



(RESEARCH ARTICLE)



ETHNOBOTANICAL AND PHYTOCHEMICAL STUDY OF GALACTOGENIC PLANTS USED IN THE ZOU AND COLLINES DEPARTMENTS, BENIN

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ABSTRACT

Exclusive breastfeeding remains uncommon in West Africa, partly because many mothers perceive themselves as not producing enough milk. Faced with this situation, women in the Zou and Collines departments, Benin, traditionally turn to plants reputed to be galactogenic. This study aimed to explore the diversity of these plant resources, identify the most consensual species among the surveyed population, and characterize its phytochemical profile. An ethnobotanical survey was conducted between April and June 2024 among 450 respondents across fifteen villages, selected through purposive sampling targeting traditional healers, herbalists and traditional birth attendants. The relative frequency of citation, the informant consensus factor, and principal component analyses were used to identify the most representative species and to characterize the structuring of its uses across sociolinguistic groups, prior to its phytochemical characterization through qualitative screening. Forty-five galactogenic species, belonging to 42 genera and 22 botanical families, were recorded, with Fabaceae largely dominating this diversity. *Mondia whitei* (Hook.f.) Skeels stood out as the most consensual species, with the highest relative frequency of citation, an informant consensus factor of 0.6979, and a medicinal and food use strongly associated with the Fon sociolinguistic group. Its phytochemical screening revealed the presence of alkaloids, tannins, saponins and steroids, with a profile that varied according to the

extraction solvent used. These findings confirm the relevance of the traditional knowledge surrounding *Mondia whitei* and provide a scientific basis for its future valorization as a galactogenic resource.

Keywords: Galactogenic plants; Ethnobotany; *Mondia whitei*; Phytochemical screening; Benin

1 INTRODUCTION

For several centuries, plants have been regarded as therapeutic resources and used to treat, relieve or prevent various diseases [1,2]. They thus constitute a promising source of medicines [3]. Many cultures around the world have developed their own medicinal traditions, often passed down from generation to generation [4]. Worldwide, the World Health Organization recognizes the growing role of traditional medicine, including phytotherapy, as well as the need for its evidence-based integration within health systems, particularly in developing countries where medicinal plants remain a major therapeutic resource [5]. In Africa, these plants constitute valuable resources for the majority of rural and urban populations and represent the primary means by which individuals seek treatment [6]. They also offer great therapeutic value for curing various diseases and regulating numerous disorders, owing to the properties they contain [7].

Among these medicinal plants, galactogenic plants occupy an important place, particularly in rural areas where breast milk remains the only means used to feed infants [8]. Exclusive breastfeeding, without any exogenous food, is nevertheless the optimal feeding mode for infants up to six months of age. This practice, however, remains uncommon in West Africa, while it is more frequent in North Africa and, to a lesser extent, in East Africa [9]. It is therefore important to examine the underlying causes of these early interruptions of breastfeeding, which are multiple. One of the major causes lies in mothers' perception that they do not produce enough milk to meet their child's needs [10]. This perception leads many women to turn to plants reputed to be galactogenic in order to stimulate their milk production.

In Africa, several research studies have focused on galactogenic plants and their importance for rural populations. Rahila et al. [11] thus studied, in Niger, medicinal plants used in mother-child care as fortifiers and galactagogues in the Boboye department, in the southwest of the country. In Benin, Imorou et al. [12] carried out a bibliographic analysis of endogenous knowledge related to the diversity and use of galactogenic plants in traditional medicine. These galactogenic properties could be attributable to the numerous chemical groups contained in these plants.

It is in this context that the present study was initiated, with the aim of exploring the biodiversity of plant resources used by women to stimulate strong milk secretion, while characterizing their chemical composition in order to improve the nutritional quality provided to infants in Benin, in the Zou and Collines departments. More specifically, the study aims to determine the diversity of medicinal plants with galactogenic effect as well as their types of use, and to characterize the phytochemical profile of the most widely used species.

2 MATERIAL AND METHODS

2.1 Study area

The ethnobotanical study was conducted in fifteen communes distributed across the Zou and Collines departments (Figure 1). The population of these two departments is predominantly composed of the Fon, Mahi, Holli, Nagot, Idaasha and Ifè sociolinguistic groups. The Zou and Collines departments cover areas of 5,243 km² and 13,931 km², respectively [13]. In each department and commune, a village was selected according to criteria of accessibility and representativeness of indigenous medicinal practices. Thus, for the Zou department, the following collection sites were chosen: Abomey (Agbokpa-Ouémé), Agbangnizoun (Tanta), Bohicon (Gnidjazoun), Covè (Lanta-Cogbé), Djidja (Yè), Ouinhi (Ahicon), Zangnanado (Gbannango), Za-Kpota (Kpozoun) and Zogbodomey (Massi), and for the Collines department: Dassa-Zoumé (Soclogbo), Bantè (Gouka), Savalou (Djalloukou), Glazoué (Ouèdèmè), Savè (Bessè) and Ouèssè (Wogoudo-Ikèmon) (Figure 1).

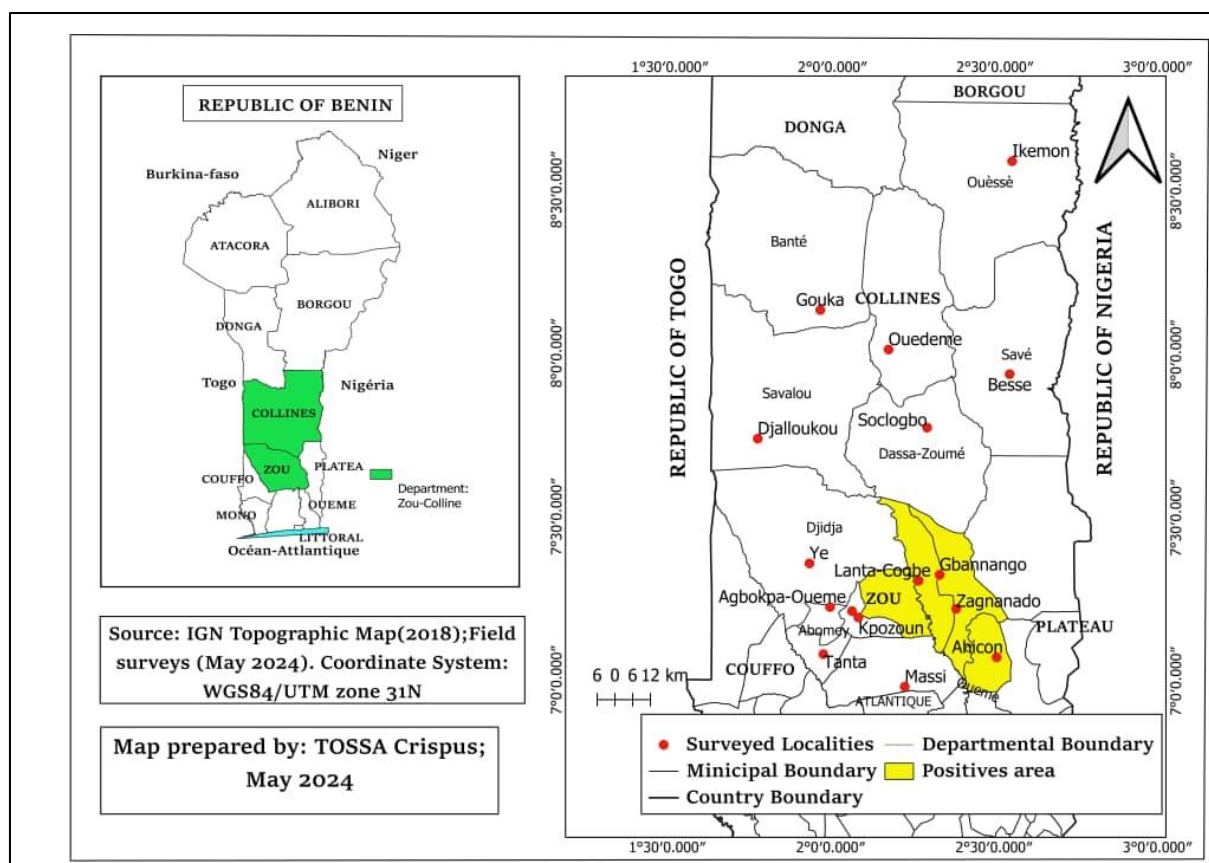


Figure 1: Location of the study area

2.2 Data collection

Data were collected between April and June 2024 through ethnobotanical surveys conducted by means of individual interviews and group discussions (focus groups), based on a semi-structured questionnaire and with the support of an interpreter for respondents who did not speak French. A total of 450 respondents were surveyed, with 30 people interviewed per village, following a purposive sampling approach with stratified distribution by village, prioritizing traditional healers, herbalists, traditional birth attendants and other resource persons recognized for their knowledge of medicinal plants. The information collected from each respondent covered their sociodemographic profile, namely village of residence, identity, sex, ethnicity, age and educational level, as well as their knowledge of galactogenic plants, namely whether or not they knew such plants, the vernacular name of the species cited, the plant parts used, the type of use (medicinal, food or spiritual), the morphological type of the plant and its form of use. The galactogenic species cited by respondents were collected in these same villages for identification purposes. Herbarium specimens were prepared and photographs of the plants were taken in the field for documentation. Botanical identification was carried out by comparison with reference specimens held at the National Herbarium of Benin, as well as with the aid of the Flore Analytique du Bénin [14]. The nomenclature of the identified species, initially established according to the Flore Analytique du Bénin [14], was subsequently updated in accordance with the APG IV phylogenetic classification system [15], which is more recent and now widely adopted by the international botanical community.

2.3 Phytochemical characterization of the most widely used species

Phytochemical characterization was carried out between July and August 2024 at the Laboratory of Genetics, Biotechnologies and Applied Botany (GéBBA), National High School of Applied Biosciences and Biotechnologies (ENSBBA), National University of Sciences, Technologies, Engineering and Mathematics (UNSTIM), Dassa-Zoumè, Benin, for the species showing the highest degree of informant consensus and used simultaneously across the three recorded use categories, namely medicinal, food and spiritual use.

Phytochemical screening was carried out on the powder and on extracts of the leaves of the selected species, obtained using three solvents of increasing polarity, namely hexane, ethanol and methanol. It is based on the differential coloration and precipitation reactions characteristic of the main groups of secondary metabolites, following the classical method described by Houghton and Raman [16].

2.4 Data analysis

Descriptive statistics of the quantitative data as well as analysis of variance were performed using R software, version 4.4.1. Multivariate analyses, in particular Principal Component Analyses (PCA), were carried out using XLSTAT software, version 2024.2.2.1422. Three separate PCAs were conducted to characterize the uses of the most consensual species, crossing respectively ethnic groups and use types, plant parts used and use types, and preparation modes and plant parts used. In addition, two quantitative ethnobotanical indices were calculated to assess the cultural importance of the recorded galactogenic species and the degree of consensus among the surveyed informants: the Relative Frequency of Citation (RFC) and the Informant Consensus Factor (ICF) (Table 1).

Table 1: Ethnobotanical indices used in the study

Index	Formula	Parameter description	Objective	Reference
Relative Frequency of Citation (RFC)	$RFC = FC / N$	FC represents the number of informants who cited the species as galactogenic, and N the total number of informants surveyed. RFC ranges from 0 (no informant cites the species) to 1 (all informants cite it). The closer the RFC is to 1, the more culturally important the species is within the surveyed community.	Assess the relative importance and degree of consensus around each recorded galactogenic species, and identify the most consensual species	Tardío and Pardo-de-Santayana [17]
Informant Consensus Factor (ICF)	$ICF = (Nur - Nt) / (Nur - 1)$	Nur: total number of citations recorded for galactogenic use, across all species; Nt: number of different galactogenic species recorded in the study	Confirm the homogeneity of the ethnopharmacological information related to the galactogenic effect	Heinrich <i>et al.</i> [18]

3 RESULTS AND DISCUSSION

3.1 Ethnobotany

3.1.1 Sociodemographic profile of respondents

The distribution of respondents by sociocultural category according to the variables of gender, age group, ethnicity and sociocultural group is given in Table 2.

The results revealed a clear female predominance among respondents, with 55.56% women and a female/male sex ratio of 1.25. This strong representation of women could be explained by the importance they traditionally place on the care, growth and development of newborns, as well as by the central role that medicinal plants play in their food practices and primary health care. This result is consistent with that of Dahdouche and Boudahi [19], whose ethnobotanical survey on the traditional use of common sage (*Salvia officinalis* L.) in the Mila region, Algeria, reported a proportion of women reaching 81%, compared with 19% of men. It also aligns with the observations of Bentabet *et al.* [20] and Mawunu *et al.* [21], where women accounted for 56% and 59.7% of informants, respectively; this predominance is attributed to their in-depth knowledge of food and medicinal plants as well as the diversity of their therapeutic uses.

The Fon ethnic group is by far the majority in the sample, accounting for 81.89% of respondents, which reflects the demographic composition of the Zou department, where this group represents 92.3% of the population.

The most represented age group is between 39 and 49 years, accounting for 41.15% of respondents, and the majority of this population is illiterate, at 71.19%. This high level of illiteracy contrasts sharply with the educational profile reported by Mawunu *et al.* [21] in Angola, where only 7.48% of respondents had received no formal education, with the majority having reached primary level, at 44.77%. This marked difference could be explained by distinct socio-educational contexts, but it mainly reinforces the idea that, in the study area, the transmission of ethnobotanical knowledge relies primarily on oral tradition. Indeed, the holders of this knowledge, often traditional healers, herbalists and traditional birth attendants, generally acquired it through family and community learning rather than through formal schooling. According to Mawunu *et al.* [21], populations with little or no schooling often remain the main custodians of endogenous knowledge related to medicinal plants.

Table 2: Sociodemographic characteristics of respondents

Variables	Categories	Frequency (%)
Gender	Male	44.44
	Female	55.56
Age group	[29-39]	18.93
	[39-49]	41.15
	[49-59]	22.63
	[59-69]	9.47
	[69-79]	7.41
	[79-89]	0.41
Ethnic group	Fon	81.89
	Nago	9.05
	Mahi	4.12
	Holli	2.06
	Yoruba	0.82
	Sahouè	1.65
Educational level	Adja	0.41
	Illiterate	71.19
	Primary	25.10
	Secondary	3.70
	University	0.00

3.1.2 Diversity, uses and characteristics of galactogenic plants recorded in the Zou and Collines departments

The diversity and multiple uses of galactogenic plants used in the Zou and Collines departments, as well as their categorization according to medicinal, food and spiritual use types, are presented in Table 3. Forty-five (45) plant species with galactogenic effect, belonging to 42 genera and 22 botanical families, were identified during this study (Figure 2). Almost all of the recorded species are primarily used for medicinal purposes. *Calotropis procera* (Aiton) Dryand. and *Mondia whitei* (Hook.f.) Skeels, both belonging to the Apocynaceae family, stand out from the other species by their versatility, being used simultaneously for all three use types. Other species, such as *Cocos nucifera*, *Adansonia digitata*, *Launaea taraxacifolia*, *Manihot esculenta*, *Musa paradisiaca*, *Ocimum gratissimum*, *Pennisetum glaucum*, *Saccharum officinarum*, *Sarcocephalus latifolius* and *Sorghum bicolor*, show both medicinal and food uses. Few of the recorded species are used for spiritual purposes, namely *Cleome viscosa*, *Ocimum canum* and *Xylopia aethiopica*.

The predominance of medicinal use among the recorded species is a widely shared finding in ethnobotanical studies conducted in West Africa, where medicinal plants remain the primary therapeutic recourse for rural populations, as noted by Adomou et al. [22] in their inventory of the Abomey-Calavi market in Benin. The versatility of use observed in *Calotropis procera* and *Mondia whitei*, the only species mobilized simultaneously for medicinal, food and spiritual purposes, is strongly supported by the scientific literature available on the latter. Oketch-Rabah [23], in a reference review on the ethnobotany, phytochemistry and pharmacology of *Mondia whitei*, confirms that this species is used across the African continent not only as a remedy for numerous ailments, but also as a galactagogue, an appetite stimulant and a food supplement, its roots being consumed raw, infused as tea or turned into a fermented beverage, while its leaves are ground into powder for nutritional use. This convergence between the field data collected in the Zou and Collines departments and observations reported elsewhere in Africa reinforces the validity of the multi-use status attributed to *Mondia whitei*, and constitutes an additional argument in favor of its selection for the phytochemical characterization carried out in the present study.

It should be noted that *Syzygium aromaticum* (L.) Merr. & L.M.Perry is not part of the spontaneous flora of Benin. The dried flower buds of this species, commonly known as cloves, are sold in local markets after being imported from

neighboring countries such as Nigeria. This species could therefore not be freshly collected in the field nor used to prepare a complete herbarium specimen, its identification having relied on examination of the dried commercial product. The presence of this imported species within the recorded ethnobotanical inventory illustrates a phenomenon commonly documented in market-based ethnobotanical studies in West Africa, where exotic species not cultivated locally are nonetheless integrated into traditional medicinal and food practices through regional trade.

Fabaceae constitute the most represented botanical family among the recorded galactogenic species, with eight species, or 17.78% of the total diversity, followed by Poaceae with four species, or 8.89%. Six families, namely Malvaceae, Apocynaceae, Euphorbiaceae, Lamiaceae and Asteraceae, each comprise three species, or 6.67% of the recorded total (Figure 2). This diversity is comparable to that reported by Lawal et al. [24] in Katsina State, Nigeria, where 40 galactogenic species belonging to 38 genera and 24 botanical families were recorded, confirming the extent of plant diversity mobilized for this use across West Africa. Two species are indeed common to both inventories, *Pennisetum glaucum* and *Vernonia amygdalina*, with Lawal et al. [24] notably showing that *Pennisetum glaucum* had the highest carbohydrate and energy content in their sample, supporting its dual nutritional and galactogenic value already noted in the present study. This predominance of Fabaceae is consistent with the observations of Adomou et al. [22], who reported that Leguminosae constitute the most represented family in terms of species richness, accounting for 15% of the medicinal species recorded at the Abomey-Calavi market in southern Benin. It also aligns with the more recent findings of Afassinou et al. [25], who identified Fabaceae as the family with the highest number of recorded species among plants used in the treatment of hypertension in the Greater Lomé region, Togo. This wide representation of Fabaceae in West African ethnobotanical inventories could be explained by the family's intrinsic taxonomic richness, one of the most diversified in the plant kingdom, as well as by the long-standing recognition of its therapeutic and nutritional properties within local traditional knowledge (Table 3).

This result also converges with that of Rahila et al. [11], who likewise identified Fabaceae as the most represented family in their work on medicinal plants used in mother-child care as fortifiers and galactagogues in southwestern Niger. It diverges, however, from the findings of Imorou et al. [12], who indicate that the Apocynaceae family, followed by Poaceae, comprises the largest number of galactogenic species recorded in Benin, without overlooking the good representation of Leguminosae in their inventory. This divergence between results obtained within Benin itself could be explained by local variations in the availability of plant resources, cultural practices and ethnobotanical knowledge specific to each study area, according to Koudokpon et al. [26]. Indeed, the present study focuses specifically on the Zou and Collines departments, whereas that of Imorou et al. [12] was based on a bibliographic analysis covering the entire national territory.

Table 3: Diversity, uses and characteristics of galactogenic plants recorded in the Zou and Collines departments

No.	Scientific name	Family (APG IV)	Vernacular name	Plant parts	Morphological type	Forms of use	Uses	RFC
1	<i>Abrus precatorius L.</i>	Fabaceae	Viviman	Leaves	Shrub	Fresh	M	0.1152
2	<i>Adansonia digitata L.</i>	Malvaceae	Kpassa	Leaves	Tree	Fresh	M, A	0.0164
3	<i>Afzelia africana Sm. ex Pers.</i>	Fabaceae	Kpakpagidè	Leaves	Tree	Fresh	M	0.0328
4	<i>Annona senegalensis Pers.</i>	Annonaceae	Wenglema	Bark	Shrub	Fresh	M	0.0328
5	<i>Argemone mexicana L.</i>	Papaveraceae	Houèchègnon	Leaves	Spiny herb	Fresh	M	0.2304
6	<i>Calotropis procera (Aiton) Dryand.</i>	Apocynaceae	Amon-man	Leaves	Shrub	Fresh	M, A, S	0.48
7	<i>Carica papaya L.</i>	Caricaceae	Kpinman	Leaves	Tree	Fresh	M	0.24
8	<i>Cascabela thevetia (L.) Lippold</i>	Apocynaceae	Lanyin	Leaves	Shrub	Fresh	M	0.0164
9	<i>Ceiba pentandra (L.) Gaertn.</i>	Malvaceae	Guédéhunsou	Bark	Tree	Fresh	M	0.0328
10	<i>Cleome viscosa L.</i>	Cleomaceae	Akaya assou	Leaves	Erect herb	Fresh	M, S	0.0328
11	<i>Cocos nucifera L.</i>	Arecaceae	Agonkè	Fruits	Shrub	Fresh	M, A	0.0492
12	<i>Combretum glutinosum Perr. ex DC.</i>	Combretaceae	Tégbéssou	Leaves	Shrub	Fresh	M	0.0164
13	<i>Combretum micranthum G.Don</i>	Combretaceae	Ayikplo	Leaves	Shrub	Fresh	M	0.0164
14	<i>Daniellia oliveri (Rolfe) Hutch. & Dalziel</i>	Fabaceae	Zatin	Bark	Tree	Dried	M	0.066
15	<i>Dioscorea alata L.</i>	Dioscoreaceae	Tevi	Tubers	Climbing liana	Fresh	M	0.0492
16	<i>Elaeis guineensis Jacq.</i>	Arecaceae	Dékin-man	Leaves	Tree	Fresh	M	0.0328
17	<i>Entada africana Guill. & Perr.</i>	Fabaceae		Leaves	Liana	Fresh	M	0.0824
18	<i>Euphorbia hirta L.</i>	Euphorbiaceae	Anonsin-wé	Leaves	Herb	Fresh	M	0.1648
19	<i>Ficus sycomorus L.</i>	Moraceae	Danlu, danba	Leaves	Tree	Fresh	M	0.066
20	<i>Hibiscus sabdariffa L.</i>	Malvaceae	Nenwi	Seeds	Erect herb	Fresh	M	0.0824
21	<i>Ipomoea batatas (L.) Lam.</i>	Convolvulaceae	Dokoui	Fruits	Herb	Fresh	M, A	0.0164
22	<i>Jatropha curcas L.</i>	Euphorbiaceae	Yankpotoun wéwé	Leaves	Shrub	Fresh	M	0.0988
23	<i>Khaya senegalensis (Desr.) A.Juss.</i>	Meliaceae	Agao	Leaves	Tree	Fresh	M	0.0328
24	<i>Launaea taraxacifolia (Willd.) Amin ex C.Jeffrey</i>	Asteraceae	Yantoto	Leaves	Herb	Fresh	M, A	0.0988
25	<i>Manihot esculenta Crantz</i>	Euphorbiaceae	Manioc	Tubers	Shrub	Fresh	M, A	0.0824

26	<i>Mondia whitei</i> (Hook.f.) Skeels	Apocynaceae	Nonsin-wé	Leaves	Liana	Fresh	M, A, S	0.68
27	<i>Musa × paradisiaca</i> L.	Musaceae	Kouékoué aloga	Fruits	Herb	Fresh	M, A	0.0164
28	<i>Ocimum basilicum</i> L.	Lamiaceae	Hissi-hissi	Leaves	Herb	Fresh	M, S	0.0164
29	<i>Ocimum gratissimum</i> L.	Lamiaceae	Tchayo	Leaves	Shrub	Fresh	M, A	0.0164
30	<i>Parkia biglobosa</i> (Jacq.) R.Br. ex G.Don	Fabaceae	Ahwatin	Leaves	Tree	Fresh	M	0.0164
31	<i>Pennisetum glaucum</i> (L.) R.Br.	Poaceae	Likun	Fruits	Herb	Fresh	M, A	0.066
32	<i>Phaseolus vulgaris</i> L.	Fabaceae	Ayikoun	Leaves	Herb	Dried	M	0.0164
33	<i>Pterocarpus santalinoides</i> L'Hér. ex DC.	Fabaceae	Gbègbètin	Leaves	Tree	Fresh	M	0.0492
34	<i>Saccharum officinarum</i> L.	Poaceae	Léké	Stems	Herb	Fresh	M, A	0.1648
35	<i>Sarcocephalus latifolius</i> (Sm.) E.A.Bruce	Rubiaceae	Kodo	Roots	Shrub	Dried or fresh	M, A	0.1152
36	<i>Sorghum bicolor</i> (L.) Moench	Poaceae	Agbokounvovo	Grains	Herb	Dried	M, A	0.1316
37	<i>Spondias mombin</i> L.	Anacardiaceae	Akikontin	Leaves	Tree	Fresh	M, A	0.066
38	<i>Syzygium aromaticum</i> (L.) Merr. & L.M.Perry	Myrtaceae	Clou de girofle	Flower buds	Tree	Dried	M, A	0.0328
39	<i>Tridax procumbens</i> L.	Asteraceae	Azoui-man	Leaves	Herb	Fresh	M, A	0.1812
40	<i>Vernonia amygdalina</i> Delile	Asteraceae	Amanvivè	Leaves	Shrub	Fresh	M, A	0.28
41	<i>Vigna unguiculata</i> (L.) Walp.	Fabaceae	Ayikun vovo	Leaves	Herbaceous liana	Fresh	M, A	0.1976
42	<i>Vitellaria paradoxa</i> C.F. Gaertn.	Sapotaceae	Wugo	Leaves	Shrub	Dried	M, A	0.1316
43	<i>Vitex doniana</i> Sweet	Lamiaceae	Fontin	Leaves	Shrub	Fresh	M	0.0988
44	<i>Xylopia aethiopica</i> (Dunal) A.Rich.	Annonaceae	Kpédjélekoun	Fruits	Shrub	Fresh	M, S	0.0164
45	<i>Zea mays</i> L.	Poaceae	Gbadé	Fruits	Herbaceous	Fresh	M, A	0.2988

M = Medicinal; A = Food; S = Spiritual. RFC = Relative Frequency of Citation.

The notable presence of Poaceae in second place, with species such as *Pennisetum glaucum*, *Saccharum officinarum*, *Sorghum bicolor* and *Zea mays*, reflects for its part the importance of locally cultivated cereals and grasses in the food-related galactogenic practices of the Zou and Collines departments, these species being both staple foods and traditional remedies integrated into the diet of breastfeeding women (Figure 2).

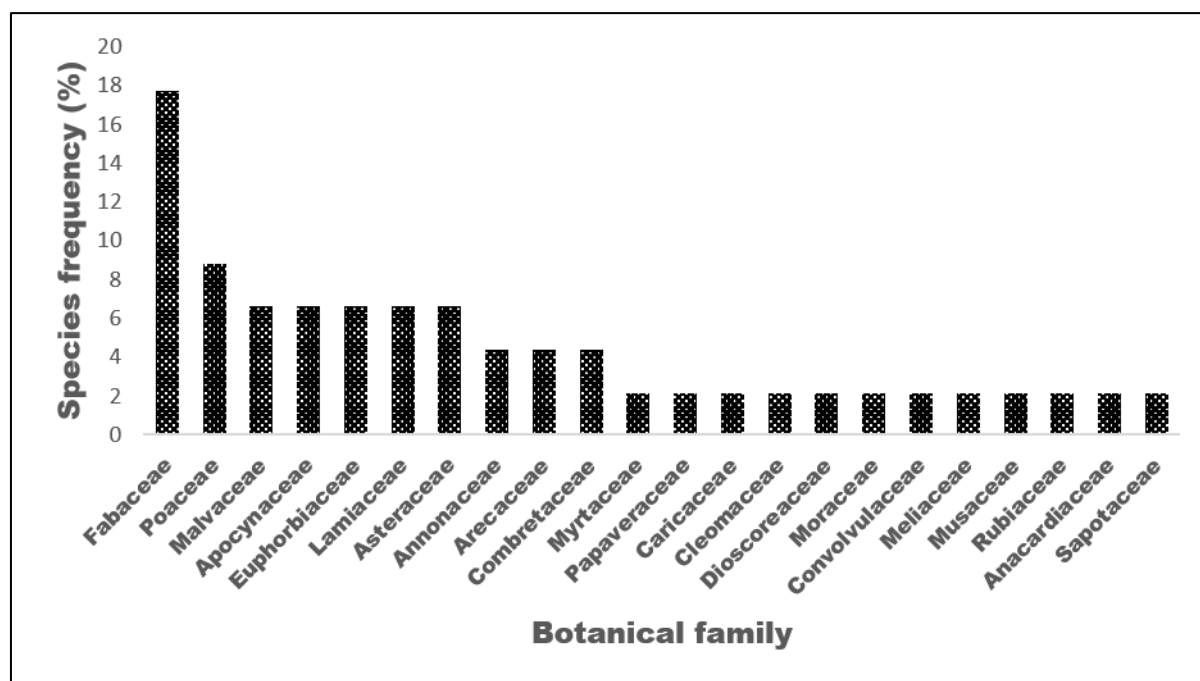


Figure 2: Galactogenic species recorded by botanical family

3.1.3 Use characteristics of *Mondia whitei* (Hook.f.) Skeels

The degree of informant consensus, measured by citation frequency, and the versatility of use made it possible to select, among the 45 recorded galactogenic species, *Calotropis procera* (Aiton) Dryand. and *Mondia whitei* (Hook.f.) Skeels, used simultaneously for the three use categories, namely medicinal, food and spiritual. Between these two versatile species, *Mondia whitei* shows a markedly higher relative frequency of citation (RFC = 0.68) than *Calotropis procera* (RFC = 0.48). *Mondia whitei* thus combines the highest degree of informant consensus with the greatest versatility of use among all the species recorded in the Zou and Collines departments, which justifies its selection for the phytochemical characterization carried out in the present study.

3.1.3.1 Use typology

Mondia whitei is predominantly used for medicinal purposes (89.24%), followed by food (7.59%) and spiritual (3.16%) uses (Figure 3). This clear predominance of medicinal use confirms the trend already observed across the 45 recorded species (Table 3), consistent with the work of Adomou et al. [22] on the primacy of therapeutic use in West African ethnobotanical inventories. The Informant Consensus Factor for the galactogenic effect reaches 0.6979; being above 0.5, it confirms strong homogeneity of the ethnopharmacological information collected and reinforces the reliability of the consensus around the galactogenic property of *Mondia whitei*.

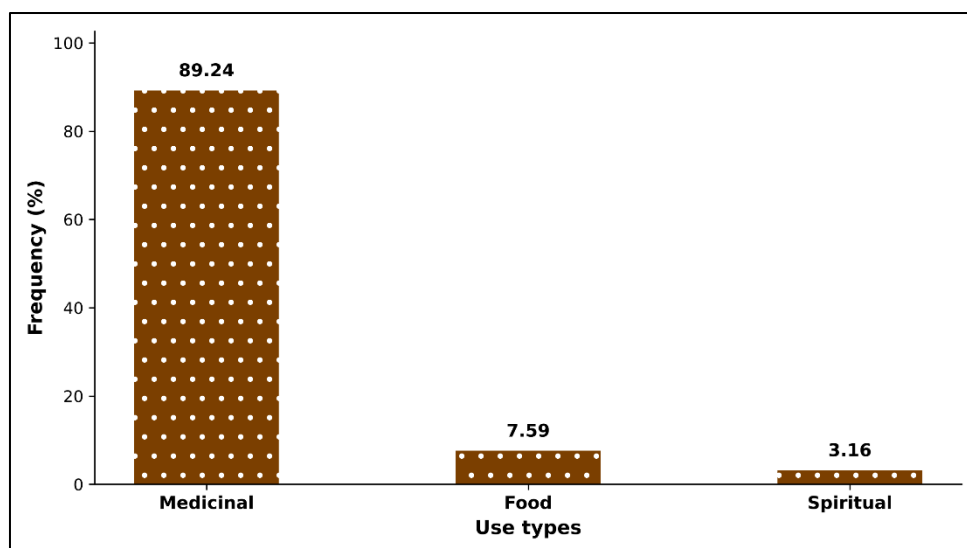


Figure 3: Use types of *Mondia whitei*

Furthermore, the principal component analysis crossing sociolinguistic groups and use types of *Mondia whitei* explains 97.8% of the total variance, across two axes, Dim1 (66.3%) and Dim2 (31.5%) (Figure 4). The Fon ethnic group stands out clearly on axis 1, positively associated with medicinal and food uses, consistent with its position already noted as the majority ethnic group in the sample (81.89%, Table 2). The Holli ethnic group stands out on axis 2, positively associated with spiritual use, while the Mahi and Sahouè ethnic groups occupy an intermediate position on the same side. The Adja, Yoruba and Nago ethnic groups cluster at the opposite end of both axes, reflecting a weaker association with the recorded uses. This ethnic structuring of use could reflect distinct traditional knowledge across ethnic groups, certain ritual practices surrounding *Mondia whitei* being specific to minority ethnic groups such as the Holli (Figure 4).

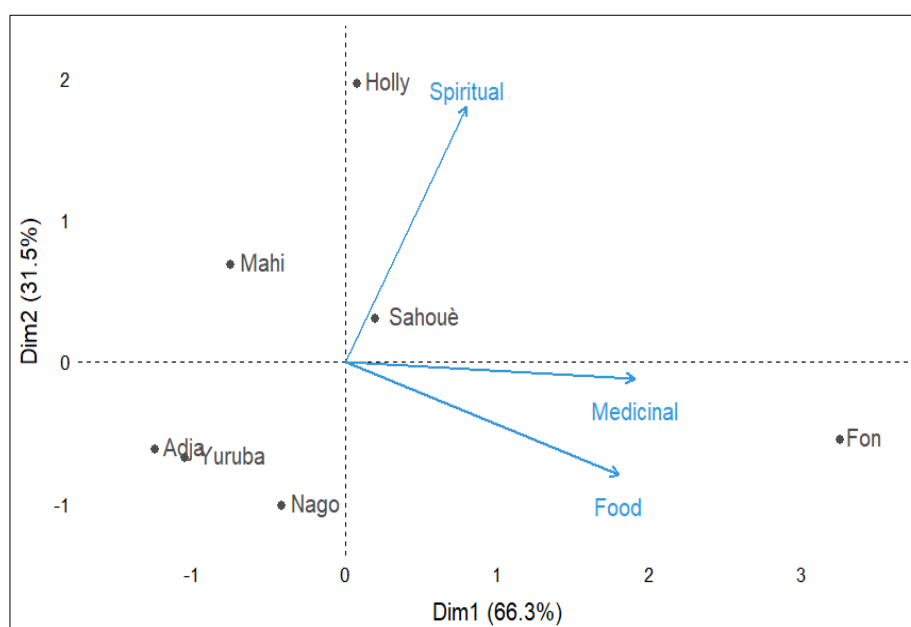
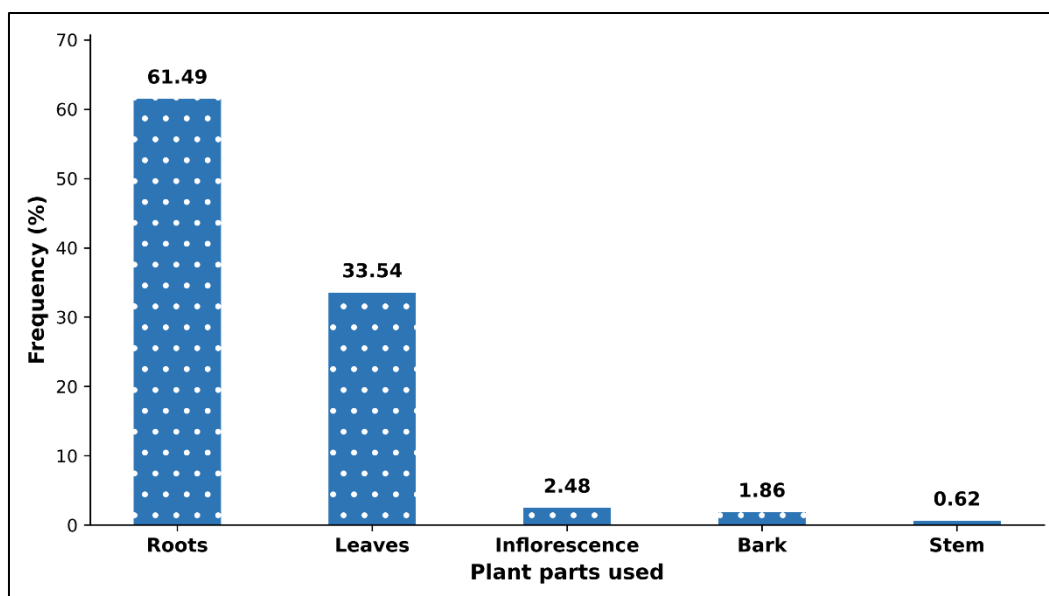


Figure 4: Representation of sociolinguistic groups and use types of *Mondia whitei*

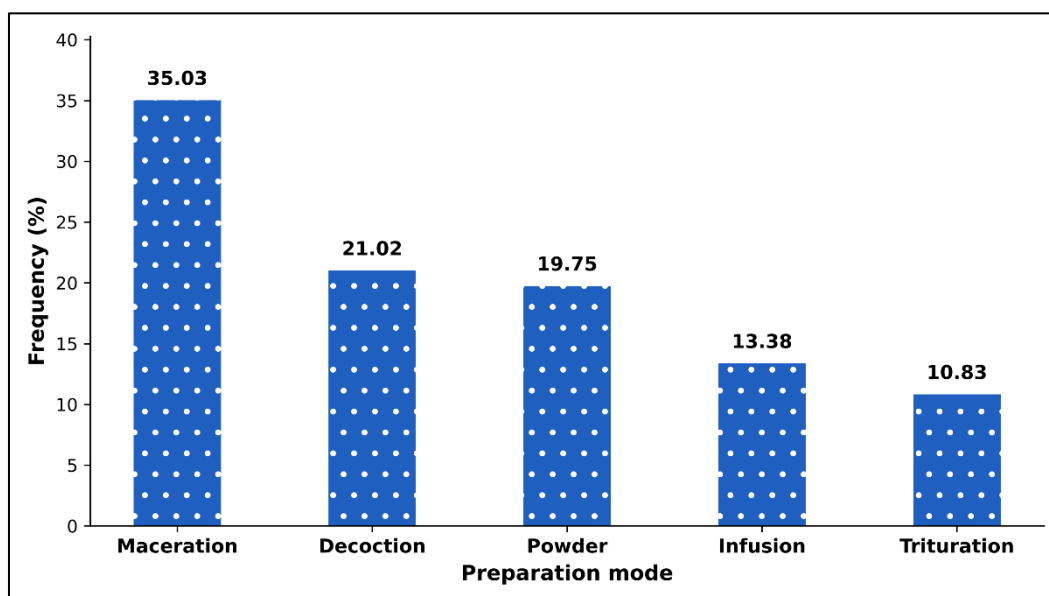
3.1.3.2 Plant parts used of *Mondia whitei*

The roots of *Mondia whitei* constitute the most widely used plant part (61.49%), followed by the leaves (33.54%), while the stem, inflorescence and bark are used only marginally (0.62%, 2.48% and 1.86%, respectively) (Figure 5). This predominance of roots is consistent with the available literature on the species. Aremu et al. [27] and Oketch-Rabah [23] both report that the root is traditionally the most used part of *Mondia whitei* across the African continent, notably due to its concentration of aromatic compounds responsible for its aphrodisiac and stimulant properties.

Figure 5: Plant parts used of *Mondia whitei*

3.1.3.3 Preparation modes of *Mondia whitei* plant parts

Maceration is the most frequently used preparation mode (35.03%), followed by decoction (21.02%), powder (19.75%), infusion (13.38%) and finally trituration (10.83%) (Figure 6). This diversity of preparation modes matches the observations of Oketch-Rabah [23], who reports that the roots of *Mondia whitei* are traditionally consumed raw, infused as tea or turned into a fermented beverage depending on the region of Africa, confirming the flexibility of use of this species according to local practices.

Figure 6: Preparation modes of *Mondia whitei* plant parts

3.1.3.4 Vernacular names

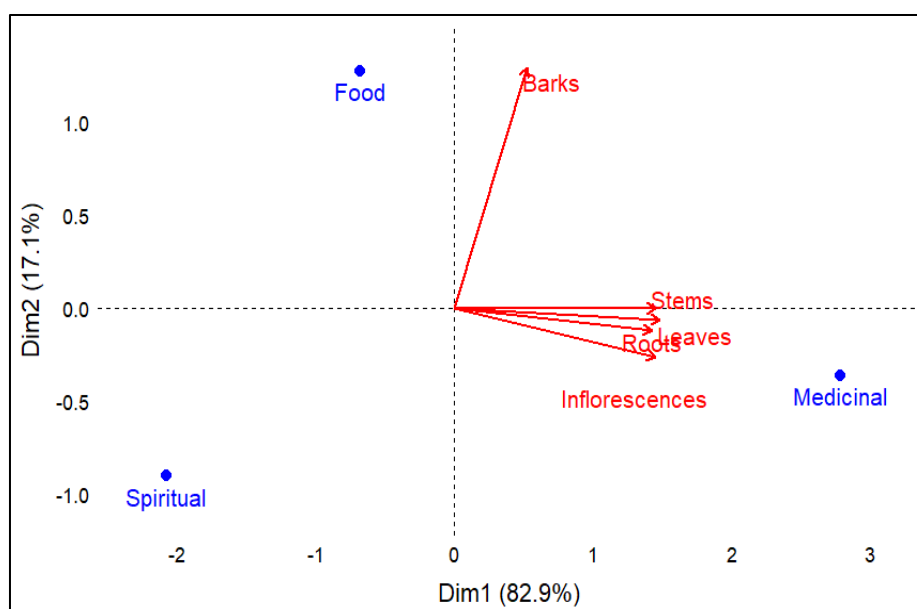
A total of three vernacular names were recorded for *Mondia whitei* according to ethnic group: Anonsinman among the Mahi, Nonsin-wé among the Fon, and Ichègoun among the Yoruba. The meaning of these names is particularly evocative of the species' galactogenic use, with Anonsinman and Nonsin-wé both literally meaning “the leaf of breast milk,” reflecting a long-standing and shared recognition of this plant's galactogenic property within local traditional knowledge, regardless of ethnic group, according to Soumaila et al. [28] (Table 4).

Table 4: Variation and meaning of vernacular names of *Mondia whitei* across the sociolinguistic groups of the study area

Vernacular name	Ethnic group	Meaning
Anonsinman	Mahi	The leaf of breast milk
Nonsin-wé	Fon	The leaf of breast milk
Ichègoun	Yoruba	—

3.1.3.5 Relationship between plant parts used and uses of *Mondia whitei*

The principal component analysis of plant parts and uses of *Mondia whitei* shows that medicinal use is strongly associated with roots, leaves, stems and inflorescences, all grouped on the positive side of axis 1. Food use stands out on axis 2, more closely associated with bark, while spiritual use is positioned at the opposite end of both axes, without a marked association with any particular plant part, suggesting that this use relates more to an overall symbolic practice of the plant than to a specific plant part (Figure 7).

**Figure 7: Representation of plant parts used and use types of *Mondia whitei***

3.1.3.6 Relationship between plant parts used and preparation modes of *Mondia whitei*

The principal component analysis of preparation modes and plant parts of *Mondia whitei* shows that roots are strongly associated with maceration, infusion, powder and decoction, grouped on the positive side of axis 1, confirming the consistency between the most used plant part and the most common preparation modes identified in Figure 6. Trituration stands out on axis 2, more closely associated with leaves, while bark, stem and inflorescence cluster at the opposite end, reflecting more marginal preparation modes for these less-used plant parts (Figure 8).

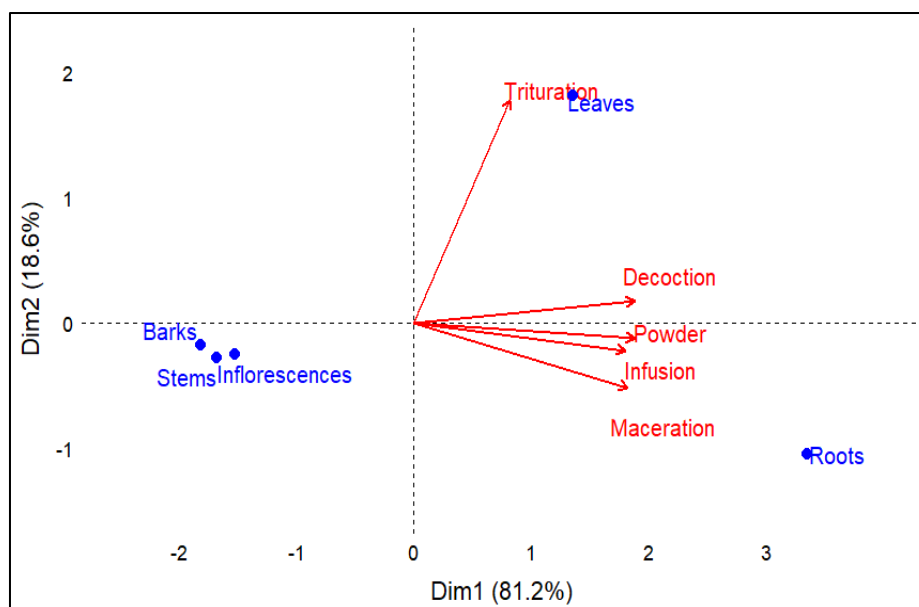


Figure 8: Representation of preparation modes and plant parts used of *Mondia whitei*

3.1.3.7 Conditions treated with *Mondia whitei*

Mondia whitei is used to treat a wide range of conditions: erectile dysfunction (13.75%), mammary hypogalactia (11.46%), vaginal infections (10.23%), skin infections (10.21%) and digestive disorders (9.79%) (Figure 9). This diversity of therapeutic indications is largely corroborated by the international literature: Oketch-Rabah [23] confirms that the most commonly reported use of *Mondia whitei* across Africa is aphrodisiac, for the treatment of sexual disorders, but that the species is also used as an appetite stimulant, against digestive disorders, against sexually transmitted infections such as gonorrhea, and as a uterine stimulant, which directly overlaps with the most cited categories of conditions in the present study, with the exception of mammary hypogalactia, which constitutes the galactogenic specificity unique to the Zou and Collines study area.

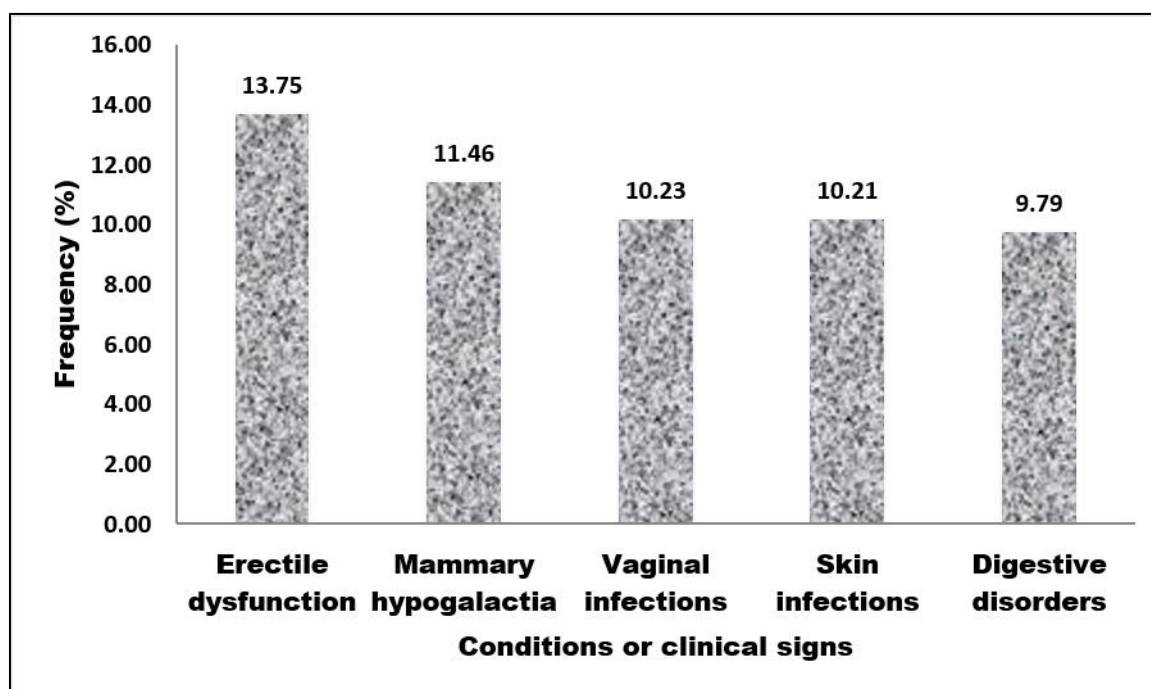


Figure 9: Conditions treated with *Mondia whitei*

3.2 Phytochemical characterization of *Mondia whitei*

The results of the phytochemical screening revealed, in the leaf powder of *Mondia whitei*, the presence of gallic tannins, flavonoids, anthocyanins, leucoanthocyanins, saponins, triterpenoids, steroids, mucilages, reducing compounds and

cardiotonic derivatives (Table 5). The ethanolic extract revealed the presence of alkaloids, gallic tannins, anthocyanins, saponins, steroids, C-heterosides and coumarins. The methanolic extract, for its part, revealed the presence of alkaloids, gallic tannins, anthocyanins, steroids, reducing compounds and C-heterosides. Finally, the hexane extract revealed only the presence of alkaloids, steroids and C-heterosides. Six chemical groups with galactogenic properties were specifically sought in this study, namely alkaloids, flavonoids, saponins, triterpenoids, steroids and cardiotonic derivatives [29,30]. Ratios of 5/6, 3/6, 2/6 and 2/6, i.e., 83.33%, 50%, 33.33% and 33.33%, of the chemical groups sought were obtained respectively for the powder, the ethanolic extract, the methanolic extract and the hexane extract; this ranks the powder, followed by the ethanolic extract, as the preparations richest in chemical groups with galactogenic potential.

Indeed, the variation in organic solvents used for extraction, of increasing polarity, made it possible to guide the choice of the most appropriate solvent for preserving the pharmacological properties of this plant drug [31].

Furthermore, the two undesirable compounds with high toxic potential sought, namely cyanogenic derivatives and O-heterosides, are absent from all preparations tested, suggesting the innocuity of this plant drug with regard to these specific compounds, regardless of the preparation method used. The presence of alkaloids, tannins, saponins and cardiotonic derivatives in *Mondia whitei* extracts also aligns with the observations of Lawal et al. [24], who report that all galactogenic species sampled in Katsina State, Nigeria, systematically contained alkaloids, cardiac glycosides, flavonoids, saponins, tannins and terpenoids, suggesting that these chemical groups constitute a common phytochemical basis for galactogenic plants in West Africa. The absence of catechic tannins in all *Mondia whitei* leaf extracts contrasts with the findings of Amoussou et al. [32], who reported, on the contrary, a richness in catechic tannins in the roots of this same species. This difference could be explained by the differential distribution of chemical groups from one plant part to another within the same plant, roots and leaves not necessarily sharing the same phytochemical profile.

Table 5: Phytochemical screening of the powder and leaf extracts of *M. whitei*

Chemical compounds	Powder	EtOH extract	MetOH extract	Hexane extract
Alkaloids	–	+	+	+
Catechic tannins	–	–	–	–
Gallic tannins	+	+	+	–
Flavonoids	+	–	–	–
Anthocyanins	+	+	+	–
Leucoanthocyanins	+	–	–	–
Quinone derivatives	–	–	–	–
Saponins	+	+	–	–
Triterpenoids	+	–	–	–
Steroids	+	+	+	+
Cyanogenic derivatives	–	–	–	–
Mucilages	+	–	–	–
Reducing compounds	+	–	+	–
Free anthracenics	–	–	–	–
O-heterosides	–	–	–	–
C-heterosides	–	+	+	+
Cardiotonic derivatives	+	–	–	–
Coumarins	–	+	–	–

Presence: (+); Absence: (–)

4 CONCLUSION

The Zou and Collines departments hold a rich body of plant knowledge surrounding lactation, carried for generations by the local populations, particularly women and traditional healers. This study captured part of this knowledge,

through forty-five species belonging to several botanical families, among which Fabaceae stand out clearly. The vast majority of these plants are primarily regarded as remedies, but *Mondia whitei* occupies a place of its own, ultimately emerging as the most consensual plant of this survey. It is not only the most frequently cited, but also the one whose high Informant Consensus Factor reflects remarkable agreement among respondents regarding its galactogenic property. The various plant parts used are most often prepared by maceration, to treat conditions as varied as erectile dysfunction, mammary hypogalactia or vaginal infections, uses that reflect the central place this liana occupies in everyday health care.

The phytochemical characterization carried out on this species confirms this knowledge, revealing in its leaves chemical groups with galactogenic properties, namely alkaloids, tannins, saponins and steroids, with profiles that vary depending on the solvent used.

Taken as a whole, these results provide a scientific basis regarding *Mondia whitei* and open a concrete avenue for its valorization, whether as nutritional supplements or phytotherapeutic preparations intended for breastfeeding mothers. Pharmacological analyses, followed by work to extract the active compounds responsible for this galactogenic activity, are needed before considering a larger-scale valorization of this resource belonging to the traditional pharmacopoeia of Benin.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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Disclosure of conflict of interest

The authors declare that they have no conflict of interest related to the present work.

Statement of ethical approval

This study was conducted in accordance with the ethical principles applicable to research involving human participants.

Statement of informed consent

Free, informed and oral consent was obtained from each respondent prior to each interview, after explanation of the study's objectives, and the confidentiality of the personal information collected was ensured throughout the research process.

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