'Akpro-Missirété au Bénin. Journal of Applied Biosciences, 2024, 196 : 20783 -20795, ISSN 1997–5902
- [21] Palmeira-de-Oliveira R., Palmeira-de-Oliveira A. et Martinez-de-Oliveira J. New strategies for local treatment of vaginal infections. *Adv. Drug Deliv. Rev.* 2015, 92, 105–122
- [22] Ouattara E., Doga D., Zirihi N. Evaluation In Vitro du Pouvoir Fongicide des Extraits De *Erigeron floribundus* (Kunth.) Sch. Bip. (Asteraceae) sur *Sclerotium rolfsii* et *Colletotrichum musae* Deux Champignons Phytopathogènes. European Scientific Journal, 2019. Vol.15, No.9 ISSN: 1857 – 7881 (Print) e - ISSN 1857- 743.
- [23] Salhi S., Fadli M., Zidane L. et Douira A. Études floristique et ethnobotanique des plantes médicinales de la ville de Kénitra (Maroc). Lazaroa, 2010, 31, 133-146.
- [24] Yapi A.B., Kassi N.J., Fofie N.B.Y., et Zirihi GN. Etude ethnobotanique des Asteraceae médicinales vendues sur les marchés du district autonome d'Abidjan (Côte d'Ivoire). International Journal of Biology Chem. Science, 2015, 9(6): 2633-2647.
- [25] Gambogou B, Ameyapoh Y. A., Gbekley H.E., Djeri B., Soncy K., Anani K., Karou S.D. Review on Garlic and its Bioactive Compounds. European Scientific Journal, 2019 edition Vol.15, No.6 ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431
- [26] Kouassi E.K., Ouattara S., Seguin C., Fournel S., Frisch B. Etude De Quelques Propriétés Biologiques De *Ocimum Gratissimum* L., Une Lamiaceae Recoltee A Daloa (Côte d'Ivoire). European Scientific Journal, 2018, 14 (3), pp.477. 10.19044/esj.2018.v14n3p477. hal-02185319