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Ethnobotanical Survey of Plants Used in the Management of Obesity in Ibadan, South-Western Nigeria

*T. O. Ajayi[A-E] and J.O. Moody[A-F]

Department of Pharmacognosy, Faculty of Pharmacy, University of Ibadan. Nigeria.

A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation; D – writing the article; E – critical revision of the article; F – final approval of article.

Abstract

Background: Until recent times, being obese was considered to be an evidence of wealth in the South-Western part of Nigeria. As a result of a combination of wrong attitudes, ignorance and carefree lifestyle, a sizeable percentage of the population has become predisposed to obesity an emerging problem in developing economies of the world.
Objective: To identify and document medicinal plants used in ethno-medical management of obesity in selected rural and urban communities within Ibadan metropolis. This is with the aim of contributing to a database of plants for future systematic biological and chemical evaluation for possible source of anti-obesity agents and drug leads.
Materials and methods: An inventory of plant species/natural remedies used in folk medicine to manage obesity in two Local Government Areas of Oyo State was undertaken. Interviews using semi-structured questionnaires and open-ended conversations were conducted among eighty (80) respondents (30% men and 70% women) aged 25 years and above to obtain relevant information..
Results: A total of fifteen (15) plants belonging to twelve (12) genera and twelve (12) families were identified. The usage profiles of the plants were quantified by the quotation frequency/mention index. Respondents from the urban rely more on finished products from local and foreign blends which are mostly multi-component remedies.
Conclusion: The study revealed that Ibadan is a rich source of plants indicated in management of obesity. More scientific work especially biological studies are needed to ascertain the efficacy, toxicity, safety and appropriate dosage regimen of these ethno-medicinal remedies.

Keywords; Obesity, *Citrullus lanatus*, Overweight

INTRODUCTION

Obesity is one of the greatest health threats that have become a global issue in this century. It has been defined as an increased adipose tissue mass, resulting from of an enlargement in fat cells and/or an increase in their number (Couillard *et al*., 2000).
A crude measure of obesity is the Body Mass Index (BMI), calculated as body weight in kilogram divided by the square of height in meters. Being overweight is defined as a BMI of 25.0–29.9 kg m^{-2}, while a BMI exceeding 30 kg m^{-2} is considered as obese. An extreme obesity is defined as a BMI of greater than 40 kg m^{-2}. Obesity has an important impact on lifestyle-related diseases such as coronary heart disease, infertility, dyslipidemia, glucose intolerance, osteoarthritis, diabetes, hypertension and some cancers (Hu *et al*., 2008).Factors such as lack of exercise, consumption of energy rich diet and an overall decadence in lifestyle are contributory to the etiology of this condition (Ekanem *et al*., 2007).

Statistics has revealed that in the next 1-2 years, many people that are overweight will become obese. In 1996, WHO stated that more than one-third of African women and a quarter of African men were overweight, and predicted that this will rise to 41 percent and 30 percent respectively by 2015 (Ogundipe *et al*., 2010). More than 1.1 billion people are overweight worldwide and 312 million are classified as obese (Hossain *et al*., 2007).
Many diets have been advocated for weight loss but there is little scientific evidence to prefer one diet over another (Thompson *et al.*, 2007). Although reduction of caloric intake by diet and increased level of physical activity are very well-known approaches to lose weight, the need for drugs and other supplements to control obesity are fast gaining acceptance (Goodman & Gilman 1992). These expensive synthetic drugs, however, fail to give desired effects without side effects and accompanying toxicity to patients. These shortcomings, coupled with the fact that

about 80% world population now depend on traditional medicine, for their primary health care needs (WHO, 2002; Muthu et al., 2006, Shrestha et al., 2007).

These alternatives as well as the synthetic medicines act through several mechanism of actions which include the lipase inhibitory effect where the inhibition of the digestion and absorption of dietary fat has been used as target in obesity treatment. It is understood that pancreatic lipase is the most important enzyme responsible for the digestion of triglycerides into monoglycerides and diglycerides and in smaller fatty acids to be absorbed by the body (Thomson et al., 1997; Mukherjee et al., 2003).

A comprehensive review on lipase inhibitors from natural sources such as saponins, polyphenols, terpenes, and microbial by-products have been described as unexplored potential in the management of obesity and new drug discovery (Birari et al., 2007).

Examples abound as in teas having been long used in Chinese traditional medicine to treat various ailments such as obesity and lipids disorders. Tea saponin, a pancreatic lipase inhibitor, was also found to suppress increase in body weight, adipose tissue weight, and diameter of adipocytes of rodents fed a high-fat diet. The excretion of triacylglycerol content in the faeces was also increased. The anti-obesity effects of tea saponins may be mediated through absorption of dietary fat through an inhibition of pancreatic lipase activity (Birari et al., 2007).

Grape seed extract (GSE) has also been found to inhibit lipoprotein lipase in vitro. It inhibited pancreatic lipase activity dose dependently, with maximum inhibition of 80%. At a concentration of 1 mg/mL, it inhibited lipoprotein lipase activity by 30% (Moreno et al., 2003). Other examples are *Thea sinensis,Acathopanax senticosus,Cassia mimosoides, Aframommum meleguetta,Nelumbo nucifera, Trigonella foenum, Salix matsudana, Saliva officinalis, Acathopanax sessiliflorous, Cassia nomane, Coffea canephora.*

Another mechanism of action of these natural products is by acting as inhibitors of adipogenesis and adipogenic factors. Adipocytes play a central role in the maintenance of lipid homeostasis and energy balance, by storing triglycerides and releasing free fatty acids in response to changing energy demands. Because adipocyte tissue growth can be due to both hyperplasia and hypertrophy of adipocytes, several studies screening for anti-obesity materials have focused on the processes of adipocyte proliferation and differentiation. Excessive adiposity results from an imbalance in energy homeostasis, in which the consequences of excessive food intake are not balanced by increased energy expenditure. The simplest scheme divides energy expenditure into three categories: (1) physical activity, (2) obligatory energy expenditure, and (3) adaptive thermogenesis. Treatment that regulates the size and the number of the adipocytes and the expression of signals involved in energy balance and the inhibition or enhancement of specific adipokines have been suggested to express anti-obesity related bioactivities (Jung et al., 2012). Example of the most common plant implicated in weight loss is green tea (Wolfram et al., 2006). There are various studies promoting the use of green teas as slimming aids. Recently, the effect of green tea epigallocatechin gallate (EGCG) was shown to inhibit the proliferation and differentiation in the primary human visceral preadipocytes. A study reported that the ability of EGCG to promote weight loss can be partly due to its ability to suppress the number of adipocytes and also suppress triacylglycerols uptake (Bose et al., 2008). Hence the long-term consumption of tea might be beneficial for the suppression of diet-induced obesity.

Hibiscus sabdariffa, a medicinal plant widely used as beverage, had also been reported to modulate negatively on obesity. Water extract of this plant inhibits adipocyte differentiation. Hibiscus extracts were also shown to inhibit pancreatic amylase, effective in decreasing levels of cholesterol, lipids, and triglycerides (Alarcon-Aguilar et al., 2007). Appetite suppression is a mechanism of action where fatty acid synthase is known to catalyze the reductive synthesis of long chain fatty acids from acetyl coenzyme A and malonyl-CoA. It is proven that an inhibition of fatty acid synthase can reduce food intake and body weight. This makes the inhibition of fatty acid synthase a potential therapeutic target to suppress appetite and induce weight loss (Jena et al., 2002).

Extracts from *Hoodia pilifera* and *Hoodia gordonii* were characterized as possessing appetite suppressing properties. *H. gordonii* is indigenous to South Africa and Namibia, where it was traditionally used by the Khoi-san tribes to suppress hunger and thirst while on long hunting trips (Holt et al., 2006). In a study, isolates from *Hoodia gordonii* decreased food consumption and body mass over an 8-day period on administration by oral gavage to rats in doses of 6.25–50 mg kg. In comparison with a known appetite-suppressant compound fenfluramine at 15mg/kg per day, (30 mg kg per day) caused a suppression in body weight, while fenfluramine administration resulted in a small decrease in food intake and increase in body weight, though less than the control group (Van Heerden et al., 2007).

Catha edulis, commonly known as khat, is usually chewed after meals in some African communities. It is known to decrease feeling of hunger and increase feeling of satiety due to release of cathinone, which suppresses appetite (Murray et al., 2008). *Garcinia cambogia* is used as a dietary supplement to lose weight. Its primary component is (-)-hydroxycitric acid, and supplementation in experimental animals has showed that hydroxycitric acid can suppress appetite and inhibit body fat biosynthesis (Soni et al., 2004). In rat brain cortex, hydroxycitric acid was shown to increase availability of 5-hydroxytryptamine or serotonin. This neurotransmitter is implicated in the appetite regulation and control. (Oben et al., 2007). Other examples are *Cissus quadrangularis, Garcina cambogia, Camellia sinensis, Hoodia gordonni, Hoodia pilifera.*

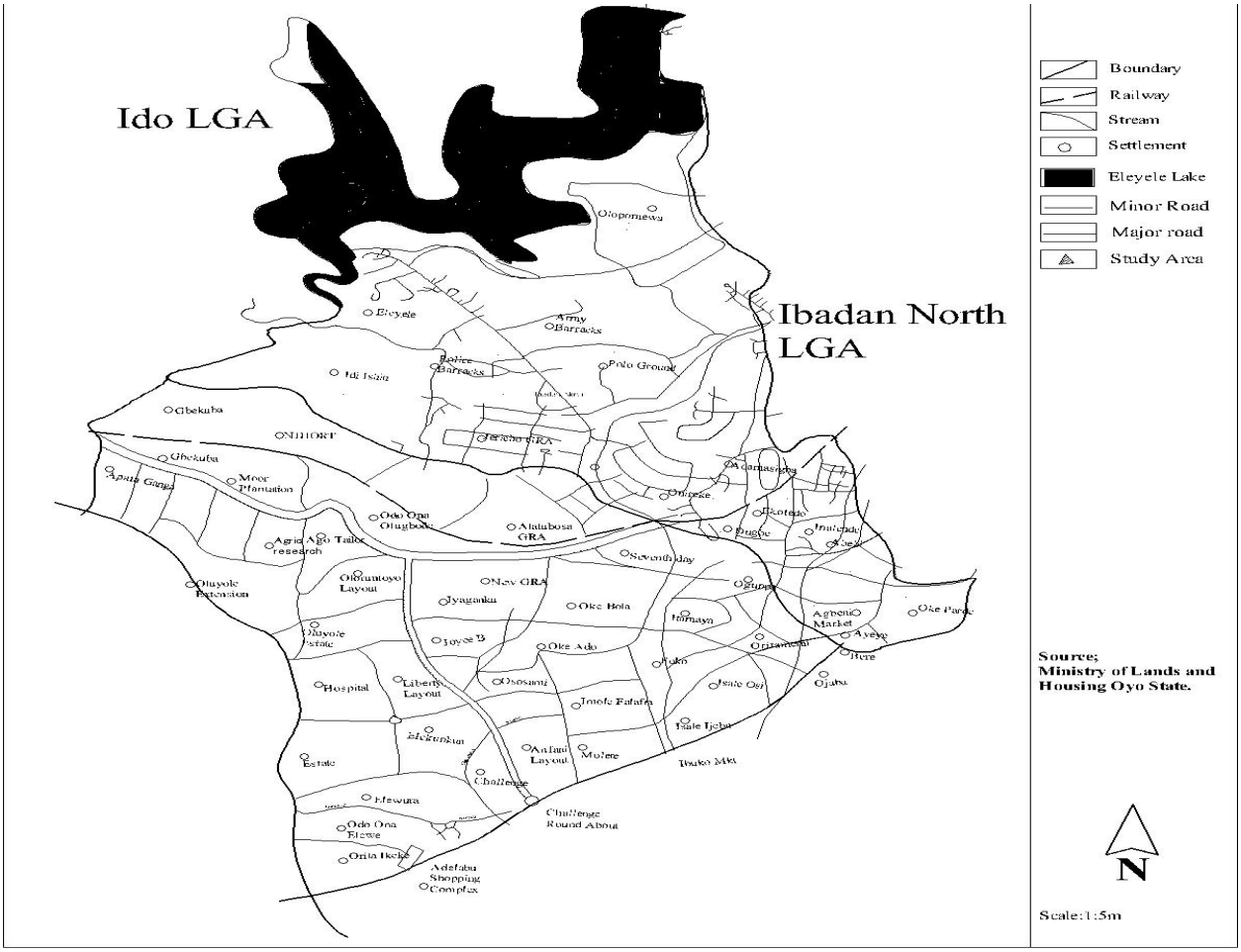

Figure 1: Map of Ibadan North-West Local Government Area.

Although Africa has a rich reservoir of some of these medicinal plants, the scientific validation of the potency, quality, safety, and efficacy as well as dosage standardization is still lacking for many of the plants. However, cultural and traditional practices relating to diet, lifestyle and beliefs predispose residents of the study site to this emerging disease.

Therefore, this study was carried out to identify and document the species, parts used and the methods of preparation of the recipes used in the management of obesity within Ibadan metropolis.

MATERIALS AND METHODS

Study setting

The study was conducted in two major Local Government Areas of Ibadan, the capital city of Oyo State, located in South-Western Nigeria, 128 km inland northeast of Lagos and 530 km southwest of Abuja, the federal capital. Oyo state is bounded in the south by Ogun State and in the north by Kwara State. In the west, it is bounded partly by Ogun State and partly by the Republic of Benin while in the east, it is bounded by Osun State. At independence, Ibadan was the largest and most populous city in the country with about two and a half million people and the third in Africa after Cairo and Johannesburg. The most predominant ethnic group in this area is the Yoruba.

Data collection

Information was collected between March and July 2011 among residents' who are mostly adult males and females of 25 years and above comprising of traders, workers and housewives. This was done by interview using semi-structured questionnaires and open ended conversation method. The contents of the semi-structured questionnaires were organized using a standard protocol (Martin, 1995; Kim et al., 2006; Namsa et al., 2009).

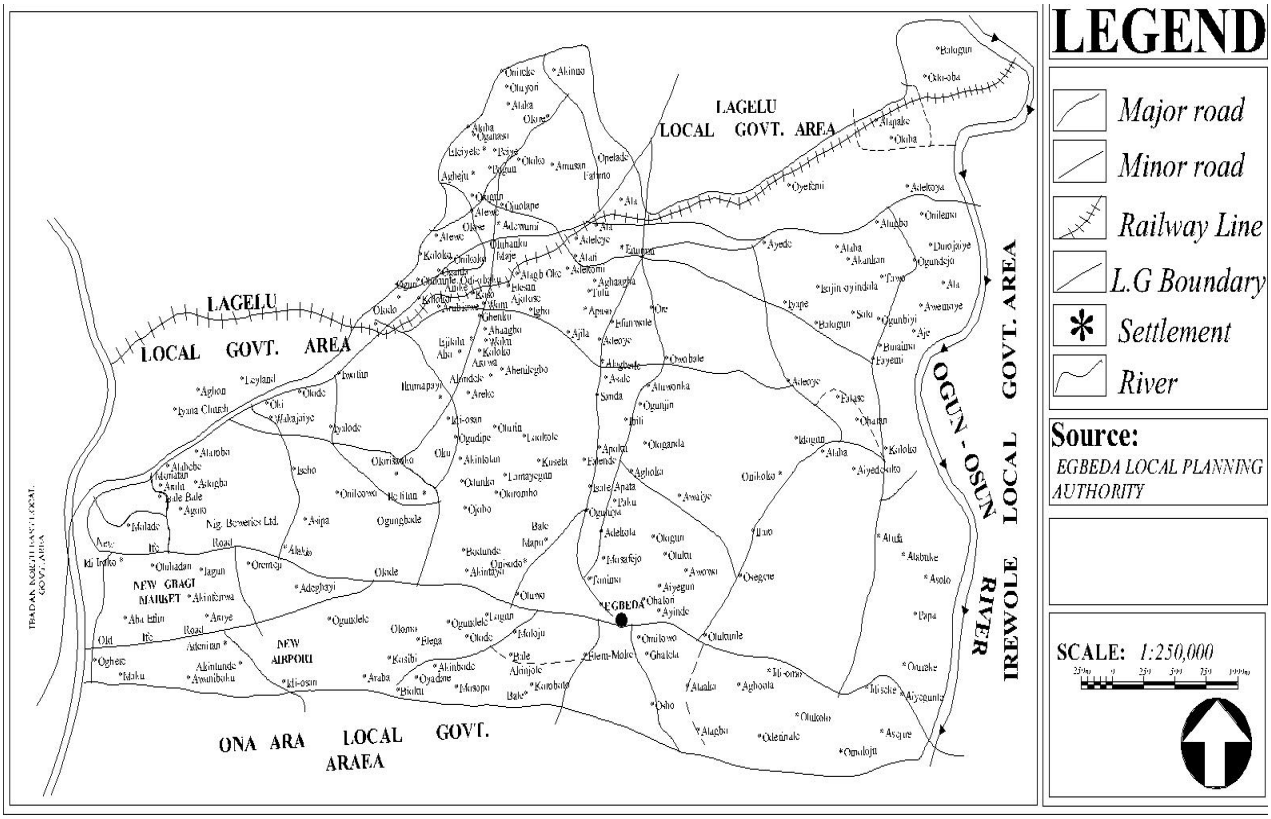

Figure 2: Map of Egbeda Local Government Area

Basic information about locality, scientific and vernacular names, part(s)used, method(s) of preparation of herbal medicines and the record of their similar use in ethnomedicine were collected (Kim et al.,2006;Poonam and Singh, 2009). Most respondents including the herb sellers and traditional healers were interviewed in the local language for clarity. However, some refused to provide helpful information and no further attempt was made to influence such subjects. Other respondents include the general residents of the local government areas with appreciable knowledge about medicinal plant use. Informed consent was obtained orally from all participants before the administration of the questionnaires and commencement of interview. The questionnaire was divided into two sections; the first section was demographic information while the other section was knowledge of medicinal plants for management of obesity through the local name.

Samples of the relevant plants were collected in the field while voucher specimens were deposited at the Forest Herbarium Institute of Nigeria for taxonomic identification.

RESULTS AND DISCUSSION

Ethnobotanical Survey

The processed information from the questionnaire reveals a total of fifteen (15) plants from fifteen (15) genera and twelve (12) families as shown in Table 3. The most mentioned family is the Rutaceae (*Citrus aurantium*, *Citrus aurantifolia*), followed by Curcubitaceae (*Citrullus lanatus*).

This study revealed the use of fifteen (15) single-species (mono-component) and four (4) multi- species (multi-component) remedies. Some of these remedies are already in the market. Ten (10) single-species remedies from the rural setting (Egbeda) five (5) single-species remedies from the urban setting (Ibadan North-West) documented as shown in Tables 1 and 2. This agrees with a report in previous studies that most herbal formulations are effective as multi-component products, though some mono-component recipes are also effective (Haddad et al., 2003; Kareru et al., 2007). The frequent use of multi-component products could however be attributable to the belief of possible synergistic actions (Giday et al., 2010).

The Use of Mention Index (UMI) was calculated by dividing the number of use of each mentioned plant by the number of respondents for all the plants both in single and multi-species remedies

The Use of Mention Index of the multi-species finished products such as Yoyo bitters®, GNLD® (China), EDMARK®(Phillipines) and Tasly® (India) are found to be 0.400, 0.200, 0.200 and 0,200 respectively.

Less than 10% of the informants from Ibadan North-West Local Government Area representing an urban setting cited *Vernonia amygdalina* and *Citrus medica* as their weight monitoring edible plant. More than 10% (but less than 40%) of the respondents cited *Zingiber officinale*, *Carica*

papaya and blends of some foreign herbs as their anti-obesity remedies, while more than 40% cited *Citrus aurantifolia* and the bitters. *Cassia fistula* and *Zanthoxyllum zanthoxyloides* were cited by less than 10% of the respondents from Egbeda Local Government representing the rural setting, while more than 10% (but less than 40%) cited *Microdesmis puberula, Carpolobia alba, Alstonia boonei* and *Sarcocephalus latifolius. Citrus aurantium* was mentioned by more than 40% of the respondents with none of them citing any foreign or local blend of herbs.

This suggests that the settlement relied more on the blends of foreign herbs and finished products that are multi-component than the rural settlement. This could be as a result of exposure and literacy because those foreign products are presented as well- packaged preparations. The record of similar use, in both settings, however, revealed that some components might be similar. For example *Citrus aurantifolia* as a single- species remedy and also as a component in "yoyo bitters" an already finished product was cited by more than 40% of the respondents in the urban setting.

The most used morphological part is the leaf accounting for 26.6% of the recipes followed by the fruits and barks which accounts for up to 20%.The seeds, rhizomes, roots and the whole plant accounted for 6.6% as shown in Figure 3.

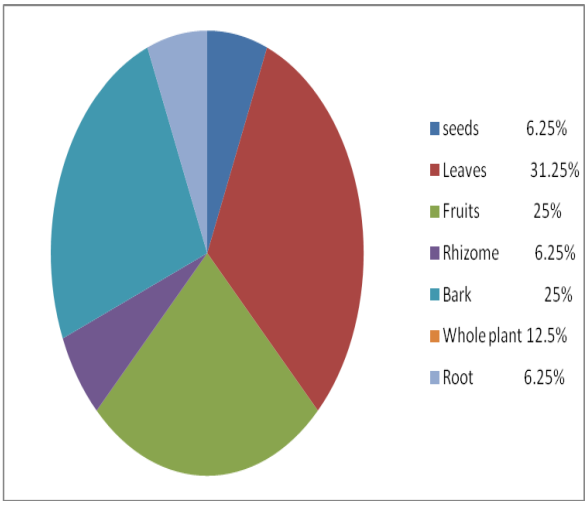

Figure 3: Pie chart showing plant parts used in percentage

The methods of preparation indicate that over 60% of the plants mentioned were prepared as decoctions. The most treated ailments were all forms of fever (37.5%) followed by diarrhea (18.75%) and measles (12.5%) as shown in Tables 1 and 2.

The Use of Mention Index for *Citrus medica, Citrus aurantifolia and Citrus aurantium* are 0.075, 0.437 and 0.462 respectively. Citrus fruit (especially tangerines) are one of the richest sources of high quality pectin - a type of dietary fiber. Pectin is a major component of the kind of fiber that is known to lower cholesterol and also helpful in stabilizing blood sugar (Jyotsna, 2011). This finding is in agreement with a study by Calapai et al.1999 where stan-dardized extracts of synephrine (4 and 6%) from *C. aurantium* fruit extracts significantly and dose-dependently reduced body weight gain and food intake in rats after 7 days of repeated oral administration.

Another study on the effect of a combination of C. aurantium extract, caffeine, and St. John's Wort (*Hypericum perforatum*) on body fat loss, lipid levels, and mood states in overweight healthy adults found a significant amount of body weight reduction of 1.4 kg. An average change of 2.9% body fat was observed and actual fat lost for the testing group was 3.1 kg. This 6-week trial with 23 subjects also included mild exercise and restricted caloric intake (Colker et al., 1999).

Citrullus lanatus had a UMI of 0.437 and a particular species (red coloured) has been reported for several pharmacological activities ranging from antigiardial, anti-inflammatory and antimicrobial (Erhirhie and Ekene 2013). However, documentation on the (white coloured) Citrullus lanatus being referred to in this survey is quite low. *Sarcocephalus latifolius* has the highest UMI of 0.475 as shown in Table 3. These plants are mostly food plants ultimately, displaying pharmacotherapy as an adjunctive support to diet, exercise, and lifestyle modification (Heal et al., 2009).

Vernonia amygdalina had the lowest UMI of 0.05 indicating that information about its antiobesity effect is still very low.

Table 1: Plants used to manage obesity in Ibadan North-West Local Government (Urban)

Botanical taxon/Herbal products/Authorities	Family	Yoruba name	Part used	Preparation	Other uses	Use Mention index	Record of similar use
Vernonia amygdalina Delile	Asteraceae	Ewuro	Leaves	Decoction	Antimalarial	0.050	No
Citrus medica L.	Rutaceae	Osan wewe	Fruit	Juice	Cough mixture	0.075	Yes
Zingiber officinale Roscoe	Zingiberaceae	Ata ile	Rhizome	Decoction	Carminative	0.175	Yes
Citrus aurantifolia (Christm.)	Rutaceae	Oronbo nla	Fruit	Juice	Jaundice	0.437	Yes
Carica papaya L.	Caricaeae	Ibepe	Seeds, Leaves	Decoction	Fever Antidyspepsia	0.200	No
Yoyo bitters	-	-	-	Mixture	Detoxifier	0.400	Yes
GNLD, TASLY, EDMARK Products	-	-	-	Powder	Detoxifier	0.200	Yes

Table 2: Plants used to manage obesity in Egbeda Local Government Area (Rural)

Botanical taxon/ authorities	Family	Yoruba name	Parts used	Preparation	Other uses	Use Mention index	Record of similar use
Zanthoxylum zanthoxyloides Waterman	Rutaceae	Ata	Bark	Decoction	Toothache	0.075	No
Microdesmis puberula Hook.f. ex Planch	Pandaceae	Aringo	Bark	decoction	Diarrhoea	0.312	Yes
Carpolobia alba G.Don	Polygalaceae	Osunsun	Bark	decoction	Measles	0.362	Yes
Sarcocephalus latifolius (Sm.) E.A.Bruce	Rubiaceae	Egbesi	Bark	Decoction	measles	0.475	Yes
Cassia fistula L.	Fabaceae	Arinda tooro	Leaves	Decoction	Laxative	0.087	Yes
Alstonia boonei De Wild	Apocynaceae	Ahun	Leaves	Decoction	Malaria therapy	0.125	Yes
Citrus aurantium L.	Rutaceae	Ganin-ganin	Fruit	Juice	Antipyretic	0.462	Yes
Cola acuminate (Beauvoir) Schott and Endlicher	Sterculiaceae	Obi abata	Fruit	Edible seed	Stimulant	0.075	No
Lonchocarpus cyanescens (Schumach and Thonn.) Benth	Leguminosae-papilionoideae	Eelu	Whole plant	Decoction	Antihypertensive	0.062	No
Citrullus lanatus	Cucurbitaceae	Baara	Root	Decoction	Worm expeller	0.437	Yes

Table 3: Species distribution from ethnobotanical survey of the two Local Government Areas of Oyo state.

S/N	Species	Quotation frequency	Use Mention Index(UMI)	%
1	*Vernonia amygdalina* Delile	4	0.050	5.0
2	*Citrus medica* L.	6	0.075	7.5
3	*Zingiber officinale* (Roscoe.)	14	0.175	17.5
4	*Carica papaya* L.	16	0.200	2.0
5	*Microdesmis puberula* Hook.f. ex Planch	25	0.312	31.2
6	*Carpolobia alba* G. Don	29	0.362	36.2
7	*Sarcocephalus latifolius* (Sm.) E.A.Bruce	32	0.475	47.5
8	*Cassia fistula* L.	7	0.087	8.7
9	*Alstonia boonei* De Wild	10	0.125	12.5
10	*Lonchocarpus cyanescens* (Schumach and Thonn.) Benth.	5	0.062	6.2
11	*Cola acuminata* (Beauvoir) Schott and Endlicher)	6	0.075	7.5
12	*Citrullus lanatus* (Thunb.) Matsum & Nakai.)	35	0.437	43.7
13	*Citrus aurantifolia* (Christm.)	35	0.437	43.7
14	*Zanthoxylum zanthoxyloides* (Waterman)	6	0.075	7.5
15	*Citrus aurantium* L.	37	0.462	46.2

Herbals or botanicals remain an inexhaustive source of novel compounds that can be developed either as therapeutic or prophylactic agents (McCorkie, 1986). Unfortunately, many of the ethnomedicinal uses of these plants have not been documented or are poorly documented. The lack of documentation results in the loss of important information that could have led to some uncommon breakthrough in drug research and development.

CONCLUSION

This study revealed that there resides among the studied population some knowledge and useful information about obesity and the use of herbal remedies to combat it. Although, this information is still scattered and totally unexplored, there is an abundant availability of the relevant plants in these communities. More scientific work is warranted to ascertain the toxicity, quality, efficacy/potency and safety as well as to determine the active principles that may be responsible for the anti-obesity activity of the mentioned plants.

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Address for correspondence:

Tayo Ajayi
Department of Pharmacognosy, Faculty of Pharmacy,
University of Ibadan, Ibadan, Oyo State, Nigeria
E-mail: tayomiajayi@yahoo.com

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