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Ethno-Botanical Survey of Medicinal Plants used in Traditional Treatment of Erectile Dysfunction in Akinyele Local Government Area, Ibadan, Oyo State, Nigeria

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Abstract
The documentation of the medicinal uses of plants is becoming increasingly urgent because of the rapid loss of some plants' natural habitat due to anthropogenic activities. Traditional knowledge of medicinal plants is also at risk of extinction due to the dependency on oral transmission, and as such, there is an urgent need to document such knowledge. The study aimed to document medicinal plants used in the traditional treatment of erectile dysfunction in Akinyele Local Government Area, Oyo State, Nigeria, and was conducted from April to December 2019. A total of 160 respondents comprised of an equal number of Traditional Medical Practitioners (TMPs) or herbalists and hunters were selected from the study area. Medicinal information was collected using semi-structured questionnaires. The interview was conducted one-on-one using the local language (Yoruba). Data were analyzed with percentages, frequency of citation (FC) and relative frequency of citation (RFC). A total number of 25 plant species belonging to 20 families were reported to be used to treat erectile dysfunction in the study area. Fabaceae subfamily of Caesalpinioidea and Mimisoideae contributed the highest number of plant species. Of the plant identified during the survey, *Epimedium grandiflorum* had the highest frequency and relative frequency of citation (FC= 150, RFC = 0.94). Roots had the highest percentage of plant parts used. The major method of preparation of the recipes was by grinding while the route of administration of recipes was oral. Most medicinal plants are rare and collected from the wild (forest) while only a few are cultivated. The study showed that local people still have good knowledge of traditional treatment of erectile dysfunction**.** There is a need for domestication, adequate protection and conservation of these useful medicinal plants to prevent their extinction. Also, studies on the phytochemicals and pharmacological constituents of these medicinal plants to confirmed their bioactive ingredients relevant to the treatment of erectile dysfunction to be utilized for synthetic drugs.

Keywords: Ethno-Botanical Survey, Medicinal Plants, Traditional Treatment of Erectile Dysfunction

Introduction

Reproductive Health care is the second most prevalent health care problem on the African continent (Maud and Hannington 2005; Chinnoch, 1996). The advocates of reproductive health care have been focusing mainly on women and disregarding men. Thus, diseases such as erectile dysfunction (ED) that deserve mention have not been given due regard, to the detriment of families and societies as a whole (Maud and Hannington, 2005). Erectile dysfunction is still a major problem in many couples around the world in general and in sub-Saharan Africa in particular and it represents a serious problem of public health. It is a disorder that potentially affects men who tend to age 50 years old which causes vary from one individual to another (Latini *et al*., 2006). According to a survey done in three countries of Nigeria, Egypt and Pakistan by Shaeer *et al*. (2003), the age-adjusted prevalence rates of ED among men attending primary care clinics was 57.4% in Nigeria, 63.6% in Egypt, and 80.8% in Pakistan. Erectile dysfunction is the repeated inability to get or keep an erection firm enough for sexual intercourse (NIH, 2003; SFNC, 2004). The estimated range of men worldwide suffering from ED is from 15 million to 30 million (NIH, 2003). According to the National Ambulatory Medical Care Survey (NAMCS), for every 1,000 men in the United States, 7.7 physician office visits were made for ED in 1985. By 1999, that rate had nearly tripled to 22.3. This is in USA, where statistics are clearly compiled, and the level of awareness and education is high as compared to sub-Saharan countries like Nigeria. This is a clear indication that there are many silent men, particularly couples affected by ED.

Sexual dysfunction in males

Sexual dysfunction in males is manifested in several forms and can be classified as (i) arousal disorders; that encompass erectile dysfunction (Wagner, 1981), premature, retrograde, retarded or inhibited ejaculation (Metz *et al*., 1997), and failure of detumescence (prolonged priapism lasting over 4 hours) (Weidner *et al*. 1997), (ii) disorders of desire (low libido); which is the lack of sexual desire or interest in sex (Benet and Melman, 1995, Schiavi and Segraves, 1995), (iii) orgasmic disorder; which is the delayed or absence of orgasm. Globally, sexual dysfunction afflicts 10% of men of all ages, ethnicities and cultural backgrounds (Guay *et al*., 2003; Patel *et al*., 2011). The prevalence however rises to over 50% for men between 50 and 70 years of age (Rendell *et al*. 1999). In terms of numbers, Kandereel *et al*. (2001), approximates that 250 million men experience some form of sexual dysfunction and the number is expected to increase to 322 million by 2025.

Erectile Dysfunction (ED)

This is the persistent failure to generate sufficient penile body pressure to achieve vaginal penetration and/or the inability to maintain this degree of penile rigidity until ejaculation (Wagner, 1981), is associated with several factors including; hypogonadism (Chamness *et al*., 1995; Lugg *et al*., 1995), priapism (failure of detumescence) caused by the intake of phenothiazines or trazodone drugs (Crenshaw and Goldberg, 1996; Finger *et al*., 1997), psychological disorders (Arauju *et al*., 1998, Casper *et al*., 1985), diabetes mellitus (Podolsky, 1982), chronic and passive smoking, chronic liver disease (Jensen and Gluud, 1985), renal failure (Palmer, 1999), chronic obstructive pulmonary disease (Aasebo *et al*., 1993), tumour (Andersen, 1985; Cull, 1992), age related psychological issues (Shabsigh *et al*., 1998) and side effects of antidepressants and antihypertensive medication (Kandeerel *et al*., 2001). Premature ejaculation and disorders of sexual desire, for instance, are the frequently reported problems in young adult males with adverse familial relationships and could therefore arise from psychological disorders, and difficulty. A critical level of plasma androgens is essential for the maintenance of normal sexual desire.

Causes of Erectile Dysfunction (ED)

The causes of ED vary from one individual to another. For whatever cause, since an erection requires a precise sequence of events, ED can occur when any of the events is disrupted. This sequence includes nerve impulses in the brain, spinal column, and area around the penis, and response in muscles, fibrous tissues, veins, and arteries in and near the corpora cavernosa (NIH, 2003). Thus, ED causes reported include, damage to nerves, arteries, smooth muscles, and fibrous tissues. These are often as a result of diseases, such as diabetes, kidney disease, chronic alcoholism, multiple sclerosis, atherosclerosis, vascular disease, and neurologic diseases that account for about 70 percent of ED cases (NIH, 2003). According to NIH (2003), between 35 and 50 percent of men with diabetes experience ED. NIH (2003) further reported that the usage of many common medicines such as blood pressure drugs, antihistamines, antidepressants, tranquillizers, appetite suppressants, and cimetidine (an ulcer drug) can produce ED as a side effect. Nevertheless, psychological factors such as stress, anxiety, guilt, depression, low self-esteem, and fear of sexual failure cause 10 to 20 percent of ED cases. In addition, men with a physical cause for ED frequently experience the same sort of psychological reactions (stress, anxiety, guilt, depression) (NIH, 2003). Other possible causes are smoking, which affects blood flow in veins and arteries, and hormonal abnormalities, such as not enough testosterone (NIH, 2003).

Conventional Management of Sexual Dysfunction

Modern treatments are available for the management of erectile dysfunction. The oral prescription medication of popular Sildenafil citrate (Viagra) for instance has been used since early 1990s to modify hemodynamics in the penis (Segraves, 2003). It is effective, but in some men, it is not compatible and works in less than 70% of men with various etiologies (NIH, 2003). It is still associated with unpleasant side effects; headaches, flushing, dyspepsia, nasal congestion, increased blood pressure and sometimes predisposes one to a heart attack (Segraves, 2003). The availability of Viagra has brought millions of couples to ED treatment (Maud and Hannington, 2005). Oral testosterone can reduce ED in some men with low levels of natural testosterone, but it is often ineffective and may cause liver damage (SFHC 2004, Maud and Hannington, 2005). Other drugs such as Yohimbine, papaverine hydrochloride (used under careful medical supervision, (Evans, 2002; Maud and Hannington, 2005; Catherine *et al*., 2013), phentolamine, and alprostadil (marketed as Caverject) widen blood vessels. However, all these modern medications for the ED in men are very expensive for most of the rural people in developing countries (Maud and Hannington, 2005).

Herbal or Traditional Approach to the Management of ED

World Health Organization (WHO, 1991) had earlier estimated that more than 80% of the African population uses traditional medicine to relieve their primary health issues. This is an indication that herbal medicine is important in primary health care of the people. There are several reproductive ailments that local communities have been handling and treating for ages with medicinal plants. The use of medicinal plants for various health problems is not only a choice but is also linked to poverty due to and the high costs of modern medicines (Bivalacqua *et al*., 2001; Inkoto *et al*., 2018; Ngbolua *et al*., 2016). The widespread use of herbs is compounded by the fact that sildenafil, the standard drug for treatment of erectile dysfunction (ED) is very expensive, only effective for about 70% of those with erectile dysfunction (NIH, 2003; Magoha, 2000) and there is high availability of brands that are not very effective.

Folk remedies which generally have reduced side

effects besides being readily available and relatively inexpensive have been advocated and used since the 1930's for sexual dysfunction with varying degrees of success (Malviya *et al*., 2011; Meena *et al*., 2013). WHO (2003) reported that sexual dysfunction is one of the most frequently mentioned reasons that drive men to consult traditional healers. It might be contributing more to the prevalence of domestic violence in Nigeria and indeed the rest of the world. Erectile dysfunction for instance has been handled and treated by local communities for ages using several plant species (Sumalatha *et al*., 2010; Ramachandran *et al*., 2004), including several plants that have also been used as aphrodisiacs to increase sexual desire. Other studies have gone further and demonstrated the effect of plant extract on blood testosterone concentration (Malviya *et al*., 2011). In recent years, such findings have intensified the search for natural supplements from medicinal plants that could alleviate the symptoms of sexual dysfunctions, more so since herbs that have been used successfully to boost libido and induce erection also increase sperm count and consequently male fertility (Muanya and Odukoya, 2008). ED requires the use of plants because no sufficient modern treatment is available for its management (Mulwele *et al*., 2016). There are several medicinal plants that have been relied on for use in the treatment of ED. In Nigeria, several medicinal plants are sold for the treatment of erectile dysfunction. However, there is limited information on the traditional use of plants to treat erectile dysfunction in the study area, moreover, these plants and ethnobotanical indigenous knowledge have not been properly documented therefore this study was to document indigenous knowledge and medicinal plants used in traditional treatment of erectile dysfunction.

Materials and Methods

Study area

The study area of this research work is Akinyele Local Government Area of Ibadan Oyo State, Nigeria (Figure 1). It is one of the eleven local governments that make up Ibadan metropolis. Its headquarters is located at Moniya. It has latitude of 7^0 28` and $7^0$ 31` and longitude 3^0 53` and $3^0$ 57` **(**Yekinni and Oguntade, 2014**).** The whole Local Government Council area is five hundred and seventy-five square kilometres (575km2) with a projected population of 297, 600 as at 2016 from the 2006 national population census (NPC, 2006). The average annual rainfall is about 1200mm and ecological zone type is forest savanna. Akinyele Local Government is highly heterogeneous and metropolitan in nature, especially in areas like Ojoo, Orogun, Sasa, Moniya and Akinyele where Nigerians from different tribes and foreign nationals reside. This development is evident of the friendly and accommodating nature of the people of the local government. The major occupations of the people residing in the area are farming, carpentry, trading, marketing, food processing as well as carving work. Crops such as cassava, maize, yam, pepper, cucumber, watermelon, tomatoes and okra are mostly grown in the area **(**Stella, 2009; Yekinni and Oguntade, 2014**).**

Data collection and sampling techniques

The ethnobotanical survey of this study was collected from April to December 2019 using semi-structured questionnaires amidst informal conversation according to Huntington (2000). The survey was carried out in eight different villages of Akinyele Local Government. The villages were selected purposively due to the relic of forest in those villages and the presence of Traditional Medical Practitioners (TMPs) or herbalists and hunters in those villages. The villages are Ijaye, Onidundu, Otunagbakin, Moniya, Idi- ose, Apapa, Aroro and Olanla. Respondents were stratified into 2 strata in each of the villages, namely Traditional Medical Practitioners (TMPs) or herbalists and hunters. Within each stratum, a random selection of 10 respondents was carried out thereby making 20 respondents in each village and a total number of 160 respondents as the sample size. Interviews were conducted individually to 160 respondents which comprise 80 traditional medical practitioners (TMPs) or herbalists and 80 hunters. The interview was conducted with the aid of a well-structured questionnaire in local language (Yoruba language) of the respondents. During the survey, the information regarding medicinal plants used in the treatment of erectile dysfunction, local names of the plant, plant parts used and the form in which it is used, methods of preparation and mode of administration, doses and shelf life of the herbal recipes were collected from the respondents and documented. The local names of the plant species mentioned by the respondents were interpreted to their respective scientific names using the publication by Gbile and Soladoye (2002).

Data Analysis

Descriptive statistics

The data collected were analysed with descriptive statistics such as table, percentages, frequency of citation (FC), and relative frequency of citation (RFC).

Relative frequency of citation

The Relative Frequency of Citation was used to calculate the local importance of each plant species. It identifies the mostly used plant species by the local respondents. It is calculated following Tardi and Pardo-de-Santayana (2008), by dividing the frequency of citation (FC) by the total number of respondents survey (N). RFC= FC/ N

Results and Discussion

Floristic Analysis

Erectile dysfunction and/or impotence have profound and devastating effect on psychological well-being of the victim (Catherine *et al*., 2013). They can lead to low self-esteem, depression, negative effect on relationships and reduced life satisfaction; reducing the victim's worthiness in society (Kamatenesi- Mugisha and Oryem-Origa, 2005; Catherine *et al*., 2013). Erectile dysfunction, impotence and reduced fertility are old problems and traditionally, the indigenous knowledge had ways of managing them (Maud and Hannington, 2005). In this study, as presented on Table 1, a total number of 25 plant species belonging to 20 families are

used in the treatment of erectile dysfunction by all the respondents in the study area. Among the 25 species of plants, hunters made use of 8 species from 8 families (Table 2). These showed that herbalists made use of more plant species than hunters and are more knowledgeable in the treatment of erectile dysfunction than hunters in the study area. The number of plant species used in this study in the treatment of erectile dysfunction is slightly higher than 12 plant species from 12 families recorded by Lourens *et al.* (2015) in their study of erectile dysfunction: Definition and material medica of Bapedi traditional healers in Limpopo Province South Africa. But lower than 40 plant species belonging to 38 general and 27 families identified by Emile *et al.* (2018) used against erectile dysfunction in the Democratic Republic of Congo. Catherine *et al.* (2013) reported a total of 19 plant species in 15 genera and 13 families used for the treatment of male sexual dysfunction. Seven plants (46.7%) were used as aphrodisiacs to increase sexual drive, 6 plants (40.0 %) for the treatment of ED/impotence, 6 plants (40.0 %) to treat infertility and 2 plants (13.3%) were reported for treatment of all three conditions ED/impotence, sexual drive and infertility. In another study conducted by Maud and Hannington (2005), 33 medicinal plants belonging to 25 families and 30 general were identified and documented for the management of sexual impotence and erectile dysfunction in western Uganda.

Majority (18 species) of the medicinal plants used in the treatment of erectile dysfunction are rare and are collected from the (wild) forest or sourced from herb sellers (Table 1). This corroborates the findings of Olapade and Bakare (1992) who believed that the forests contained a lot of plants suitable as medicinal remedies. Patience *et al*. (2016) stated that the traditional healers interviewed in their study lacked medicinal plant gardens and collected medicinal plants from the forest. This agrees with the findings of Ngbolua *et al.* (2015); Inkoto *et al*. (2018) and Kikufi *et al.* (2017) who reported that the forest ecosystem is more species diverse than the non-forest ecosystems. Seven species of the medicinal plants in this study are found in the savanna and also on farmland while only very few (4 species) is cultivated. Patience *et al*. (2016) stated that 56 % of the medicinal plants are from the forest, 14 % are cultivated 12 % grow in grasslands/woodlands and farmlands (18 %). 22 species of the plant are native/ indigenous in this study and only 3 species are exotic or introduced. Okafor (1991) also stressed that most indigenous plants are found in wild and semi-wild habitats and are presently suffering from genetic erosion due to large scale deforestation activities of the Nigerian people.

Relative frequency of citation (RFC)

The most used plant species in the treatment of erectile dysfunction was determined by the relative frequency of citations. The relative frequency of citation presented in Table 1 showed that the specie *Epimedium grandiflorum* C. Morren was the most cited (FC= 150, RFC = 0.94), followed by *Aframomum meleguecta* (Roscoe) K. Schum. (FC= 125, RFC = 0.78), *Musa sapientum* L. (FC= 118, RFC = 0.74), *Carpolobia lutea* G. Don (FC= 115, RFC = 0.71), *Citrullus lanatus* (Thunb.) Matsum. & Nakai (FC= 109, RFC = 0.68), *Senna siamea* (Lam.) H.S. Irwin & Barneby (FC= 81, RFC = 0.51), *Sphenocentrum jollyanum* Pierre (FC= 80, RFC = 0.50), *Dioscoreophyllum cumminsii* (Stapf) Diels (FC= 61, RFC = 0.38), *Acacia nilotica* (Linn.) Wild ex. Del. (FC= 60, RFC = 0.38), *Buchholzia coriacea* Gilg (FC= 46, RFC = 0.29), *Dracaena mannii* Baker (FC= 40, RFC = 0.25), *Microdesmis puberula* Hook. f. ex Planch. (FC= 39, RFC = 0.24) and *Dioscorea alata* L. (FC= 35, RFC = 0.22) accounted for the most used species in the treatment of erectile dysfunction. Other medicinal plants species such as *Cnestis ferruginea* DC., *Picralima nitida* (Stapf) T. Durand & H. Durand, *Rauvolfia vomitoria* Afzel., *Cassia fistula* L., *Grewia venusta* Fresen., *Gladiolus dalenii* Van Geel, *Lecaniodiscus cupanioides* Benth., *Triplochiton scleroxylon* k.Schum, *Hyptis lanceolata* Poir, *Terminalia glaucescens* Planch. ex Benth., *Solenostemon monostachyus* (P. Beauv.) Briq. and *Senna tora (*L.) Roxb. had between 30 to 5 frequency of citation and 0.19 to 0.03 relative frequency of citation respectively. This showed the relative importance of these plants in the treatment of erectile dysfunction. However, plant species with high RFC should be further analyzed for phytochemical and pharmacological compounds, to recognize their active chemical components for drug discovery; similar observation was made by (Vitalini *et al*., 2009).

Family distribution of medicinal plants

The family distribution of medicinal plants presented on Table 3 showed that Fabaceae sub family of Caesalpinioidea and Mimisoideae contributed the highest number of species (3) used in the treatment of erectile dysfunction and it accounted for 12%. Families such as Apocynaceae, Lamiaceae, Malvaceae and Menispermaceae had 2 species each (8%) while other families where represented with only one species (4%). This agrees with the finding of Patience *et al*. (2016) which stated that members of the family Fabaceae were used to treat the highest percentage (28 %) of ailments. This was followed by Solanaceae (24 %), Asteraceae and Euphorbiaceae (19 %) each, Amaranthaceae, Balanitaceae and Rutaceae 14 % each, Anarcadiaceae, Moraceae, Poaceae, Bignoniaceae 12 % each while families Alliaceae, Caricaceae, Dracaenaceae, Lamiaceae, Minespermaceae, Rosaceae, Rubiaceae, Verbenaceae and Zingiberaceae 10 % each and the rest treated less than 10 %. Maud and Hannington (2005) found the family Rubiaceae (4) to be the most represented followed by Alliaceae, Euphorbiaceae, Mimosaceae, Papilionaceae and Caesalpinaceae families which have two species each and the rest with one species. Catherine *et al*. (2013) in their study reported that Capparaceae was the most represented family with 3 species, followed by Annonaceae, Combretaceae, Labiatae, Tiliaceae with 2 species each, and the rest with 1 specie each.

Growth form of medicinal plants

The analysis of the growth form of medicinal plants used in the treatment of erectile dysfunction on Table 4 showed that trees and herbs had an equal number (8 species each) of plants used in the treatment of erectile dysfunction, this forms 32% each. This was followed by shrubs with 7 plant species which constitute 28% while climbers had only 2 plant species used and it account for 8%. However, Emile *et al*. (2018) reported that the medicinal plants used against erectile dysfunction are mainly represented by trees (38%), and then followed by shrubs (26%), lianas and perennials 15% respectively. While the sub-shrubs and annual herbs represent each 3% respectively. Maud and Hannington (2005) in their study found the plant composition to consist of 42.4% shrubs, 39.4% herbs and herb climbers and 18.2% trees. In another study conducted by Tilahun and Moa (2018), shrubs constitute the highest proportion being represented by 34 species (48.6%), herbs represented by 17 species (24.3%), trees represented by 13 species (18.6%), and climbers represented by 5 species (7.1%), while there was one species (1.4%) of epiphyte. The high use of herbs in this study could be attributed to their abundance throughout the year as reported previously by (Hamilton, 2004; Tabuti *et al*., 2003; Oryem-Origa *et al*., 2003; Namukobe *et al*., 2011). The popularity of herbs as a source of herbal therapies is often attributed to their high pharmacologically active ingredients as compared to woody plants (Kamatenesi *et al*., 2011). Shrubs are preferred due to their availability all year round since they are relatively drought resistant and are not affected by seasonal variations (Katema *et al*., 2013).

Plant parts used in the preparation of herbal remedies (Recipes)

Different plant parts of medicinal plants are used to make herbal preparations. The plant parts used in the preparation of recipes for the treatment of erectile dysfunction are roots, leaves, seeds, barks, fruits pod, tubers and sticks (Table 5). According to Emile *et al*. (2018), the different plant parts used for the preparation of recipes used against erectile dysfunction are root, bark, leaf, fruit rhizome and seed. The most widely use plant part in this study was roots with 34.48%. This agrees with the finding of Catherine *et al.* (2013) which stated that the plant parts mostly used in the management of males sexual dysfunction and infertility were roots (84%) and root bark (16%). Emile *et al*. (2018) also stated that roots (42%) are the most used part of different plants utilized to relieve erectile dysfunction in the DRC. They were followed by barks (25%), leaves (23%), fruits and seeds (4% each) and rhizomes. The finding of the roots as the most plant part used is also in line with similar study conducted by (Hunde *et al*., 2006), in which roots (31.4%) were reported as the most widely used plant part followed by leaves 24.4%. The study conducted by Yineger and Yewhalaw (2007) showed that roots 42% is the major plant parts used and Teklehaymanot and Giday (2007) also documented roots 35.8% as a major plant parts used in the treatment of human ailments. However, Maud and Hannington (2005) stated that leaves (57.6%) are the commonest plant parts followed by roots (42.1%) and barks (27.3%). Other plant parts used are stem, root-tuber, fruit, seeds and whole plant. The most feasible explanation for the widely use of roots in this study could be due to cultural belief that roots due to their close contact with soil contain the highest concentration of bio-active compounds. Similar report was made by Lourens *et al.* (2015). It is also believed that roots contain more concentration of active ingredients (Tilahun and Moa, 2018). In this regard, Mesfin *et al.* (2009) have indicated that plant harvest involving roots, rhizomes, bulbs, bark, and stem has a serious effect on the survival of the mother plant in its habitat. Emile *et al*. (2018) stated that the large-scale use of roots is a dangerous practice as it would contribute to the erosion of these plant resources. However, the findings of Regassa *et al.* (2017), Alemayehu *et al*. (2015), Abera (2003) and Kitata *et al*. (2017) indicated that traditional medicinal preparations mainly involve the use of leaves. As leaves of medicinal plant species were also reported to be harvested for most remedy preparations next to roots, the collection of leaves could be promoted as a more sustainable method since in most cases at least many leaves are left over on the parent plant (Lulekal *et al*., 2013). Harvesting leaves for medicinal use ensures plant survival, unlike the roots which may threaten its continuity (Lulekal *et al*., 2008; Yin, 2009), unless a sustainable harvesting strategy has been developed (Cunningham, 2001). The use of roots in this study was followed by leaves which had 17.24%, seeds and fruits had equal value of 13.39%. The use of bark constitutes 10.34% while pod, tuber and stick had equal value of 3.45% each respectively. Plant species such as *Aframomum meleguecta*. *Carpolobia lutea*, *Lecaniodiscus cupanioides*, *Dioscoreophyllum cumminsii*, and *Buchholzia coriacea* has more than one part used in the preparation of recipes used in the treatment of erectile dysfunction.

Method of preparation, mode of administration, dosage and shelf life of the recipe

Tables 6 and 7 showed the method of preparation and mode of administration of recipes used in the treatment of sexual dysfunction and male infertility in the study area. A total number of eleven herbal remedies were revealed by the herbalists and eight by the hunters. Herbal remedies, ranging from those for promoting sperm production and motility to formulations for increasing testosterone levels, enhancing normal functioning of the male reproductive organs, and strengthening erection and sex drive are easily available in Nigeria (Afolayan and Yakubu, 2008).

When herbal remedies are used, the dosage form, as well as the method of preparation and administration is very important, as it will determine bio-availability (Steencamp, 2003). The respondents employed various herbal preparation methods to treat erectile dysfunction in the study area. The result showed that most of the herbal remedy preparations were formulated from the mixture of two or more plants (Table 1) to provide a

synergistic effect (when the combined effect exceeds the sum of the effects of individual herbs) in the treatment of erectile dysfunction. This showed that herb-herb interaction may lead to a better bioavailability of the active ingredient (Sun *et al*. 2012). Also animals such as deer, horse, he-goat parts, vertebrates and invertebrates like viper snake, honey and snail were used in the preparation of recipes for the treatment of erectile dysfunction (Table 8). This finding is in line with the statement of Chun *et al*. (2013) that most Chinese medicine prescriptions contain more than one medicinal plant (and/or animal/mineral substance) to form a multi-item concoction (*fu-fang*). This also agreed with the report of Yineger and Yewhalaw (2007) and Yineger *et al*. (2008) where mixtures of different species were used to treat ailments than the use of single species. The potency of using a mixture of different plant or plant parts increased compared to using a single plant to cure a disease is evident (Tilahun and Moa, 2018). Some of the Traditional Medical Practioners (TMP's) or herbalists stated that the use of multiple plant species in the preparation of recipes could increase the efficacy of the recipe in the treatment of erectile dysfunction. According to Bussmann and Sharon (2006), the use of more than one plant species to prepare a remedy for ailments is attributed to additives or synergistic effects during ailment treatment. The use of a mixture of herbs could bring positive (complementation) or negative (antagonism) outcomes in the treatment of disease. The combined effect, either complementary or antagonistic, would be manifested in the clinical outcome.

The method of preparation of recipe in this study varied from grinding, squeezing soaking, burning and steaming (Table 6). Maud and Hannington (2005) reported that the herbal medicines used in the management of sexual impotence and erectile dysfunction are mainly prepared by boiling, pounding, cooking, roasting and smoking. Some of the recipes were mixed with adjuvants such as honey, alcohol/ hot drinks/ gin, and fermented water from pap. The use of honey, milk, sugar, and other non-plant adjuvants in the preparation of herbal medicines has been reported in other studies (Benarba *et al*. 2015; Bhatia *et al*., 2015; Ouelbani *et al*., 2016). Additives used in herbal medicine preparation included silverfish, ash, salt, alcohol, tea and onions (Patience *et al*., 2016). The use of alcohol may possibly improve the kind of active chemicals extracted from the plants than water; similar observation was made by Kamatenesi-Mugisha (2004). According to Kamatenesi-Mugisha (2004), the dispensing of herbal medicines is used in sexual impotence and ED using local beers, fermented milk, porridge and alcohol.

The mode of administration of the herbal recipes is mainly oral administration (drinking and licking) and rubbing on the incision. This agrees with the finding of Catherine *et* al. (2013) which stated that all preparation for the management of male sexual dysfunction and infertility were administered orally. According to Maud and Hannington (2005), the commonest method of herbal administration was by oral means such as food, herbal teas or by mixing in several drinks including locally made beer. Some more studies reported that the oral route of administration is the most common (Belayneh *et al*., 2012; Megersa *et al*., 2013; Teklehymanot and Giday, 2007; Yineger and Yewhala, 2007; Yineger et al., 2008). The choice of oral administration in this study may be related to the use of some solvents/ additives or adjuvants such as water, honey, alcohol/ hot drinks/ gin, fermented water from pap that are commonly believed to serve as a vehicle to transport the remedies.

The measurement of the dosage used includes half a stainless cup, a teaspoon, one shot of glass and a tumbler. There is no standard dosage for the recipes and none of the respondents provided any information on the optimization and standardization of the administration of these recipes. This represents the major drawback of traditional medicine (Asase *et al*., 2005). Lack of precision and standardization was mentioned as a global drawback of traditional healthcare system (Abebe, 1986; Megersa *et al*., 2013; Parvez and Yadav, 2010). Similarly, in this study where the major route of administration of herbal recipes was orally, lack of precision can be taken as the major drawback. The lack of precise dosage is one of the drawbacks of traditional medicinal plants (Getahun, 1976; Yirga, 2010).

Most of the respondents in this study especially traditional medical practitioners (TMPs) or herbalists believed that the practice of herbal medicine should be done with secrecy to guide their native knowledge. They stated that the secret practices of traditional medicines came from their ancestors and also for the potency of their herbal medicine. This agrees with the finding of Abel and Busia (2005) and Darko (2009) who stated that it is a common practice for some traditional herbalists to guide their native knowledge by creating mystery around herbal formulations and dosages administered to patients. Secrecy is considered one of the primary obstacles facing the spread of traditional indigenous knowledge among inhabitants (Kwame *et al*., 2019). This mystery of secrecy surrounding medicinal plants also blocks any attempts to reconcile the divide between herbalists and conventional medicinal systems.

It is important to note that some of the plants documented in this research have been reported by several authors while others are coming up for the first time in the treatment of erectile dysfunction. Kwame *et al*. (2019) agree with the use of *Sphenocentrum jollyanum* in the treatment of erectile dysfunction and impotence. The use of *Carpolobia lutea*, *Citrilus lanatus*, *Musa sapientum* and *Aframomum melegueta* on the treatment of male infertility has been reported by these respective authors (Aiyeloja and Bello, 2006; Burkill, 1985; Erhabor *et al*., 2013; Kafaru, 1994; Yativ and Harary, 2010). *Epimedium* herbs such as *Epimedium grandiflorum* (horny goat weed) have been found to be useful in the treatment of erectile dysfunction (HO & Tan, 2011). This is in line with Dr

Popola report on the pages of newspaper The Nation (2015) which stated that *Epimedium grandiflorum* is a local herb that has been in use for over 100 years to enhance sexual prowess. This, he said, can be given to men suffering from impotence to invigorate their sexual organs without any side effect. It was also reported that some *Acacia* species are regarded as aphrodisiacs in Niger (Baoua *et al*., 1976). The report of Selin *et al.* (2018) showed that *Cassia fistula* is used as stimulant of sexual intercourse (aphrodisiac agent). Emile *et al.* (2018) reported the use of *Microdesmis puberula* in the treatment of erectile dysfunction.

However, some of the plant species such as *Acacia nilotica, Buchholzia engleri, Senna tora, Cnestis ferruginea, Dioscoreophyllum cumminsii, Dioscorea alata, Dracaena manni, Grewia venusta, Gladiolus dalenii, Hyptis lanceolata, Lecaniodiscus cupanioides, Picralima nitida, Rauvofia vomitoria, Senna siamea, Solenostemon monostachyus, Triplochiton scleroxylon* and *Terminalia glaucescens* documented in this work has not been reported in literature for the treatment of erectile dysfunction. These plant species will add to the already existing indigenous knowledge of plants used in the treatment of male infertility in Nigeria and the world at large.

The sexual performance enhancing properties of the inventory plants could not be validated but there are evidence from the literature that Arginine is a regulator of penile erection and those disorders that reduces its synthesis or release in its penile tissues result in erectile dysfunction (Burnett 1997, 2004). The presence of steroidal saponins as possible cause of increase in testosterone levels in animals (Walid *et al*., 2007). Studies by Gauthaman *et al*. (2002), Gauthaman and Ganesan (2008) also reported increase in testosterone levels caused by steroids, specifically Protodioscin. Free amino acids and specifically arginine, which has been reported to have aphrodisiac effects as it is converted into nitric oxide which is an important vasodilator in the penile cavernosal tissue (Burnett, 2004). Ambrein has been shown to relax corpus cavernous smooth muscle or other smooth muscles in animal models (Kim *et al*., 1998; Taha *et al*., 1998). Some plants are usually used as aphrodisiac agents due to their strong antioxidant activities (Selin *et al*., 2018). Oxidative stress or excessive production of free radicals can damage sexual hormones and also decrease libido (Selin *et al*., 2018). This damage can cause infertility and decrease libido in both women and men. Recently, studies revealed that lipid peroxidation plays significant role at infertility especially affecting sexual hormones, sperm motility and viability (Selin *et al*., 2018).

Similarities and Differences in the Knowledge of Herbalists and Hunters in the Treatment of Erectile Dysfunction in the study area

The study showed differences and similarities in the knowledge of herbalists and hunters in the treatments of erectile dysfunction in the study area. This study clearly showed that herbalists are more experienced and knowledgeable in the treatment of erectile dysfunction than hunters in the study area. This was judged based on the number of plant species used by the two groups of respondents. Herbalists made use of 25 plant species while hunters used only 8 plant species (Table 1 & 2). Herbalists made use of non-plant materials, animals both vertebrates and invertebrates (Table 8) in the preparation of recipes while hunters used only plant species in the treatment of erectile dysfunction. All the 11 recipes used in the treatment of erectile dysfunction in this study were mentioned by the herbalist among which only five were mentioned by the hunters (Tables 6 & 7). The mode of preparation of the herbal remedy by the herbalist was more complex ranging from grinding, squeezing, soaking, burning and steaming while hunter prepared their recipes by squeezing and grinding.

Conclusion

Nigeria is endowed with abundant forest land rich in valuable medicinal plant species with a vast heritage of traditional knowledge. The use of medicinal plants and traditional or indigenous knowledge has played and will continue to play a critical role in the health care delivery system in Nigeria for as long as modern health care facilities continue to be an illusion and unavailable to the vast majority of the populace. However, it can be concluded from the findings of the studies that a total number of 25 plant species belonging to 20 families were used in the treatment of erectile dysfunction by the respondents in the study area. Herbalist uses more plants than hunter and is more experienced and knowledgeable in the treatment of erectile dysfunction than hunters in the study area. Plant species with the highest number of families are found in Fabaceae sub-family of Caesalpinioidea and Mimisoideae while trees and herbs had the highest percentage of plant growth form. Roots had the highest percentage of plant parts used. The major method of preparation of the recipes was by grinding while the route of administration of recipes was oral. Majority of medicinal plants used are rare and gotten from the wild (forest) while only a few are cultivated. There is need for domestication, adequate protection and conservation of these useful medicinal plants to prevent their extinction. Research on the efficacy and safe use of these plants, standardization of doses and quality of the products are to be embarked upon. Also studies on the phytochemical and pharmacological constituents of these medicinal plants to confirmed their bioactive ingredients relevant to the treatment of erectile dysfunction to be utilized for synthetic drugs. Some of the plant species used as medicine for erectile dysfunction in this study may have some medicinal value for any other diseases. This area needs to be explored in future study.

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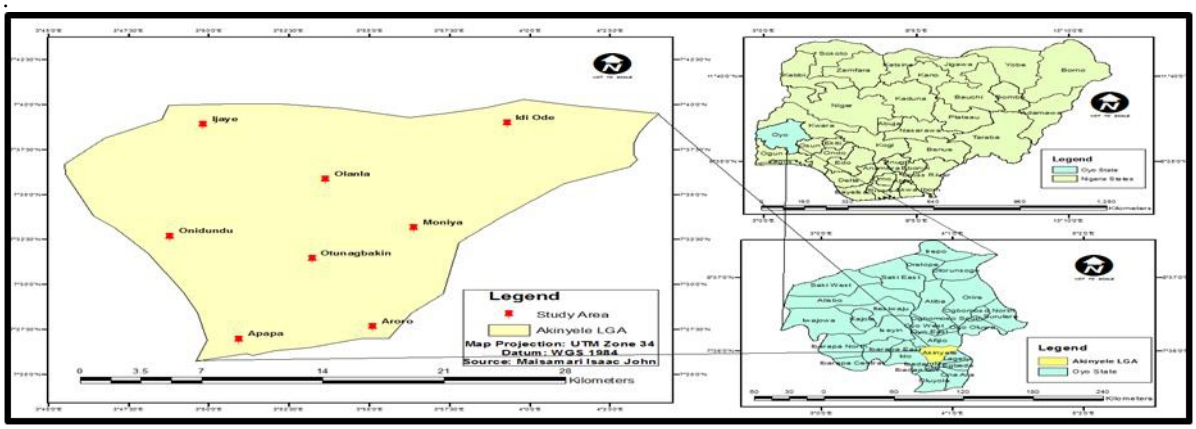

Figure 1: Map of Nigeria showing Oyo State and the Study Area

Table 1: Plants used in the treatment of Erectile Dysfunction in the study area

S/n	Botanical names	Family name	Form	Common names	Local name	Plant part and form used	Habitat, Cultivation, Abundance (Rare/ common), Native/ Introduced	Frequency of citation (FC)	Relative frequency of citation (RFC)
1	*Acacia nilotica* (Linn.) Wild ex. Del.	Fabaceae-Mimo	Shrub	Gum Arabic tree	Bonni	Dry seed	Forest, rare, wild, exotic	60	0.38
2	*Aframomum meleguecta* (Roscoe) K. Schum.	Zingiberaceae	Herb	Alligator pepper	Atare	Fruit or bunch, seed	Forest/ farmland, cultivated, common, native.	125	0.78
3	*Buchholzia coriacea* Gilg	Capparaceae	Tree	Wonderful kola	"Uwuro"	Fresh or dried bark and fruit	Forest, wild, rare, native	46	0.29
4	*Carpolobia lutea* G. Don	Polygonaceae	Shrub	Cattlestick	Osunsun	Stick, Fresh or dry root	Forest, rare, wild, native	115	0.71
5	*Cassia fistula* L.	Fabaceae- Caes.	Tree	Golden tree	Aidantooro	Fresh or dry seed	Savanna, wild, rare, native	19	0.12
6	*Citrullus lanatus* (Thunb.) Matsum. & Nakai	Cucurbitaceae	Herb	Mellon pod	Bara	Pod	Farmland, cultivated, common, native	109	0.68
7	*Cnestis ferruginea* DC.	Connaraceae	Shrub	Cnestis	Akara-aje, Omu-aja	Fresh young leaves	Fforest, savanna, wild, rare, natives	30	0.19
8	*Dioscorea alata* L.	Dioscoreaceae	Climber	Water yam	Isu ewura	Fresh tuber	Farmland, cultivated, common, native	35	0.22
9	*Dioscoreophyllum cumminsii* (Stapf) Diels	Menispermaceae	Climber	Serendipity Berry	Inunurin	Root and fruits	Forest, wild, rare, native	61	0.38
10	*Dracaena mannii* Baker	Agavaceae	Shrub	Small leaf dragon-tree	Peregun	Fresh root	Secondary forest, savanna, wild. rare, native	40	0.25
11	*Epimedium grandiflorum* C. Morren	Berberidaceae	Herb	Honey goat weed	Gboingboin, egbo atorin	Fresh or dried root	Forest, wild, rare, native	150	0.94
12	*Gladiolus dalenii* Van Geel	Iridaceae	Herb	(Sword lily)	Eso Baaka	Fresh or dry seed	Farmland/savanna, common, native	15	0.09
13	*Grewia venusta* Fresen.	Malvaceae	Tree		Ogbolo	Fresh root	Forest, wild rare, native	18	0.11
14	*Hyptis lanceolata* Poir	Lamiaceae	Herb	Hyptis	Jogbo	Fresh leaf	Forest edges/ farmland, rare, exotic	9	0.06
15	*Lecaniodiscus cupanioides* Benth.	Sapindaceae	Tree	Lecaniodiscus	Aaka	Dry root, fresh young growing	Forest, wild, rare, native	13	0.08

						leaves			
16	*Microdesmis puberula* Hook. f. ex Planch.	Pandaceae	Shrub	Microdesmis	Osunsun	Dried root	Forest, wild, rare, native	39	0.24
17	*Musa sapientum* L.	Musaceae	Herb	Plantain	Ogede agbagba	Ripe fruit	Forest, savana, farmland, common, cultivated, exotic	118	0.74
18	*Picralima nitida* (Stapf) T. Durand & H. Durand	Apocynaceae	Tree	Akuamma plant, Picralima	Abere	Dry seed	Forest, rare, wild, native	25	0.16
19	*Rauvolfia vomitoria* Afzel.	Apocynaceae	Shrub	African serpentwood, African snakeroot	Asofeyeje	Fresh or dry bark	Secondary forest, savanna, wild, rare, native	22	0.14
20	*Senna siamea* (Lam.) H.S. Irwin & Barneby	Fabaceae- Caes.	Tree	Senna	Kasia	Fresh root	Forest/ farmland, cultivated, common, native.	81	0.51
21	*Senna tora (*L.) Roxb.	Liliaceae	Herb		Epa ikun	Root	Farmland/savanna, rare, native	5	0.03
22	*Solenostemon monostachyus* (P. Beauv.) Briq.	Lamiaceae	Herb	Catnip	Agogo-igun, Aranpolo	Fresh leaves	Savanna, wild, common, native	7	0.04
23	*Sphenocentrum jollyanum* Pierre	Menispermaceae	Shrub	Sphenocentrum, Local gum plant	Akerejupon,Burantasi	Fresh or dry root	Forest, wild, rare, native	80	0.5
24	*Terminalia glaucescens* Planch. ex Benth.	Combretaceae	Tree		Idi-apata	Fresh or dried bark	Forest, wild, rare, native	6	0.04
25	*Triplochiton scleroxylon* k.Schum	Malvaceae	Tree	Obeche, African white wood	Arere	Young growing fresh leaves	Forest , wild, rare, native	10	0.06
Total: Forest = 18, Savanna = 7, Farmland =7, Wild = 15, Rare = 18, Common = 7, Cultivated = 4, Native/ indigenous = 22, Exotic/ introduced= 3									

Table 3: Family distribution of medicinal plants

S/N	Families	Frequency	% Occurrence
1	Agavaceae	1	4.0
2	Apocynaceae	2	8.0
3	Berberidaceae	1	4.0
4	Capparaceae	1	4.0
5	Combretaceae	1	4.0
6	Connaraceae	1	4.0
7	Cucurbitaceae	1	4.0
8	Dioscoreaceae	1	4.0
9	Fabaceae- Caes.	2	8.0
10	Fabaceae-Mimo	1	4.0
11	Iridaceae	1	4.0
12	Lamiaceae	2	8.0
13	Liliaceae	1	4.0
14	Malvaceae	2	8.0
15	Menispermaceae	2	8.0
16	Musaceae	1	4.0
17	Pandaceae	1	4.0
18	Polygonaceae	1	4.0
19	Sapindaceae	1	4.0
20	Zingiberaceae	1	4.0
	Total	**25**	**100**

Table 4: Distribution of plant growth form of medicinal plants

S/N	Plant Form	Frequency	% Occurrence
1	Climber	2	8.0
2	Herb	8	32.0
3	Shrub	7	28.0
4	Tree	8	32.0
	Total	**25**	**100**

Table 5: Plant parts used in the preparation of recipes

S/N	Plant parts	Frequency	% occurrence
1	Root	10	34.48
2	Leaves	5	17.24
3	Seed	4	13.79
4	Fruit	4	13.79
5	Bark	3	10.34
6	Pod	1	3.45
7	Tuber	1	3.45
8	Stick	1	3.45
	Total	**29**	**100**

Table 6: Result of Herbalist Method of preparation and mode of administration of recipes

S/n	Method of preparation of recipes	Mode of administration, dosage and shelflife
1	Collect equal fresh root of *Senna siamea* (Kasia) and *Grewia venusta (Ogbolo*). Cut the root of cassia and split the root of *Grewia venusta* and put in a plastic bottle. Add the seeds of *Picralima nitida* (Abere) and *Acacia nilotica* (Bonni). With small leaves of *Hyptis lanceolata.* (Jogbo). Grind ''*edo tiro*'' to powder and add it to it. Then pour fermented water from pap (*omi ogi* or *omidun*) to it and leaf it overnight.	Drink half stainless cup twice daily. Until it finishes
2	The tail of viper snake (Ejo oka) is grinded with one seed of *Aframomum meleguecta* (Atare) into powder.	Make one incision at the back near the bottom (*eba idi* or *igegeru*) and rub it with the powder
3	The rod inside the horn of Deer (*Odocoileus virginianus*) (*opa inu iwo igala*) is grinded or burnt with one bunch of *Aframomum meleguecta* (*odidi atare kan*) and pour inside the horn of Deer or bottle with honey. Use the stick of *Carpolobia lutea* (Osunsun) to stir it.	Lick the honey from the stick three times daily for three days. Do not use hand to lick it otherwise it will not work. Do not go near woman until after three days. Until it finishes
4	Steam two *Citrullus lanatus* pods (mellon pod) or (*bara*) in fire (*a o bu bara meji ninu ina*). Squeeze water out of the steam melon pod and add equal quantity of honey to the water from squeezed melon pod, and mix together.	The man should take two teaspoon in the first day and one tea spoon the third day and two teaspoon again after the third day all at night. Do not go near woman until after three days. Until it finishes
5	Fresh root of *Dracaena manni* (*Peregun*) and *Dioscorea alata* ("*Isu ewura*"), one big matured *Achatina achatina* (snail- *Igbin*), small sugar are grinded together and dried. Ash the shell of the same snail and grind it with the powder obtained above, dry it and put it in a bottle.	Use a tea spoonful with pap or hot drink or lick For treatment of low sperm count and weak erection. When the powder finishes
6	Root of *Epimedium grandiflorum* (Gboingboin), *Sphenocentrum jollyanum* (Akerejupon), *Lecaniodiscus cupanioides* (Aaka), *Carpolobia lutea* (Osunsun), and *Senna tora* (Epa ikun), vine and fruits of *Dioscoreophyllum cumminsii* (Inunurin), bark of *Rauvofia vomitoria* (Asofeyeje), bark and fruit of *Buchholzia coriacea*(Uwuro), seeds of *Gladiolus dalenii* (Baaka), *Cassia fistula* (Aidantooro), penis of goat, horse, and *Ese* (Oko *obuko, esin* and *ese*), Cut all into pieces and put in a rubber container or bottle with cover, pour hot drink/ local gin or shinnapp/ Gin on it and cover	Drink one shot twice daily When it becomes tasteless
7	Collect fresh root of *Sphenocentrum jollyanum* (*Akerejupo*) and put it in a covered bottle with hot drink.	Drink a shot every morning. Until it finishes
8	Squeeze the leaves of *Triplochiton scleroxylon* (*Arere*) with water and filter	Drink half stainless cup two times daily. One day
9	Squeeze fresh leaves of *Solenostemon monostachyus* (*Agogo-igun*) with water, filter and collect the filtrates.	Drink half stainless cup of the filtrate 3 times daily. A day
10	Squeeze the young growing fresh leaves of *Cnestis ferruginea* (*Akara-aje, Omu-aja*) in water and filter to collect the filtrates	Drink one tumbler daily. A day
11	Get the root of *Microdesmis puberula* (Osunsun*)*, *Lecaniodiscus cupanioides* (Aaka), *Terminalia glaucescens* (Idi-apata) and "*Iyun eye*". Also get fresh young growing leaves of *Lecaniodiscus cupanioides* (Aaka), dry it and grind all together into powder and put it in a bottle.	Take one table spoon of the powder and put it in a saucer, use riped "Ogede agbagba" (*Musa sapientum*) to eat the powder. For treatment of low sperm count in male and erectile dysfunction

Table 7: Result of Hunters Method of preparation and mode of administration of recipes

S/n	Method of preparation of recipes	Mode of administration, dosage and shelflife
1	Collect fresh root of *Sphenocentrum jollyanum* (*Akerejupo*) and put it in a covered bottle with hot drink.	Drink a shot every morning. Until it finishes
2	Squeeze the leaves of *Triplochiton scleroxylon* (*Arere*) with water and filter	Drink half stainless cup two times daily. One day
3	Squeeze fresh leaves of *Solenostemon monostachyus* (*Agogo-igun*) with water, filter and collect the filtrates.	Drink half stainless cup of the filtrate 3 times daily. A day
4	Squeeze the young growing fresh leaves of *Cnestis ferruginea* (*Akara-aje, Omu-aja*) in water and filter to collect the filtrates	Drink one tumbler daily. A day
5	Get the root of *Microdesmis puberula* (Osunsun*)*, *Lecaniodiscus cupanioides* (Aaka), *Terminalia glaucescens* (Idi-apata) and "*Iyun eye*". Also get fresh young growing leaves of *Lecaniodiscus cupanioides* (Aaka), dry it and grind all together into powder and put it in a bottle.	Take one table spoon of the powder and put it in a saucer, use riped "Ogede agbagba" (*Musa sapientum*) to eat the powder. For treatment of low sperm count in male and erectile dysfunction

Table 8: Non- plant materials used for the preparation of recipes

S/n	Animal names or vertebrate and invertebrate names	Family name	English name	Common names	Local name	Part and form used	Habitat, Cultivation, Abundance (Rare/ common), Native/ Introduced
1	*Naja pallida*	Elapidae	Snake	Viper snake	Ejo oka	Dry tail of viper snake (ase iru oka)	Forest, farmland, savanna, rare, wild
2	*Odocoileus virginianus*	Cervidae	Animal	Deer	Igala	Horn of igala	Forest/ farmland, rare, wild, native
3	*Achatina achatina*	Achatinidae		Snail	Igbin	Mature snail and shell	Forest, farmland, common, native
4	*Apis mellifera*	Apidae	Insect	Honey	Oyin	Honey	Forest, savanna, common, exotic
5	*Equus caballus*	Equidae.	Mammalia	Horse	Esin	Dried penis	Savanna, common,
6	*Capra aegagrus*	Bovidae	Animalia	He goat	Oko Obuko	Dried penis	