AJBS Asian Journal of Biological Sciences

OPEN ACCESS

Insight the Medicinal Plants Used to Treat Urinary Tract Infections in Benin

[1]Funkè Faïzatou Assouma, [1]Gautier Roko, [2]Machioud Maxime Sangaré, [1]Durand Dah-Nouvlessounon, [1]Rachidatou Karimou, [1]Farid Badé, [1]Brice Dagnon, [3]Nicodème Worou Chabi, [1]Lamine Baba-Moussa and [1]Haziz Sina

[1]Laboratory of Biology and Molecular Typing in Microbiology, Department of Biochemistry and Cell Biology, Faculty of Science and Technology, University of Abomey-Calavi, Republic of Benin

[2]Department of Animal Physiology, Faculty of Science and Technology, University of Abomey-Calavi, Republic of Benin

[3]Unit of Biochemistry and Molecular Markers in Nutrition, Laboratory of Research in Applied Biology, Polytechnic School of Abomey-Calavi, University of Abomey-Calavi, Republic of Benin

ABSTRACT

Background and Objective: Plants have been traditionally used as an alternative option to treat infections when conventional treatments fail. The present study aimed to provide local knowledge of plants used in Benin to treat urinary tract infections. **Materials and Methods:** The study involved questionnaires and interviews with medicinal plant sellers, with 80 participants from markets and shops. This questionnaire helped us gather information on the users' and sellers' socio-demographic characteristics, the variety of plant species used to treat urinary infections and the preparation and administration methods of the recipes. **Results:** The study found that 68.75% of respondents were female, with 61.25% aged between 30 and 60. The frequency of medicinal plant use varied based on age, gender and education level. The study identified 29 plants from 22 botanical families. *Khaya senegalensis*, *Ocimum americanum*, *Cassytha filiformis*, *Heliotropium indicum* and *Caesalpinia bonduc* were the most cited species with a citation frequency above 20%. Preparations mainly used leaves as decoction and the oral route was mostly used. **Conclusion:** This study emphasizes the importance of traditional medicine in treating urinary tract infections in Benin. Evaluating the biological activities of prominent species is a promising area of research.

KEYWORDS

Ethnobotanical study, medicinal plants, urinary tract infections, decoction, valorization, Benin

INTRODUCTION

Plants are an essential part of biodiversity and have been important to human well-being for many decades[1]. Nearly 80% of the Earth's population, which is five billion people, uses medicinal plants[2]. Africa has a rich diversity of these plants, making it a valuable resource for rural communities[3]. The World Health Organization (WHO) encourages African countries to promote safe and effective traditional medicines to improve the well-being of their populations. Indeed, plants have been used for centuries as a reliable source of treatment for various illnesses across different regions[4]. There has been a recent surge of interest

ISSN: 1996-3351 (Print)
https://doi.org/10.3923/ajbs.2023.438.445

Received: 10 Aug. 2023
Accepted: 18 Sep. 2023
Published: 31 Dec. 2023

in using remedies derived from medicinal plants[5]. As per the WHO, a medicinal plant is any plant that contains substances in one or more parts, which can be used for therapeutic purposes or as a precursor to creating valuable drugs. Utilizing medicinal plants to treat various health conditions has several benefits, such as being cost-effective and having fewer side effects than conventional drugs, which can be expensive and risky. Furthermore, it serves as an alternative option when traditional treatments fail. In recent years, studies have shown that the increasing resistance of infectious and bacterial diseases to conventional drugs has led people to turn to medicinal plants as an immediate solution for their healthcare need[6,7].

The people of Benin value their diverse vegetation, particularly the lush forests home to more than 5,000 plant species. Of these, 172 are used as food and 814 for medicinal purposes. Beninese people rely on abundant medicinal plants with potent therapeutic properties to treat various ailments, including urinary tract infections (UTIs). Over 404.6 million people worldwide are affected by UTIs, with developing countries being the main targets and prevalence varying among different population groups[8]. In Benin, UTIs are a common cause of consultations and hospitalizations[9,10] and over 80% of the population relies on traditional medicine for their healthcare needs, it is crucial to highlight the prevalence of UTIs in the region and the importance of alternative remedies like medicinal plants.

Many people nowadays are looking for natural methods to support community health sustainably. As a country, Benin can contribute to this effort by responsibly using its plant life. Researchers can aid the medical field by conducting ethnobotanical research and gathering empirical knowledge on medicinal plants. In Benin, researchers have conducted several studies on medicinal plants to enrich and sustain ethnomedical knowledge[11-14]. This ethnobotanical research also aims to document traditional medicinal plants used by the Beninese to treat urinary tract infections.

MATERIALS AND METHODS

Study area: The study was conducted in six localities of Benin, focusing on the main cities within each. These cities were selected based on a prior study that examined the pathogenicity of urinary tract infections in Benin[9,10]. The towns included Cotonou in the Littoral department, Abomey-Calavi in the Atlantic Department, Lokossa in the Couffo Department and Abomey in the Zou Department. Semè-Kpodji and Porto-Novo were chosen for the Ouémé Department, Natitingou in the Atacora Department, Djougou in the Donga Department and Parakou in the Borgou Department.

Southern cities have an equatorial climate characterized by high humidity and alternating dry and rainy seasons. Conversely, northern cities have a tropical climate with a distinct dry season from November to April, followed by a rainy season from June to September.

Data collection method: A survey was conducted between November, 2022 and February, 2023, interviewing 80 traditional healers (18) and medicinal plant vendors (62). The respondents were given a questionnaire and provided free consent to participate. The herbalists were chosen based on the richness of their display. Thus, a face-to-face interview in local languages, including Fon, Yoruba, Mina and Goun, was conducted to ensure reliable answers to all questions. Data were collected on the resource person's profile and ethnopharmacological information such as local names, preparation methods, frequency of use, side effects and the plant parts used.

A picture of every species was taken and samples were taken for comparison using exsiccate. Various reference documents were accessible at the National Herbarium of Benin, including the Analytical Flora of Benin[11] and the ethnobotanical expeditions of the Cultural and Technical Cooperation Agency[15]. This agency helped to identify each species based on their scientific name and family.

Data processing: Collected data were analyzed using R (R Core Team, V 4.2.3) software and a chi-square test was performed to check conformity to a uniform distribution. Furthermore, the frequency of citations for various species was determined using the formula from Orsot *et al.*[16]:

$$FC = \frac{n}{N} \times 100$$

The number of individuals referenced in the species is denoted by "n." This is about the total number of individuals "N" surveyed.

RESULTS

Sociodemographic characteristics of respondents: Table 1 displays the breakdown of survey participants based on their gender, age, religion, level of education and ethnicity. Of all respondents, 68.75% are female and 31.25% are male. Most participants (61.25%) fall within the age range of 30 to 60. The ethnic groups with the highest representation among respondents are the Fon and related at 30%, followed by the Goun and related groups at 26.25% and the Yoruba and related groups at 18.75%. The Adja, Bariba, Dendi and Mina are represented in the minority group of respondents. The analysis of the respondents' education level indicated that the majority (45%) have the secondary level. Next comes the primary (33.75%) and university (6.25%) levels. Some respondents (15%) have not benefited from formal education. Among respondents, the majority practice Christianity (66.25%) and only 27.5% practice Islam and 6.25% traditional religions.

Sociodemographic characteristics of users: Analysis of the distribution of users of medicinal plants for the treatment of urinary tract infections according to gender reveals that the majority were female (Table 2). Young people between 30-40 years old use medicinal plants more frequently. Regarding the academic level of users of medicinal plants, most users had the primary level of study with a rate of 34%. People with zero and secondary education use medicinal plants at 31 and 25%, respectively, while university students have the lowest rate (10%).

Table 1: Socio-demographic characteristics of herbalists interviewed during the survey

Variables	Terms	Workforce	Proportion (%)
Age range	<30 years	31	38.75
	30-60 years old	49	61.25
Sex	Feminine	55	68.75
	Male	25	31.25
Religion	Christianity	53	66.25
	Islam	22	27.50
	Traditional	5	6.25
Marital status	Single	11	13.75
	Divorcee	4	5.00
	Bride	64	80.00
	Widow	1	1.25
Educational level	No	12	15.00
	Primary	27	33.75
	Secondary	36	45.00
	University	5	6.25
Ethnic group	Adja and related	7	8.75
	Fon and relatives	24	30.00
	Goun and relatives	21	26.25
	Bariba and related	2	2.50
	Dendi and relatives	5	6.25
	Yoruba and relatives	15	18.75
	Mina and relatives	5	6.25
	Lokpa and relatives	1	1.25

Table 2: Socio-demographic characteristics of plant users interviewed during the survey

Variables	Terms	Proportion (%)
Age range	<20 years	29.46
	20-40 years	35.71
	40-60 years	32.59
	>60 years	2.23
Sex	Feminine	70.00
	Male	30.00
Marital status	Single	13.75
	Divorcee	5.00
	Bride	80.00
	Widow	1.25
Educational level	No	31.00
	Primary	34.00
	Secondary	25.00
	University	10.00

Table 3: List of medicinal species used in the treatment of urinary tract infections in Benin

Scientific name	Botanical family	Local name	Citation frequency (%)
Khaya senegalensis (Desr.) A.Juss.	Meliaceae	Pipignèkou, Fakpénauga, Biri agao	26.92
Ocimum americanum L.	Lamiaceae	Késsou-késsou	25.64
Cassytha filiformis L.	Lauraceae	Agbégbékan, Danxomey gbe	24.36
Ocimum gratissimum L.	Lamiaceae	Gbossou azowin (goun), Tchayo	21.79
Caesalpinia bonduc (L.) Roxb.	Caesalpiniaceae	Adjikouin	20.51
Heliotropium indicum L.	Boraginaceae	Koklossoudinkpadja	19.23
Xylopia aethiopica (Dunal) A.Rich.	Annonaceae	Kpedjrekoun	17.95
Boerhavia erecta L.	Nyctaginaceae	Katchounayi (goun)	15.38
Euphorbia hirta L.	Euphorbiaceae	Kpalanga waa, Gangansekan	15.38
Phyllanthus amarus Schumach. & Thonn.	Phylalanthaceae	Hlinwe	15.38
Vernonia amygdalina Delile	Asteraceae	Souwaka	15.38
Acacia nilotica (L.) Willd. ex *Delile* ssp. *Nilotica*	Fabaceae	Vanli	14.10
Calotropis procera (Aiton) W.T.Aiton	Asclepiadaceae	Amonman	14.10
Calyptrochilum christyanum (Rchb.f.) Summerh.	Orchidaceae	Yinwa	14.10
Combretum micranthum G.Don	Combretaceae	Kpakitomon	14.10
Combretum racemosum P.Beauv.	Combretaceae	Wéman	14.10
Crateva adansonii DC. ssp. Adansonii	Capparaceae	Hontonzinzin	14.10
Curculigo pilosa (Schumach. & Thonn.) Engl.	Hypoxidaceae	Ayoté	14.10
Entada gigas (L.) Fawcett & Rendle	Fabaceae	Gbagbala	14.10
Hoslundia opposita Vahl	Lamiaceae	Agahouman	14.10
Hyptis suaveolens (L.) Poit.	Lamiaceae	Zassoukpoman	14.10
Lagenaria siceraria (Molina) Standl.	Cucurbitaceae	Ka	14.10
Lantana camara L.	Verbenaceae	Hlachiayo	14.10
Momordica charantia L.	Cucurbitaceae	Gninsinkin	14.10
Newbouldia laevis (P.Beauv.) Seemann ex Bureau	Bignoniaceae	Aflaman	14.10
Piper nigrum L.	Plumbaginaceae	Ninninkouman	14.10
Syzygium aromaticum (L.) Merr & L.M. Perry	Myrtaceae	Massororo	14.10
Tetrapleura tetraptera (Schumach. & Thonn.) Taub.	Fabaceae	Lendja	14.10
Vernonia cinerea (L.) Less.	Asteraceae	Hounsikonou	14.10

Diversity of plant species used in the treatment of urinary tract infections: The floristic analysis of medicinal plants used by the Beninese population to treat urinary tract infections identified 29 medicinal species belonging to 22 botanical families harvested directly or purchased by herbalists (Table 3). The most used species are *Khaya senegalensis* (Desr.) A. Juss, *Ocimum americanum* L., *Cassytha filiformis* L., *Ocimum gratissimum* L., *Caesalpinia bonduc* (L.) Roxb and *Heliotropium indicum* L.

Various plant organs ranging from leaves, stems, fruits, roots, barks and seeds were used in the current study area. Leaves represent the most used organs (46.96%), followed by stems (22.25%), barks (16.56%), roots (9.44%), fruits (3.10%) and seeds (1.68%).

Mode of preparation and forms of administration of the recipes: Different therapeutic practices are used for the treatment of urinary tract infections. A decoction is the most practised mode, with a percentage of 88.75%, followed by infusion (10%), trituration (6.25%) and maceration (1.25%).

The oral route (100%), the bath (2.47%) and the rectal route (1.23%) are the modes of administration used for the treatment of urinary tract infections in this region.

DISCUSSION

Medicinal plants are the subject of sustained scientific research to research and enhance the natural bioactive substances in plant extracts. In this study, an ethnobotanical study on medicinal plants used in Benin to treat urinary tract infections was conducted. At the end of the survey, results showed that the sale of plants is a predominantly female activity (68.75%) of people of an average age between 30 and 60 years old. These results confirm the results of other ethnobotanical work carried out in Benin and several other countries[17-19], which showed that the category of middle-aged women manifests more interest in traditional medicine. On the other hand, men were reported to be the most represented since women could only travel short distances to collect samples[20]. The predominance of women among the respondents would be justified by the critical role women play in therapy and nutrition within households as mothers[21]. This state could also be explained by the fact that in Benin, the sale of items in the market is generally reserved for women[12]. It has also been demonstrated by N'Diaye *et al.*[21] that picking is generally a female activity and constitutes an essential income source for women.

The current study found that the herbalists tended to be older individuals. This is likely because knowledge about medicinal plants is typically passed down through generations and gained through extensive experience[5]. Many young people nowadays are more focused on other hobbies and interests, which can lead to a lack of interest in traditional medicine. This can result in a decline in the transmission of knowledge about medicinal plants between generations. Surprisingly, most survey respondents had at least completed primary school or higher education. This contradicts the common belief that selling medicinal plants is a profession for poor and illiterate individuals.

Regarding family dynamics, the current study findings closely align with those of El Hilah *et al.*[22] in Morocco. Most individuals, 80%, are married, with only 19% still single[22]. The use of medicinal plants correlates with age and gender. Women between the ages of 20 and 40 were found to be the primary users of plants for urinary tract infections. This may be due to the higher prevalence of urinary tract infections among women. Interestingly, current research shows that the level of education does not impact the use of traditional medicine, as individuals of all education levels utilize plants. This finding contradicts the work of Chaachouay *et al.*[18], who reported that over 60% of the population studied who used herbal medicine were illiterate. Hele *et al.*[23] research supports the current study results, indicating that academics are the most prevalent users of medicinal plants.

Through this ethnobotanical survey, 29 plant species were discovered that belong to 22 different families. This confirmed the abundance of medicinal plants found in Benin's flora. After analyzing citation frequencies, it was recorded those five plants had notably higher or lower frequencies. These plants were *Khaya senegalensis* (26.92%), *Ocimum americanum* (25.64%), *Cassytha filiformis* (24.36%), *Caesalpinia bonduc* (21.7%) and *Heliotropium indicum* (19.23%). The current study investigation primarily focused on the plant's leaves, which were found to be the most used part of the plant. Current findings were consistent with those of Barkaoui *et al.*[24] and Bene *et al.*[25], who also found that leaves were the most frequently used plant in traditional medicinal recipes. This trend may be because leaves are the most accessible part of the plant and contain secondary metabolites responsible for their biological properties.

To use medicinal plants thoughtfully and effectively, choosing a preparation method that allows for the extraction and assimilation of active ingredients while maintaining the integrity of their properties is crucial. This observation was previously highlighted by several authors[26-28]. As per the literature, infusion and decoction are the most used methods to prepare medicinal plants for treating urinary tract infections. The present investigation also revealed the same observation. This technique helps extract water-soluble active ingredients, even those weak in their pure state[29]. This study's extracts for treating urinary tract infections are only given orally. This method helps molecules be absorbed more efficiently, as explained[30].

This study sheds light on the customary knowledge of plant species utilized to treat urinary tract infections in various regions of Benin. The findings can be utilized to create a medication with diverse biological properties. Nonetheless, this study is limited in scope as it has not yet included all the communes in the country and neighboring regions.

CONCLUSION

It was observed that women between 30 and 50 years old, most of them married with varying levels of education, are the most frequent users of plants to treat UTIs. The survey has identified 29 species of plants belonging to 22 families, mostly used as decoction by oral routes in Benin. Furthermore, this study has demonstrated that leaves are the most used part of these plants. Managing urinary tract infections can be effectively done by utilizing medicinal plants. Therefore, it is essential to conduct pharmacological studies on these plants to verify their recommended therapeutic properties by traditional healers.

SIGNIFICANCE STATEMENT

This research identifies Benin's primary medicinal plant species for treating urinary tract infections. Thus, 29 medicinal plants from 22 botanical families were mentioned during the survey. Furthermore, it documents the traditional uses of these plants. Therefore, the study can aid scientists in exploring the biological potential of these listed medicinal plants in greater depth.

REFERENCES

1. Corlett, R.T., 2016. Plant diversity in a changing world: Status, trends, and conservation needs. Plant Diversity, 38: 10-16.
2. Ekor, M., 2014. The growing use of herbal medicines: Issues relating to adverse reactions and challenges in monitoring safety. Front. Pharmacol., Vol. 4. 10.3389/fphar.2013.00177.
3. Liu, U., M. Gianella, P.D. Aranda, M. Diazgranados and C.M.F. Ortíz *et al*., 2023. Conserving useful plants for a sustainable future: Species coverage, spatial distribution, and conservation status within the Millennium Seed Bank collection. Biodivers. Conserv., 32: 2791-2839.
4. Anarado, C.E., C.J.O. Anarado, N.L. Umedum, F.M. Chukwubueze and I.L. Anarado, 2020. Phytochemical and antimicrobial analysis of leaves of *Bridelia micrantha*, *Cassytha filiformis*, *Euphorbia hirta* and *Securinega virosa*. J. Pharmacogn. Phytochem., 9: 581-587.
5. Nesrine, B., R. Rajaa and N. Sakina, 2022. Ethnobotanical study and inventory of medicinal plants used in the treatment of dermatological diseases in the town of Ain Temouchent. J. Appl. Biosci., 170: 17704-17719.
6. Mongeke, M.M., K.T.N. Ngbolua, R.D. Bakola, C.L. Inkoto, P.N. Elikandani and C.Y. Mouli, 2018. Investigation into plants used in traditional medicine by the Bambenga: Pygmies from the Dongo sector in the Democratic Republic of Congo. Rev. Mar. Sci. Agron. Vét., 6: 469-475.
7. Vaou, N., E. Stavropoulou, C. Voidarou, C. Tsigalou and E. Bezirtzoglou, 2021. Towards advances in medicinal plant antimicrobial activity: A review study on challenges and future perspectives. Microorganisms, Vol. 9. 10.3390/microorganisms9102041.
8. Zeng, Z., J. Zhan, K. Zhang, H. Chen and S. Cheng, 2022. Global, regional, and national burden of urinary tract infections from 1990 to 2019: An analysis of the global burden of disease study 2019. World J. Urol., 40: 755-763.

9. Assouma, F.F., H. Sina, A.D. Dossou, A. Socohou and M.C. Hounsou *et al*., 2023. Antibiotic resistance profiling of pathogenic *Staphylococcus* species from urinary tract infection patients in Benin. BioMed Res. Int., Vol. 2023. 10.1155/2023/6364128.
10. Assouma, F.F., H. Sina, T. Adjobimey, A.D.P. Noumavo and A. Socohou *et al*., 2023. Susceptibility and virulence of enterobacteriaceae isolated from urinary tract infections in Benin. Microorganisms, Vol. 11. 10.3390/microorganisms11010213.
11. Ouachinou, J.M.A.S., G.H. Dassou, R. Idohou, A.C. Adomou and H. Yédomonhan, 2019. National inventory and usage of plant-based medicine to treat gastrointestinal disorders with cattle in Benin (West Africa). South Afr. J. Bot., 122: 432-446.
12. Guinnin, F.D.F., T.I. Sacramento, A. Sezan and J.M. Ategbo, 2015. Ethnobotanic study of medicinal plants used in the traditional treatment of viral hepatitis B and C in some departments of Benin. Int. J. Bio. Chem. Sci., 9: 1354-1366.
13. Houmenou, V., A. Adjatin, M.G. Tossou, H. Yedomonhan, A. Dansi, J. Gbenou and A. Akoegninou, 2017. Ethnobotanical study of plants used in the treatment of sterility women in the departments of Ouémé and Plateau in South Benin [In French]. Int. J. Biol. Chem. Sci., 11: 1851-1871.
14. Chabi-Sika, K., H. Sina, B. Boya, H.A. Salami and G.A. Dossou *et al*., 2023. Ethnobotanical survey and some biological activities of *Ageratum conyzoides* collected in Southern-Benin. Int. J. Biochem. Res. Rev., 32: 9-25.
15. Adjanohoun, E., 1989. The ethnobotanical expeditions of the Agency for Cultural and Technical Cooperation (ACCT): Objective-results-prospective [In French]. Bull. Soc. Botanique France. Actualités Botaniques, 136: 9-12.
16. Orsot, B.A.M.B., S. Soro, N.G. Konkon, D. Kone and G.N. Zirihi, 2016. Ethnobotanical study and *in vitro* evaluation of the antifungal activity of extracts from the bark of *Zanthoxylum gilletii* (from Wild Waterman) on two phytopathogenic strains of *Sclerotium rolfsii* [In French]. J. Appl. Biosci., 98: 9309-9322.
17. Zaher, A., M. Boufellous, H. Jaber, H. El Hartiti, M. Barrahi, M. Ouhssine and B. Bourkhiss, 2018. Ethnobotanical study of medicinal plants used in the province of Sidi Slimane (Morocco). J. Biosci. Med., 6: 25-35.
18. Chaachouay, N., O. Benkhnigue, M. Fadli, H. El Ibaoui and L. Zidane, 2019. Ethnobotanical and ethnopharmacological studies of medicinal and aromatic plants used in the treatment of metabolic diseases in the Moroccan Rif. Heliyon, Vol. 5. 10.1016/j.heliyon.2019.e02191.
19. Anand, U., N. Jacobo-Herrera, A. Altemimi and N. Lakhssassi, 2019. A comprehensive review on medicinal plants as antimicrobial therapeutics: Potential avenues of biocompatible drug discovery. Metabolites, Vol. 9. 10.3390/metabo9110258.
20. Nnanga, J.F., G. Todou, S. Konsala and R.J. Priso, 2022. Ethnobotanical study of traditional pharmacopoeia in the District of Dargala, Far North Cameroon. J. Appl. Biosci., 177: 18538-18553.
21. N'Diaye, M., F.B. Kéita and P. Martin, 2003. Main harvested fruits consumed and marketed in Guinea [In French]. Fruits, 58: 99-116.
22. El Hilah, F., F.B. Akka, R. Bengueddour, A. Rochdi and L. Zidane, 2016. Ethnobotanical study of medicinal plants used in the treatment of dermatological conditions in the Moroccan Central Plateau [In French]. J. Appl. Biosci., 98: 9252-9260.
23. Hele, B., K. Metowogo, A.P. Mouzou, R. Tossou and J. Ahounou *et al*., 2014. Ethnobotanical investigation into plants used in the traditional treatment of muscle contusions in Togo [In French]. Rev. Ivoir. Sci. Technol., 24: 112-130.
24. Barkaoui, M., A. Katiri, H. Boubaker and F. Msanda, 2017. Ethnobotanical survey of medicinal plants used in the traditional treatment of diabetes in Chtouka Ait Baha and Tiznit (Western Anti-Atlas), Morocco. J. Ethnopharmacol., 198: 338-350.
25. Bene, C., R.M. Al-Hassan, O. Amarasinghe, P. Fong, J. Ocran, E. Onumah and D.J. Mills, 2016. Is resilience socially constructed? Empirical evidence from Fiji, Ghana, Sri Lanka, and Vietnam. Global Environ. Change, 38: 153-170.

26. Idm'hand, E., F. Msanda and K. Cherifi, 2019. Ethnobotanical survey of medicinal plants used in treatment of kidney stones in Tarfaya Province (Morocco) [In French]. Int. J. Innovation Appl. Stud., 26: 711-719.
27. Stéphane, F.F.Y., B.K.J. Jules, G.E.S. Batiha, I. Ali and L.N. Bruno, 2021. Extraction of Bioactive Compounds from Medicinal Plants and Herbs. In: Natural Medicinal Plants, H. El-Shemy (Ed.), IntechOpen, London, UK, ISBN: 978-1-83969-276-5, pp: 1-29.
28. Abubakar, A.R. and M. Haque, 2020. Preparation of medicinal plants: Basic extraction and fractionation procedures for experimental purposes. J. Pharm. BioAllied Sci., 12: 1-10.
29. Ladoh-Yemeda, C.F., T. Vandi, S.D. Dibong, E.M. Mpondo and J.D. Wansi *et al*., 2016. Ethnobotanical study of medicinal plants sold in the markets of the City of Douala, Cameroon [In French]. J. Appl. Biosci., 99: 9450-9466.
30. Bi, F.H.T., G.M. Irie, K. N'Gaman and C.H.B. Mahou, 2008. Study of some therapeutic plants used to treat arterial hypertension and diabetes: Two emergent diseases in Côte d'Ivoire [In French]. Sci. Nature, 5: 39-48.