South African Journal of Botany 97 (2015) 165–175

Contents lists available at ScienceDirect

South African Journal of Botany

journal homepage: www.elsevier.com/locate/sajb

Ethnobotanical survey of medicinal plants used for traditional maternal healthcare in Katsina state, Nigeria

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ARTICLE INFO

Article history:
Received 23 September 2014
Received in revised form 12 January 2015
Accepted 14 January 2015
Available online 7 February 2015

Edited by V Steenkamp

Keywords:
Ethnobanical survey
Katsina State
Maternal healthcare
Medicinal plants
Traditional

ABSTRACT

Women in Katsina State, Nigeria have been using medicinal plants to cure various ailments associated with maternal health since time immemorial; however the use of such plants was never documented. In this study an ethnobotanical survey was conducted to document medicinal plants used for traditional maternal healthcare in Katsina State, Nigeria. Semi structured questionnaire method was used to interview 300 respondents (50 from 2 Local Government Areas of each of the 3 Senatorial Districts) comprising of herbalists, Traditional Birth Attendants (TBAs), Traditional Medical Practitioners (TMPs), House Wives, Farmers and others. Medicinal plants belonging to 101 genera distributed among 50 families were documented. Most of the reported plants belong to the Fabaceae (22.52%), Asteraceae (7.21%) Malvaceae (5.41%) and Anacardiaceae (4.51%) families. *Acacia nilotica* (L) Delile and *Gueira senegalensis* J.F. Gmel had the highest Relative Frequency of Citation (RFC) and Fidelity Level (FL) of 0.93; 100% and 0.92; 100%, respectively. Among the 18 categories of ailments, headache, navel pain, postpartum hemorrhage, and postpartum wound healing had the highest Informant Consensus Factor (ICF) of 1.00 each. Most of the reported plants (68.47%) were herbs and shrubs and about 84.68% of the surveyed plants were wild. Leaves were the most frequently used (32.14%) plant's part. Most of the medications (32%) were prepared as decoctions and preparations are mostly administered orally (84.68%). Scientific validation of the biological properties of the surveyed plants is highly advocated and cultivation of medicinal plants to minimize the pressure on wild species is also recommended.

1. Introduction

Nigeria, one of the world's leading producers of oil, is Africa's most populous country, and the majority of its people dwell in rural areas. Due to the mismanagement of public funds, a high level of corruption and a successive rule by a military dictatorship, the majority of the population (approximately 66%) lives below the poverty line of US$ 1 per day. Healthcare services in Nigeria are inadequate and unevenly distributed, and only a small number of healthcare facilities provide antenatal care, delivery and postnatal services. This deficiency has really contributed to the extremely high maternal mortality ratio, which is among the highest in the world. The maternal mortality ratio in Nigeria is 630 per 100,000 live births, which places the country as the country with the tenth highest mortality ratio (WHO, 2012). Nigeria and other five countries account for almost half (49%) of the overall maternal mortality figure worldwide (Hogan et al., 2010). This unprecedented figure cannot be disassociated from the fact that most Nigerian women employ the services of alternative traditional healthcare through the services of Traditional birth Attendants (TBAs) and Traditional Healers (THs), who inevitably use medicinal plants for maternal healthcare, particularly in rural areas where orthodox health facilities are either absent or extremely difficult to access.

The utilization of plants and their resources for combating various ailments predates written history and they are still in use all over the world (Abe and Ohtani, 2013). The oldest written evidence of the usage of medicinal plants for the preparation of drugs has been found on a Sumerian clay slab from Nagpur, which is believed to be approximately 5000 years old (Cristine et al., 2012). The isolation of morphine from opium in the early 19th century served as a gate opener for many studies aimed at isolating active compounds from medicinal plants (Balunas and Kinghorn, 2005), and this breakthrough led to the isolation of other bioactive compounds, such as cocaine, codeine, digitoxin, and quinine. Although pharmaceutical companies and Research and Development (R&D) organizations are placing increased interest in molecular modeling, combinatorial chemistry and other synthetic chemistry techniques, natural products, specifically medicinal plants, remain the source of new drugs, new drugs leads and new chemical entities (Newman et al., 2000; Butler, 2004).

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http://dx.doi.org/10.1016/j.sajb.2015.01.007
0254-6299/

Medicinal plants are widely used for pre and postnatal care in many parts of the world (Zumsteg and Weckerle, 2007); thus, various studies (Singh et al., 1984; Browner, 1985; Bourdy and Walter, 1992; Varga and Veale, 1997; Ticktin and Dalle, 2005; Lamxay et al., 2011; Attah et al., 2012; Nordeng et al., 2013; Borokini et al., 2013; Abdillahi and Van Staden, 2013) have documented many medicinal plants used to treat obstetric and gynecological conditions, such as birth control, complications during pregnancy and child birth and problems associated with infertility. Indigenous people worldwide have used oral traditions and empirical means to compile detailed knowledge regarding the use of medicinal plants, and this information is disseminated from generation to generation (Abel et al., 2005).

Based on inherited knowledge and long-term usage for the treatment of various ailments over the centuries, medicinal plants are considered natural and therefore safer than conventional synthetic pharmaceuticals. There is, however, scarce scientific evidence supporting this belief (Raskin et al., 2002). Recent scientific evidence has revealed that many plants considered to be medicinal are potentially toxic, mutagenic and carcinogenic (Fennell et al., 2004). Poisoning by medicinal plants may be attributed to misidentification, incorrect preparation or inappropriate administration and dosage. Information from health centers and emergency rooms has reported many dangerous and lethal effects from the use of herbal products (Rodriguez-Fragoso et al., 2008).

Most medicinal plants are traditionally obtained from the wild, where they grow naturally. However, as a result of many negative human and environmental factors, such as overharvesting, deforestation, desertification and global warming to mention a few, medicinal plants are faced with the serious problem of extinction. It has been reported that approximately 15,000 medicinal plants species are at risk of becoming extinct due to habitat destruction, overharvesting and large business throughout the world (Naguib, 2011). This is further compounded by the fact that many medicinal plants are also useful as raw materials for some industries, such as cosmetics, textile, biomass, food and confectionaries; thus, the pressure on the diversity of medicinal plants is extremely high. The overexploitation of medicinal plants is relatively higher in developing countries, where the majority of the population depend on medicinal plants for their primary healthcare services.

Katsina, one of the poorer states in Nigeria, is among the most populous states in the country with a population of 5,801,584 (NPC, 2006). Culturally, the state houses two ancient cities, namely Daura and Katsina, and the former is believed to be the origin of the Hausa language and cultural administration. Despite the effort made by the past and present democratically elected governments in building many health institutions across the state, these institutions are not equipped with the necessary equipment and trained medical personnel, particularly those in rural areas, where the majority of the population live. This and other reasons, such as affordability, accessibility and cultural conservativeness, prompt most people of the state to patronize complementary alternative healthcare services through the use of medicinal plants, which are readily available and considered to be relatively safer than the synthetic drugs that are inevitably used in orthodox medicine. The use of these plants to alleviate medical ailments has resulted in the indiscriminate cutting of plant resources, and this is posing a great danger to the plant biodiversity in the state, which is already facing threats from deforestation, desert encroachment, and global warming consequences. Although people have been using medicinal plants to cure various diseases in Katsina since time immemorial, their usage is never documented, and the information is being passed verbally from generation to generation, which poses a negative impact on Indigenous Knowledge (IK) because it will be lost over time. Documenting the medicinal plants used in traditional maternal healthcare will therefore go a long way in providing baseline data that may aid the devising of conservation strategies, and the information gathered would be an invaluable source for pharmacological studies aimed at isolating additional compounds that could be useful for providing new drug leads. As a result, this study attempts to document the medicinal plants used for traditional maternal healthcare in Katsina state, northern Nigeria.

2. Materials and methods

2.1. Study area

This study was conducted in Katsina state, northern Nigeria. Katsina state, which covers an area of 23,938 sq km, is located between latitudes 11°08′N and 13°22′N and longitudes 6°52′E and 9°20′E. The state is bounded by Niger Republic to the north, Jigawa and Kano states to the east, Kaduna state to the south and Zamfara state to the west (Fig. 1). The state has 34 Local Government Areas. For the purpose of this study, the state was divided into three senatorial districts, namely the South, North and Central Senatorial Districts, and two Local Government Areas (LGAs) were randomly selected from each senatorial district.

2.2. Data collection

This study was conducted from August, 2013 to March, 2014. Ethnobotanical data were obtained using a semi-structured questionnaire method. The target groups for this study were herbalists, traditional medical practitioners, traditional midwives, housewives, farmers and other people of old age who have practiced and used medicinal plants. Prior to the questionnaire administration, conversation sessions with the potential respondents were organized and facilitated by the traditional rulers in each Local Government Area. During the conversation, the potential respondents were informed how rapidly the knowledge and plants used for traditional medicine are diminishing and were thus told that the purpose of the study was to protect this wealth from being lost. The questionnaire was divided into two parts, namely parts A and B. In part A, the socio-demographic information of the respondents was recorded, and information on plants that are used for traditional maternal healthcare was recorded in part B. Fifty (50) respondents were selected from each LGA. The interviews were conducted in Hausa language, and each respondent was interviewed alone to ensure confidentiality. Only those plants that were cited to cure the same ailment by at least three respondents are reported. Ethical approval was obtained before embarking on the study.

2.3. Collection and identification of plants specimens

A series of field trips were conducted to collect specimens of the reported plants from the natural vegetation and home gardens with the help of some guides selected among the respondents. Identification of the sampled plants was achieved by the aid of herbarium specimens and literature on Nigerian medicinal plants. The online plant diversity resources further confirmed the identity of the surveyed plants. Voucher specimens were collected, pressed and deposited in the herbarium of Umaru Musa Yar'adua University, Katsina, Nigeria.

2.4. Data analysis

A descriptive statistical method using frequencies and percentages was used to analyze the socio-demographic data of the respondents, and the results of the ethnobotanical survey were analyzed using the Relative Frequency of Citation (RFC), Fidelity Level (FL) and Informant Consensus Factor (ICF) measures.

2.4.1. Relative Frequency of Citation (RFC)

This measure was calculated to determine the relative importance of a particular species. This value was determined using

Fig. 1. Map of Katsina State, Nigeria showing the selected locations for the study.

the relation RFC = F_c / N (Tardıo and Pardo-de-Santayana, 2008), where F_c is the number of respondents who cited a particular species and N is the total number of the respondents.

2.4.2. Fidelity Level (FL)

This measure is an index used to determine the relative healing potential of each medicinal plant against a particular ailment and

was calculated using the formula: FL = N_s / N × 100 (Friedman et al., 1986), where N_s is the frequency of citation of a particular species for a particular ailment and N is the total number of citations of that species.

2.4.3. Informant Consensus Factor (ICF)

This measure was calculated for each category of ailment to identify the level of agreement among the respondents on the reported medicinal plants used to cure a particular ailment. The ICF was calculated using the relation: ICF = (n_{ur} − n_t) / n_{ur} − 1 (Fisseha et al., 2009), where n_{ur} is the number of citations for each particular ailment and n_t is the number of species reported to cure that ailment.

3. Results and discussion

3.1. Socio-demographic information

Table 1 shows the socio-demographic information of the respondents. As shown in the table, most of the respondents (64.33%) were female, and this finding may not be unconnected to the fact that females are more concerned with maternal healthcare and were easily accessed during the study. This result agrees with the findings reported by Borokini et al. (2013) who reported that 58.1% of the respondents in an ethnobiological study of traditional medicines used for women's health in Oyo state, Nigeria were female. The table also revealed that the majority of the respondents (37.33) are 61 to 70 years of age, which shows that people of old age are the main custodians of traditional knowledge. This, however, poses a serious threat to the indigenous knowledge because it may eventually be lost following the demise of the older generation. This result is contrary to the findings reported by Fakeye et al. (2009), who found that 66.5% of the respondents who reported the use of herbal medicines among pregnant women in Nigeria are 21 to 30 years of age. Most of the respondents (68%) had no formal education, and this finding is attributed to the fact that women, who were the majority of the respondents, were not enrolled in western schools. Most of the respondents (37.33%) were Traditional Birth Attendants (TBAs) because these individuals are the most cooperative during the survey and have more experience on the use of medicinal plants for maternal healthcare.

Table 1
Socio-demographic information of the respondents.

Biodata	Frequency	Percentage (%)
Sex		
Male	107	35.67
Female	193	64.33
Age		
20–30	11	03.67
31–40	37	12.33
41–50	63	21
51–60	45	15
61–70	112	37.33
>70	32	10.67
Education		
None	204	68
Basic	55	18.33
Secondary	39	13
Tertiary	02	0.67
Occupation		
Herbalists	73	24.33
TBAs	112	37.33
House wives	32	10.67
TMPs	30	10
Farmers	43	14.33
Others	10	03.33

TBAs = traditional birth attendants, TMPs = traditional medical practitioners.

3.2. Plant species used for traditional maternal healthcare

Information on the medicinal plants used for traditional maternal healthcare in the study area is presented in Table 2. The table shows the plant species, their common names, the parts used, their modes of preparation and the routes of administration. A total of 111 plant species belonging to 101 genera distributed among 50 families are used to treat various illness associated with maternal healthcare in Katsina state, Nigeria. One of the species, "*Cancana kwanikka*", could not be identified to the genus level due to the absence of floral parts. The family Fabaceae was the dominant family with 25 species, followed by the Asteraceae family with eight species and the Malvaceae family with six species, whereas most of the families (31) are represented by one species each (Fig. 2). This result agrees with the findings reported by Boer and Cotingting (2014), who found that most of the plants used for women's healthcare in Southeast Asia belong to the Fabaceae family. A review by Steenkamp (2003) also revealed that most plant species used for gynecological complaints in South Africa belong to the Fabaceae family. Euphorbiaceae, Asteraceae and Fabaceae were the most frequently used families for the treatment of gynecology and obstetrics disorders in northern Maputaland, South Africa (De Wet and Ngubane, 2014). Kaingu et al. (2013), however, reported that Euphorbiaceae is the most frequently used family for the management of women's reproductive health in Tana River County, Kenya. Poaceae and Caesalpiniaceae were the dominant plant families used for women's health in Oyo state, Nigeria (Borokini et al., 2013). The high occurrence of the family Fabaceae could be explained by the fact that most species belonging to the Fabaceae family are mostly found throughout the seasons because they are adapted to withstand the adverse effects of Sahel regions. Most of the reported plants (84.68%) are wild plants (Fig. 3), which may be due to the belief that wild medicinal plants are more effective than their cultivated counterparts. The majority of medicinal plants used by pregnant women in Anyi-Ndenya, Eastern Cote d'Ivore are also sourced from the wild (Malan and Neuba, 2011). Ticktin and Dalle (2005), however, reported that cultivated plants are mostly used for midwifery practice in rural Honduras. Most of the reported plants (68.47%) were herbs and shrubs, whereas only 31.53% were trees (Fig. 4). This discrepancy could have negative consequences on the plants' diversity because herbs and shrubs are the most seriously affected by other anthropological factors, such as bush burning and overgrazing. The over usage of wild plants poses a great danger to the plants' biodiversity because some species may become extinct as a result of overexploitation. Leaves were the most frequently used plant part identified in this study (32.14%), followed by the stem bark (26.78%) and whole plant (24.11%), whereas the roots, rhizomes, bulb, seed, twig, pod and flower account for only 16.97% all together (Fig. 5). The leaves were also the most used plant part by pregnant women in Mali (Nordeng et al., 2013). This result, however, is not in agreement with the findings reported by Steenkamp (2003), who found that roots are the most frequently used plant part for the management of gynecological problems in South Africa. Shrivastava (2013) also reported that plant roots are mostly used to treat gynecological problems in Dindori district of Madhya Pradesh, India. The frequent use of leaves identified in this study may be explained by the fact that leaves are the site of photosynthesis and therefore the repository of most secondary metabolites. Although the use of leaves may seem less dangerous to the plants' biodiversity than the use of barks or whole plants, it can also contribute to the effect of global warming by reducing the carbon dioxide uptake and oxygen production.

Although most of the species recorded in this study have been reported to have one or more biological properties, only a very few of these plants were previously reported to be used for maternal healthcare. For example, *Vernonia amygdalina*, a medicinal plant that is widely reported to be used for maternal and other women reproductive healthcare (Lamxay et al., 2011; Attah et al., 2012; Nordeng et al., 2013; Borokini et al., 2013; Abdillahi and Van Staden, 2013), was also

Table 2
Medicinal plants used for traditional maternal health care in Katsina State, Nigeria.

Family	Scientific name	Local name	Common name	Voucher specimen number	RFC	FL (%)	Habit/domestication	Part used	Condition managed	Mode of preparation	Route of administration
Acanthaceae	*Peristrophe bicalyculata* (Retz) Nees	Tubanin dawaki	Horse flower	SSK036	0.17	28.00	S/W	L	Ease labor	Maceration	Oral
Aizoaceae	*Zaleya pentandra* (L.) C. Jeffrey	Gadon maciji		SSK063	0.41	36.29	H/W	WP	General well being	Maceration	Oral
Amaryllidaceae	*Allium sativum* L.	Tafarnuwa	Garlic	SSK085	0.62	55.68	H/C	Bu	Cold	Powder	Oral
Anacardiaceae	*Lannea acida* A. Rich.	Faru	African grape	SSK045	0.67	50.25	T/W	B	General well being	Maceration	Oral
Anacardiaceae	*Mangifera indica* L.	Mangwaro	Mango	SSK010	0.58	56.00	T/WorC	B	General well being	Maceration	Oral
Anacardiaceae	*Ozoroa mucronata* (Bernh. ex Krauss) R. and A. Fernandes	Kasheshe	Eastern cape resin tree	SSK007	0.25	47.30	T/W	L	Breast milk enhancement	Maceration	Oral
Anacardiaceae	*Sclerocarya birrea* (A. Rich.) Hochst.	Danya	Marula	SSK022	0.38	30.97	T/W	B	General well being	Powder	Oral
Anacardiaceae	*Anacardium occidentale* L.	Yazawa	Cashew	SSK013	0.32	37.11	T/WorC	B	Stomach ache	Maceration	Oral
Apocynaceae	*Anisopus mannii* N.E.Br.	Sakayau		SSK088	0.71	92.49	H/W	WP	Ease labor	Maceration	Oral
Araceae	*Anchomanes difformis* (Blume) Engl.	Hantsar gada	Forest Anchomanes	SSK048	0.82	82.45	S/W	R	Breast milk enhancement	Powder	Oral
Asclepiadaceae	*Leptadenia hastata* (Pers.) Decne	Yadiya		SSK079	0.72	63.13	H/L	L	General well being	Direct	Oral
Asclepiadaceae	*Caralluma dalzielii* N.E. Brown	Karan masallaci	Mosque reed	SSK099	0.71	74.06	H/W	WP	Nausea	Direct	Oral
Asteraceae	*Acanthospermum hispidum* DC.	Yawo	Bristly star bur	SSK057	0.29	42.53	H/W	WP	Diarrhea	Decoction	Oral
Asteraceae	*Artemisia annua* L.	Tazargade	Sweet annie	SSK015	0.89	95.13	S/C	L	Fever	Maceration	Oral
Asteraceae	*Vernonia kotschyana* Sch.Bip. ex Walp.	Kumbura fage		SSK020	0.44	40.91	H/W	R	Vomiting	Powder	Oral
Asteraceae	*Baccharoides adoensis* Sch.Bip. exWalp.	Dumashi		SSK025	0.30	51.69	S/W	LandR	Inflammation	Maceration	Oral
Asteraceae	*Centaurea acarnanica* (Matthäs) Greuter	Dayi	Thistle	SSK024	0.19	59.65	H/W	WP	General well being	Decoction	Oral
Asteraceae	*Centaurea perrottetii* DC.	Surandi	Star thistle	SSK040	0.26	85.90	H/W	WP	Postpartum hemorrhage	Maceration	Oral
Asteraceae	*Vernonia amygdalina* Delile	Shuwaka	Bitter leaf	SSK086	0.33	30.61	S/W	L	Breast milk enhancement	Powder	Oral
Asteraceae	*Vernonia strumambiguum* (Kotschy and Peyr.) H.Rob.	Tattaba		SSK056	0.22	40.30	H/W	WP	Fever	Decoction	Oral
Bignoniaceae	*Stereospermum kunthianu* Cham.	Sansami	Pink jacaranda	SSK073	0.58	48.85	T/W	B	Diarrhea	Powder	Oral
Brassicaceae	*Lepidium sativum* L.	Zamantarori	Garden cress	SSK078	0.36	41.67	H/W	L	Jaundice	Decoction	Oral
Bretschneideraceae	*Carica papaya* L.	Gwanda	Papaya	SSK002	0.29	54.02	S/C	L	Fever	Decoction	Oral
Burseraceae	*Boswellia dalzielii* Hutchinson	Hano	Frankincense tree	SSK017	0.71	57.55	T/W	B	Pile	Powder	Oral
Burseraceae	*Commiphorahil debrandtii* (Engl.) Engl.	Dashi	Corkwoods	SSK043	0.36	39.45	S/W	L	General well being	Decoction	Oral
Capparidaceae	*Boscia salicifolia* Oliv.	Zure	Willow-leaved shepherds tree	SSK038	0.42	25.20	H/W	L	Breast milk enhancement	Powder	Oral
Cleomaceae	*Cleome gynandra* L.	Gasaya	White massambee	SSK104	0.58	55.43	H/W	WP	Fever	Decoction	Oral
Cochlospermaceae	*Cochlospermum tinctorium* Perr. ex A. Rich.	Rawaya		SSK070	0.28	67.86	S/W	R	Jaundice	Powder	Oral
Combretaceae	*Anogeissus leiocarpa* (DC.) (Guill. And Perr.)	Marke	African birch	SSK071	0.66	55.33	T/W	B	Fever	Powder	Oral
Combretaceae	*Combretum micranthum* G. Don	Geza	Kinkeliba	SSK064	0.67	43.28	S/W	L	General well being	Decoction	Oral
Combretaceae	*Guiera senegalensis* J.F. Gmel.	Sabara	Moshi medicine	SSK009	0.92	100	S/W	L	Nausea, vomiting, diarrhea and general well being	Powder	Oral
Connaraceae	*Byrsocarpus coccineus* Schum and Thonn	Tsamiyar kasa	Tamarind of the valley	SSK035	0.62	39.46	H/W	WP	Breast milk enhancement	Powder	Oral
Convolvulaceae	*Evolvulusalsinoides* (L.) L.	Kafi malam	Dwarf morning glory	SSK065	0.72	66.51	H/W	WP	General well being	Powder	Oral
Convolvulaceae	*Ipomoea asarifolia* (Desr.) Roem. And Schult.	Duman kada	Morning glory	SSK108	0.52	53.50	H/W	WP	General well being	Decoction	Body bath
Cucurbitaceae	*Momordica balsamina* L.	Garahuni	Balsam apple, African pumpkin	SSK029	0.34	85.15	S/W	L	Navel pain	Ointment	Dermal
Cyperaceae	*Cyperus articulates* L.	Kajiji	Jointed flatsedge	SSK087	0.25	50.00	S/C	R	Cold	Decoction	Oral
Dioscoreacea	*Dioscorea bulbifera* L.	Tuwon biri	Air potato	SSK077	0.19	43.86	S/W	B	Pile	Powder	Oral
Ebenaceae	*Diospyrosme spiliformis* Hochst. ex A. DC.	Kanya	African ebony	SSK016	0.52	56.69	T/W	B	Breast milk enhancement	Maceration	Oral
Euphorbiaceae	*Chrozophora senegalensis* (Lam.) A.Juss	Damaigi		SSK001	0.70	45.97	H/W	WP	Stomach ache	Powder	Oral

(continued on next page)

Table 2 (*continued*)

Family	Scientific name	Local name	Common name	Voucher specimen number	RFC	FL (%)	Habit/domestication	Part used	Condition managed	Mode of preparation	Route of administration
Euphorbiaceae	*Euphorbia balsamifera* Aiton, Hort.	Aliyara	Balsam spurge	SSK041	0.51	49.67	T/W	T	General well being	Decoction	Body bath
Euphorbiaceae	*Euphorbia convolvuloides* Hochst. ex Benth	Nonon kurciya	Athsma herb	SSK091	0.78	88.89	H/W	WP	Breast milk enhancement	Powder	Oral
Euphorbiaceae	*Jatropha curcas* L.	Cin da zugu	Barbados Nut	SSK042	0.77	62.77	S/WorC	T	General well being	Maceration	Oral
Fabaceae	*Acacia nilotica* (L.)Delile	Bagaruwa	Black Piquant	SSK011	0.93	100	T/W	P	Postpartum wound healing	Decoction	Soaking
Fabaceae	*Acacia polyacantha* Willd.	Karaki	Catechu tree	SSK100	0.81	72.02	T/W	B	General well being	Maceration	Oral
Fabaceae	*Acacia senegal* (L.)Willd	Dakwara	Gum Arabic Tree	SSK061	0.31	25.53	T/W	L	Stomach ache	Decoction	Oral
Fabaceae	*Acacia sieberiana* DC.	Farar kaya	Paper bark Acacia	SSK107	0.29	65.52	T/W	B	Ease labor	Maceration	Oral
Fabaceae	*Albizia chevalieri* Harms	Katsari	Flat crown	SSK098	0.60	73.74	S/W	B	Stomach ache	Maceration	Oral
Fabaceae	*Bauhinia reticulata* DC.	Kalgo	Mountain Ebony	SSK067	0.65	44.39	T/W	L	General well being	Decoction	Oral
Fabaceae	*Bauhinia rufescens* Lam.	Tsattsagi		SSK037	0.69	68.60	T/W	B	General well being	Maceration	Oral
Fabaceae	*Cassia arereh* Delile	Malga		SSK093	0.68	38.24	S/W	R	Breast milk enhancement	Maceration	Oral
Fabaceae	*Cassia mimosoides* L.	Bagaruwar kasa	Fishbone cassia	SSK060	0.41	45.97	H/W	L	Skin rashes	Ointment	Dermal
Fabaceae	*Detarium microcarpum* Guill. And Perr.	Taura	Sweet dattock	SSK034	0.38	51.33	T/W	B	Pile	Maceration	Oral
Fabaceae	*Dichrostachys cinerea* (L.)Wight and Arn.	Dundu	Kalahari Christmas tree	SSK027	0.33	45.92	S/W	L	Headache	Ointment	Dermal
Fabaceae	*Entada Africana* Guill. And Perr.	Tawatsa	Sweet adenanthera	SSK075	0.28	67.86	T/W	L/B	Stomach ache	Powder	Oral
Fabaceae	*Erythrina senegalensis* DC	Minjirya	Coral tree	SSK092	0.58	51.45	H/W	WP	Anemia	Powder	Oral
Fabaceae	*Faidherbia albida* (Delile) A. Chev.	Gawo	Winter thorn	SSK103	0.72	46.54	T/W	B	General well being	Decoction	Oral
Fabaceae	*Indigofera astragalina*DC.	Kaikai koma kan mashekiya	Silky indigo	SSK006	0.77	73.28	H/W	WP	General well being	Decoction	Body bath
Fabaceae Family	*Isoberlinia doka* Craib and Stapf	Doka	Doka	SSK062	0.25	49.33	T/W	R	Stomach ache	Decoction	Oral
Fabaceae	*Parkia biglobosa* (Jacq.) G.Don	Dorawa	African Locust Bean Tree	SSK023	0.46	54.74	T/W	B	Stomach ache	Powder	Oral
Fabaceae	*Prosopi safricana* (Guill. And Perr.) Taub.	Kirya	African mesquite	SSK050	0.54	46.01	T/W	B	Fever	Maceration	Oral
Fabaceae	*Senna obtusifolia* (L.) H.S. Irwin and Barneby	Tafasa	Sickle pod	SSK033	0.19	82.14	S/W	L	Stomach aches	Powder	Oral
Fabaceae	*Senna occidentalis* L.	Tafasar Masar	Coffee Senna	SSK084	0.84	84.58	S/W	L	Fever	Decoction	Steaming
Fabaceae	*Senna singueana* (Delile) Lock	Runhu	Wild cassia	SSK054	0.25	46.67	S/W	R	Skin rashes	Ointment	Dermal
Fabaceae	*Sesbania dalzielii* E.Phillips and Hutch	Kalumbo		SSK049	0.75	73.89	H/W	WP	Labor inducement	Maceration	Oral
Fabaceae	*Stylosanthes erecta* P.Beauv.	Fasafako	Salazamby	SSK105	0.52	57.05	H/W	L	General well being	Powder	Oral
Fabaceae	*Tamarindus indica* L.	Tsamiya	Indian Date	SSK076	0.33	29.59	T/W	B	General well being	Maceration	Oral
Fabaceae	*Vigna unguiculata* (L.) Walp	Wake	Cowpea	SSK014	0.28	40.96	H/C	S	Breast milk enhancement	Powder	Oral
Lamiaceae	*Leucas martinicensis* (Jacq.) W.T. Aiton	Bunsurun fadama	White wort	SSK032	0.32	23.71	H/W	WP	Fever	Decoction	Oral
Lamiaceae	*Ocimum basilicum* L	Daddoya	Sweet basil	SSK109	0.52	33.97	H/W	WP	Ease labor	Maceration	Oral
Loganiaceae	*Strychnos spinosa* Lam.	Kokiya	Monkey orange	SSK097	0.19	33.33	S/W	B	Breast milk enhancement	Powder	Oral
Malvaceae	*Adansonia digitata* L.	Kuka	Baobab	SSK096	0.48	62.24	T/W	B	Diarrhea	Powder	Oral
Malvaceae	*Ceiba pentandra* (L.) Gaertn.	Rimi	Silk cotton tree	SSK090	0.62	73.26	T/W	L	Diarrhea	Powder	Oral
Malvaceae	*Gossypium barbadense* L.	Kada 'yar karfi	Tree cotton	SSK101	0.89	80.52	S/W	L	Diarrhea	Powder	Oral

Malvaceae	*Hibiscus sabdariffa* L.	Soborodo	Roselle	SSK074	0.46	38.85	S/C	FandL	General well being	Maceration	Oral
Malvaceae	*Pavonia senegalensis* (Cav.) Leistn.	Tsu		SSK081	0.44	75.94	S/W	R	General well being	Maceration	Oral
Malvaceae	*Sida ovate* Forssk.	Miyar tsanya		SSK008	0.27	56.25	H/W	WP	Diarrhea	Powder	Oral
Meliaceae	*Azadirachta indica* A. Juss	Bedi	Neem Tree	SSK003	0.72	49.77	T/WorC	L	Fever	Decoction	Body bath
Moraceae	*Ficus congensis* Engl.	Baure	Fig	SSK106	0.44	56.82	S/W	L	Diarrhea	Decoction	Oral
Moraceae	*Ficus platyphylla* Del.	Gamji	Guttapercha tree	SSK018	0.70	47.14	T/W	B	General well being	Powder	Oral
Moraceae	*Ficus thonningii* Bl.	Cediya	Strangler Fig	SSK111	0.19	23.21	T/W	B	Fever	Powder	Oral
Moraceae	*Ficus vallis-choudae* Del.	Kamasagi	False cape fig	SSK021	0.60	56.42	T/W	B	Ease labor	Maceration	Oral
Moringaceae	*Moringa oleifera* Lam.	Zogala	Drumstick tree	SSK058	0.85	83.98	S/WorC	L	Anemia	Direct	Oral
Myrtaceae	*Eucalyptus camaldulensis* Dehnh	Turare	River red gum	SSK012	0.68	55.12	T/W	L	Fever	Decoction	Steaming
Myrtaceae	*Psidium guajava* L.	Gwaba	Guava	SSK102	0.71	45.79	S/WorC	L	Fever	Decoction	Oral
Nyctaginaceae	*Boerhavia diffusa* L.	Babba jibji	Common Hogweed	SSK059	0.55	28.48	H/W	WP	Inflammation	Decoction	Oral
Olacaceae	*Ximenia americana* L.	Tsada	Tallow wood	SSK083	0.34	44.55	T/W	B	Skin rashes	Ointment	Dermal
Onagraceae	*Ludwigia octovalvis* (Jacq.) P.H.Raven	Shashatau	Willow Primrose	SSK039	0.30	50.56	S/W	L	Inflammation	Poultice	Dermal
Opiliaceae	*Opilia amentacea* Roxb.	Rugaggada	Opilia	SSK072	0.22	43.28	H/W	WP	Fever	Maceration	Oral
Papaveraceae	*Argemone mexicana* L.	Kankamarka ta bika	Mexican poppy	SSK066	0.38	39.47	S/W	L	Cold	Decoction	Steaming
Pedaliaceae	*Sesamum alatum* Thonn.	Ridin barewa	Winged-seed sesame	SSK053	0.52	55.77	H/W	WP	Ease labor	Decoction	Oral
Phyllanthaceae	*Bridelia ferruginea* Benth.	Kirni		SSK068	0.25	36.84	T/W	B	General well being	Decoction	Oral
Plantaginaceae	*Scoparia dulcis* L.	Ruma fada	Sweet broomweed	SSK089	0.30	34.83	H/W	WP	General well being	Decoction	Oral
Poaceae	*Cynodon dactylon* (L.) Pers.	Tsarkiyar zomo	Bermuda grass	SSK082	0.22	43.28	H/W	WP	General well being	Decoction	Oral
Poaceae	*Pennisetum glaucum* (L.) R.Br.	Gero	Pearl millet	SSK047	0.77	66.67	S/C	S	Breast milk enhancement	Direct	Oral
Poaceae	*Phragmites australis* (Cav.) Trin. ex Steud	Katala	Common reed	SSK051	0.46	41.61	S/W	B	Ease labor	Maceration	Oral
Polygalaceae	*Securidaca longipedunculata* Fresen.	Sanya	Violet tree	SSK055	0.59	60.11	S/W	B	General well being	Decoction	Oral
Rhamnaceae	*Ziziphus mauritiana* Lam.	Magarya	Indian jujube	SSK094	0.48	59.44	S/W	L	Jaundice	Maceration	Oral
Rhamnaceae	*Ziziphus spina-christi* (L.) Desf.	Kurna	Christ's thorn	SSK095	0.39	64.10	S/W	B	General well being	Maceration	Oral
Rubiaceae	*Gardenia aqualla* Stapfand Hutch.	Gaude	Gardenia	SSK046	0.26	36.71	S/W	L	Fever	Decoction	Oral
Rubiaceae	*Mitragyna inermis* (Willd.) Kuntze	Giyayya	False abura	SSK030	0.85	84.25	S/W	L	Inflammation	Poultice	Dermal
Rutaceae	*Citrus aurantifolia* (Christm.) Swingle	Lemun tsami	Lime	SSK069	0.71	82.63	S/C	L	Fever, Nausea	Decoction	Steaming
Sapotaceae	*Vitellaria paradoxa* C.F. Gaertn.	Kadanya	Shea butter tree	SSK019	0.45	34.33	T/W	B	Stomach ache	Maceration	Oral
Solanaceae	*Schwenkia Americana* Kunth	Dandana		SSK005	0.43	59.38	H/W	WP	Diarrhea	Decoction	Oral
Solanaceae	*Solanum americanum* Mill.	Gautan kaji	Bird pepper	SSK028	0.45	35.07	H/W	L	Skin rashes	Ointment	Dermal
Solanaceae	*Solanum lycopersicum* L.	Tumatir	Tomato	SSK080	0.38	46.49	H/C	F	Stomach ache	Juice	Oral
Vitaceae	*Ampelocissus Africana* (Lour.) Merr.	Farun makiyaya	Simple-leaved wild grape	SSK026	0.40	61.98	H/W	WP	General well being	Decoction	Oral
Vitaceae	*Cissus populnea* Guill. And Perr.	Loda	Food gum	SSK052	0.11	50.00	T/W	L	Labor inducement	Maceration	Oral
Vitaceae		Cancana kwanikka	SSK044	0.67	61.19	H/W	WP	Stomach ache	Powder	Oral	
Zingiberaceae	*Aframomum melegueta* K. Schum.	Citta mai 'ya'ya	Grains of Paradise	SSK031	0.59	65.73	S/C	Rh	Cold	Decoction	Oral
Zingiberaceae	*Zingiber officinale* Roscoe	Citta	Ginger	SSK110	0.66	44.16	S/C	Rh	Cold	Decoction	Oral
Zygophyllaceae	*Balanites aegyptiaca* (L.) Delile	Aduwa	Desert date	SSK004	0.40	26.89	T/W	L	Stomach ache	Maceration	Oral

RFC = Relative Frequency of Citation, FL = Fidelity Level, H = herbs, S = shrubs, T = tree, W = wild, C = cultivated, WorC = wild or cultivated B = bark, Bu = bulb, F = fruit, L = leaves, P = pod, Rh = rhizome, S = seed, and WP = whole plant.

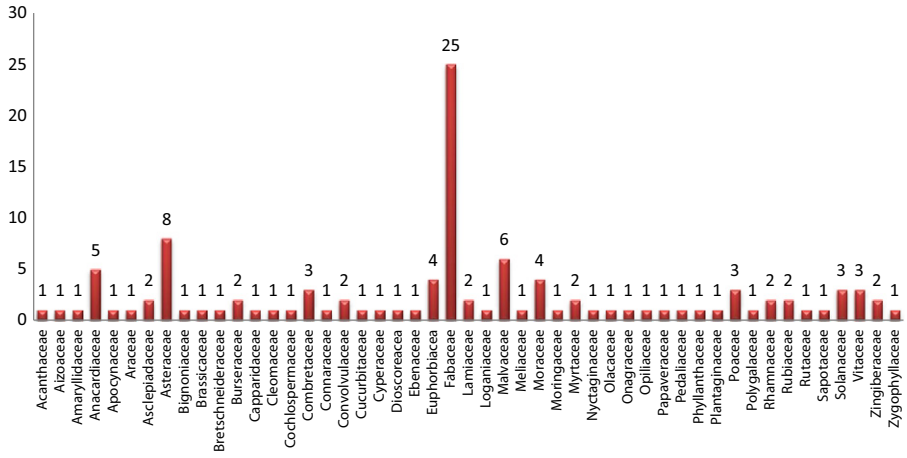

Fig. 2. Distribution of plant families used for traditional maternal health care in Katsina State, Nigeria.

identified in this study. *Guiera senegalensis*, *Ximenia americana*, *Parkia biglobosa*, *Anogeissus leiocarpa*, *Combretum micranthum*, *Securidaca longipedunculata*, *Adansonia digitata* and *Detarium microcarpum* are among the commonly reported medicinal plants used by pregnant women in Mali (Nordeng et al., 2013). *Zingiber officinale* is also used by pregnant women in Palestine to treat cold and fever (Al-Ramahi et al., 2013), whereas in Lao PDR, it is used for postpartum recovery and to enhance breast milk flow (Lamxay et al., 2011). Borokini et al. (2013) reported the use of *Argemone mexicana*, *Aframomum melegueta*, *Jatropha curcas* and *Euphorbia convolvuloides* by women in Oyo state, Nigeria. *Lawsonia inermis* is used to treat fibroids by women in Kenya (Kaingu et al., 2013). Abdillahi and Van Staden (2013) reported the use of *Senna occidentalis* and *Vigna unguiculata* for maternal healthcare and infertility in South Africa. It is interesting to note that this study provides the first medicinal report of *Centaurea perrottetii*, which was found to be the only plant utilized to cure postpartum hemorrhage, because to the best of our knowledge, no available literature exist on the medicinal utilization of this species. It is also worth noting that *Ricinus communis*, which was reported in almost all previous studies on maternal healthcare in Nigeria and other African countries, was not identified in this study. This finding indicates that the people in the study area use only locally available plant species for maternal health purposes because *R. communis* is only grown in the southern part of Nigeria.

It is also interesting to note that some medicinal plants used to treat diarrhea were identified in this study. Although diarrhea appears to not be included in the maternal health category, some nursing mothers do take these herbs because they believe that their babies would be cured from diarrhea by receiving the medication through breast feeding.

3.3. Relative Frequency of Citation (RFC) and Fidelity Level (FL)

Acacia nilotica, *G. senegalensis*, *Gossypium barbadense*, *Artemisia annua*, *Moringa oleifera* and *Mitragyna inermis* exhibited the highest Relative Frequency of Citation (RFC) values of 0.93, 0.92, 0.89, 0.89, 0.85 and 0.85, respectively, whereas *A. nilotica*, *G. senegalensis*, *A. annua*, *Anisopus mannii*, and *Euphorbia convolvuloides* had the highest Fidelity Level (FL) values of 100%, 100%, 95.13%, 92.49% and 85.49%, respectively. This analysis revealed that *A. nilotica*, *G. senegalensis* and *A. annua* had the highest RFC and FL combinations (0.93/100%, 0.92/100% and 0.89/95.13, respectively). Although *G. barbadense* has an RFC of 0.89, its FL is 80.52%, and *M. inermis* has an RFC of 0.85 and an FL value of 84.25%. *A. nilotica* was reported to be used for postpartum wound healing and was the only plant used for that purpose; thus, its Informant Consensus Factor (ICF) for postpartum wound healing was 1 (Table 3). Although many plants were reported to cure nausea, vomiting and diarrhea, *G. senegalensis* had a FL of 100% for these ailments, indicating consensus among all of the respondents who cited *G. senegalensis*; thus, this plant appeared to be the most important plant species identified in this study. Many studies (Yagana et al., 2012; Djifaby et al., 2012; Mamman and Isa,

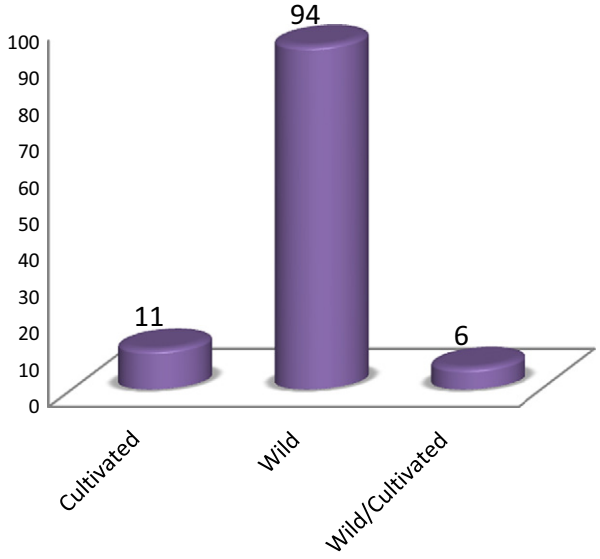

Fig. 3. Domestication status of medicinal plants used for traditional maternal health care in Katsina State, Nigeria.

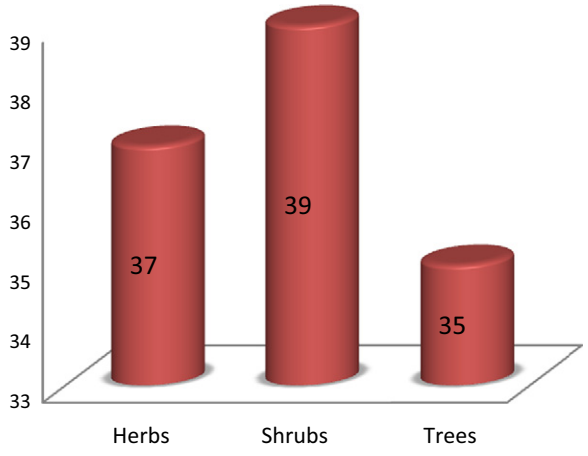

Fig. 4. Habit status of medicinal plants used for traditional maternal health care in Katsina State, Nigeria.

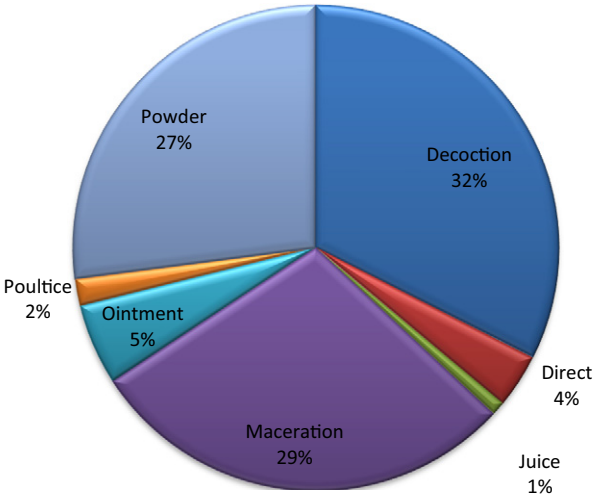

Fig. 5. Mode of preparation of medicinal plants used for traditional maternal health care in Katsina State, Nigeria.

2013; Sombié et al., 2013) support the use of *G. senegalensis* for antimicrobial activities. Kim and Lean (2013), however, reported that *Anastatica hierochuntica* L. is the most common herb used by pregnant women in Malaysia. Although previous studies have evaluated the biological activities of *A. nilotica* (Singh et al., 2008; Mlambo et al., 2009; Kalaivani and Mathew, 2010; Riaz et al., 2011), only one study (Baravkar et al., 2008) reported the wound healing activity of an extract of its leaves, and no scientific study has reported the wound healing activity of *A. nilotica* pods, which are frequently used for postpartum wound healing in the study area.

3.4. Informant Consensus Factor (ICF)

Eighteen categories of ailments associated with maternal health are reported in this study, and markedly high ICF values (0.983–1.000) were observed (Table 3). The highest ICF (1.000) was observed for headache, navel pain, postpartum hemorrhage and postpartum wound healing because only one plant was reported to cure each of these ailments and there was consensus among all of the respondents who cited these ailments. The lowest ICF (0.983) was recorded for skin rashes, although only four plants are used for treating this ailment. The high ICF observed in this study may be related to the filtering mechanism used because only those plants cited by at least three different respondents are reported due to the large sample population (300). The high ICF may also be linked to the effectiveness of the plants in curing the reported ailments, information sharing among the populace and the long-term usage of herbal medicine in the study area. Most of the reported plants (27) are used for general wellbeing, which may be linked to the antioxidant and immunostimulatory properties attributed to the identified plant species.

Table 3
Informant Consensus Factor (ICF) of categories of ailments associated with maternal health in Katsina State, Nigeria.

SN	Ailments	Taxa	Use citations	ICF
1	Anemia	2	304	0.996
2	Breast milk enhancement	11	954	0.989
3	Cold	5	389	0.989
4	Diarrhea	8	759	0.990
5	Ease labor	7	569	0.989
6	Fever	15	1411	0.990
7	Stomach pain	12	758	0.985
8	General well being	28	2420	0.988
9	Headache	1	45	1.000
10	Inflammation	4	352	0.991
11	Jaundice	3	187	0.989
12	Labor inducement	2	184	0.994
13	Nausea	3	456	0.995
14	Navel pain	1	86	1.000
15	Pile	3	205	0.990
16	Postpartum hemorrhage	1	67	1.000
17	Postpartum wound healing	1	279	1.000
18	Skin rashes	4	184	0.983

3.5. Dosage, mode of preparation and route of administration

In this study, no specific dosage with regard to quantity was found to be employed during medication. This represents a serious problem considering the fact that herbs, although considered safe, may contain some toxic elements, particularly when they are taken at a high dose. Fig. 6 shows the mode of preparation of the surveyed plants. Most of the medicines (32%) are prepared as decoctions, followed by maceration (29%), powder (27%), ointment (5%), direct intake (4%), poultice (2%) and lastly juice (1%). Decoctions are used mostly because of the belief that hot water extracts more constituents and because pregnant women and nursing mothers are always encouraged to take hot foods and drinks. This result agrees with the findings reported by Abdillahi and Van Staden (2013), who found that medicinal plants used for maternal health and infertility in South Africa are mostly prepared as decoctions. Decoction is also the most used herbal preparation by pregnant women in Mulanje District, Malawi (Maliwichi-nyirenda and Maliwichi, 2010). A special white potassium known as *jar kanwa* is in most cases added to the decoctions to neutralize the bitter taste of most of the medications. Ointments are mostly prepared using petroleum jelly, shea butter (*man kadanya*) and/or condensed fat from cow milk (*danyen mai*). Powdered medicines are mostly dissolved in liquid food, such as *fura*, *kunu*, *koko* or cow milk (*nono*). Medications are mostly administered via the oral route (84.68%), whereas only a few (15.32%) are administered by body bath, dermal, soaking or steaming methods, as shown in Fig. 7. Previous studies have revealed that most medicinal plants used for maternal healthcare are also administered orally (Bussmann and Glenn, 2010; Razafindraibe et al., 2013; Nordeng et al., 2013; De Wet and Ngubane, 2014)

4. Conclusions

This study provides the first documentation of the medicinal plants used for traditional maternal healthcare in Katsina state, Nigeria. It is obvious that this study opens the door to the scientific approach, which could lead to the transfer of natural wealth from folk traditions to the scientific evaluation of the pharmaceutical properties of the surveyed plants. The study reveals that despite the penetration of orthodox medicine, people in the study area still use medicinal plants for maternal healthcare. The plants are, however, menaced by many factors

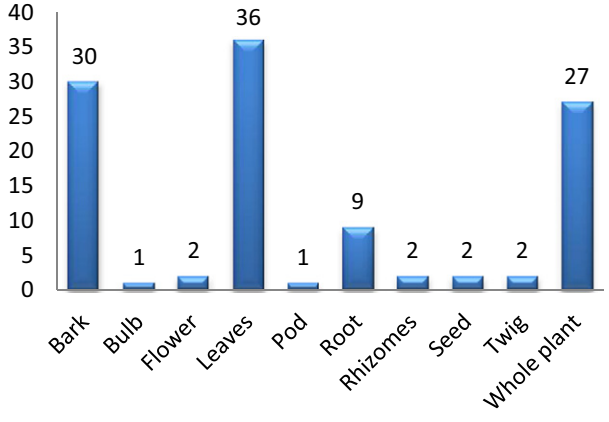

Fig. 6. Plants parts used for traditional maternal health care in Katsina State, Nigeria.

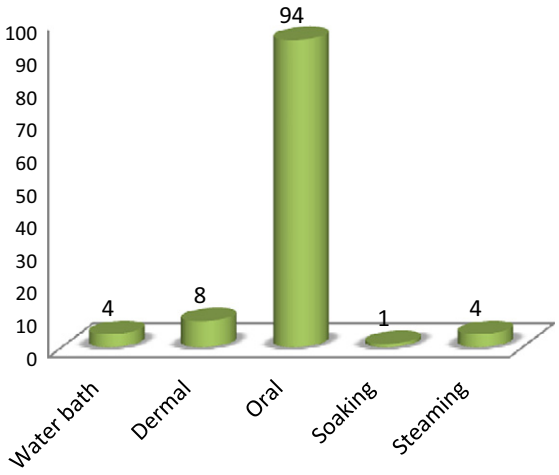

Fig. 7. Route of administration of plants used for traditional maternal health care in Katsina State, Nigeria.

associated with so-called "modernization". It is therefore imperative to conserve this cultural heritage by scientifically evaluating the biological activities of these medicinal plants. It is also important to encourage the populace to practice the cultivation of these plants because most of the plants reported are collected from the wild, and these wild species are facing other negative consequences.

Acknowledgments

We wish to express our sincere appreciation to the Management of Umaru Musa Yar'adua University Katsina for the PhD scholarship. We are also grateful to the local informants for sharing their invaluable wealth of knowledge with us. We equally thank all those who helped during the sampling and identification of the reported plant species.

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