



Nigerian Medicinal Plants with Anti-Diabetic and Anti-Hypertensive Properties

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Review Article

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ABSTRACT

This review paper examined some of the Nigerian medicinal plants with anti-diabetic and anti-hypertensive properties. The study revealed Sixteen species of Nigerian medicinal plants with anti-diabetic properties and they are *Dioscorea dumentorum*, *Anthocleista vogelii*, *Larantus begwensis*, *Catharantus roseus*, *Ceiba pentandra*, *Musa paradisiaca*, *Emilia sonchifora*, *Solenostemon monostachys*, *Carica papaya*, *Ipomea batatas*, *Musa sapientum*, *Myrianthus arboreus*, *Allium cepa*, *Allium sativum* and *Zingiber officinale* and twenty-one Nigerian medicinal plants with anti-hypertensive properties which include *Hibiscus sabdariffa*, *Vitex domeina*, *Manihot esculent*, *Persea americana*, *Combretodendron macrocarpum*, *Tetrapleura tetraptera*, *Nuclear latifolia*, *Pareta crassipes*, *Vitex dodiana*, *Phyllanthus amarus*, *Lepidium latifolium*, *Rhaptopetalum coriaceum*, *Musanga cecropioides*, *Vernonia amygdalina*, *Parinari curatellifolia*, *Psidium guajava*, *Bryophyllum pinnatum*, *Persea americana*, *Loranthus micranthus*, *Acalypha wilkesiana hoffmannii*, and *Allium sativum*. Further studies on these medicinal plants are necessary to elucidate the pharmacological activities of these medicinal plants which will stimulate future pharmaceutical development of therapeutically beneficial drugs in the management of diabetes mellitus and hypertension. Clinical trials of these medicinal plants in humans are recommended to prove their efficacy in humans and determine their mechanism of

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action, safety/toxicity profile and chemically characterize the bioactive principle as a prerequisite for drug development. The huge medicinal plants available in Nigeria should be fruitfully exploited for health care and economic development of Nigeria in other to free Nigerians from disease and poverty.

Keywords: Medicinal plants; dosage; physiological effects; diabetes mellitus; hypertension.

1. INTRODUCTION

Nigeria is richly blessed with abundant medicinal plants within the nation's biodiversity and most of them have been scientifically validated for the management of diabetes mellitus and hypertension [1]. Reported that roughly 80% of African's 750 million population use medicinal plants due to the prohibitive cost of many modern medicines for the management of different health disorders and Nigeria is no exception to this for over 85% of Nigerian population patronize traditional medicine practitioners for their health care needs. Diabetes mellitus is a metabolic disorder of multiple etiology characterized by chronic high blood sugar with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both [2]. In 2006, according to the World Health Organization, at least 171 million people worldwide suffer from diabetes [3]. Its incidence is increasing rapidly and it is estimated that by the year 2030, this number will double becoming 342 million [3]. There are two major types of diabetes mellitus; Type 1 Diabetes, which is caused by lack of insulin secretion by beta cells of the pancreas and Type 2 Diabetes, which is caused by decreased sensitivity of target tissues to insulin [3]. Despite considerable progress in the treatment of diabetes by oral hypoglycemic agents, the search for newer drugs continues because the existing synthetic drugs have several limitations. World Health Organization (WHO) and International Society of Hypertension (ISH) defined hypertension as a systolic blood pressure (SBP) of 140 mm/Hg or diastolic blood pressure (DBP) of 90 mm/Hg or more [4]. Mild hypertension was defined as a SBP between 140 - 150 or DBP between 90 - 99 mm/Hg, moderate hypertension as a SBP between 160 -176 mm/Hg or DBP between 90 -99 mm/Hg and severe hypertension as a SBP 180 mm/Hg or DBP >110 mm/Hg [4]. Many people have hypertension without knowing it and hypertension remains a major health hazard, with prevalence ranging between 15 and 30% in adults [5]. In Nigeria, there is an overall crude prevalence of 21% in the respondent population,

[6] reported a prevalence of 36.6% in Nigeria. High blood pressure occurs when the body's smaller blood vessels (arterioles) narrow, thereby causing the blood to exert excessive pressure against the vessel walls and the heart works harder to maintain higher blood pressure. Although the body can tolerate increased blood pressure for months and even years, eventually they enlarge and get damaged, a condition called hypertrophy and causes injury to blood vessels in the kidney, brain and the eyes. Hypertension has been aptly called a silent killer, because it usually produces no noticeable symptoms. Hypertension is one of the most important public health problems in the world, Statistics show that more than seven million people worldwide are affected by this disease each year and hypertension is the third cause of death in the world. Orthodox medicines used to treat hypertension are available and include captopril, prazosin, hydrochlorothiazide, atenolol, hydralazine, methyl dopa but synthetic medicines have devastating effects on the patient's body. The use of medicinal plants in the prevention, control and treatment of hypertension has interested researchers because of its safety and lesser side effects. Nigeria has a population of over 120 million people and is the largest black nation in the world, the crude prevalence of hypertension has been documented as 11.2% (based on blood pressure threshold of 160/95 mmHg) with an age- adjusted ratio of 9.3% [7]. This number translates into approximately 4.33 million Nigerian hypertensive aged greater than 15 years [8]. The major target organ complications of hypertension such as left ventricular hypertrophy [9] diastolic dysfunction [10] congestive heart failure [11] ischemic heart disease [12] stroke [13] and renal failure [14] are well documented by various researchers in Nigeria. Although there is a paucity of data on prevalence of diabetes in Nigeria and other African countries, available data suggested that diabetes is emerging as a major health problem in Africa including Nigeria [15]. Diabetes is a major health problem in Nigeria with a prevalence of 1.4 – 2.7% [16,17,18] and over 90% of these are non- insulin dependent diabetes mellitus [19]. Higher prevalence of

hypertension among diabetics in India has been reported since 1985 [20]. Recent studies from Manipal revealed that about 40 percent of diabetics are hypertensive [21]. These studies though done in India are important for a clear understanding of the relationship between diabetes mellitus and hypertension in a human system which could apply to Nigerian population. There are four types of hypertension in diabetes mellitus.

- i. Essential hypertension
- ii. Hypertension consequent to nephropathy
- iii. Isolated systolic hypertension and
- iv. Supine hypertension with orthostatic fall [22].

The possible mechanism in pathogenesis includes

- a. uncontrolled metabolic state and
- b. insulin resistance leading to abnormalities in
 - i. renal tubular ion exchange
 - ii. Transmembrane ion exchange in vascular bed
 - iii. Renin angiotensin system
 - iv. Prostaglandin kallikrein/ kinin system
 - v. Inter-relationship with mg
 - vi. atrial natriuretic peptide
 - vii. Diabetic nephropathy
 - viii. Sympathetic nervous system involvement
 - ix. Other endocrine syndromes/secondary causes [22].

In diabetic patients, particularly those with mild to moderate hypertension, the first line of treatment includes life style modifications such as weight control, low fat anti-atherogenic diet, salt restriction, reduction in alcohol intake, discontinuation of smoking and supervised regimes of physical activity [23]. Hypertension and diabetes mellitus for several decades has been globally recognized as the most prevalent disease and their complications are associated with high mortality and morbidity. The use of conventional medicine has been associated with many side effects; it becomes imperative to continue the search for a novel drug with better cost effectiveness and lesser side effects. It has been estimated that approximately 25% of all prescribed medications today are of natural plant sources [24]. Considering the paucity of scientific information on medicinal plants with anti-diabetic and anti-hypertensive properties in Nigeria, the economic resources constraints of rural dwellers to using orthodox medicine and the cheapness of

these medicinal plants. This present study was designed to search for some Nigerian medicinal plants with anti-diabetic and anti-hypertensive properties.

2. RESEARCH DESIGN AND METHODS

A comprehensive literature search was made from internet and serial materials of Nnamdi Azikiwe Library, University of Nigeria, Nsukka. Different scientific Journal articles, proceedings of learned societies of medicinal plants, herbal medicine and World health organization documents were consulted vis -a- vis Nigerian medicinal plants with anti-diabetic and anti-hypertensive properties. The search keywords such as medicinal plants, effective dosage, experimental subject and physiological effects were crossed with the terms such as diabetes mellitus and hypertension in Nigeria. Following the search, the entire findings though not exhaustive were summarized in Tables 1 and 2.

3. RESULTS

The study revealed sixteen species of Nigerian medicinal plants with anti-diabetic properties, they are *Dioscorea dumetorum*, *Anthocleista vogelii*, *Loranthus begwensis*, *Cathartus roseus*, *Ceiba pentandra*, *Musa paradisiaca*, *Emilia sonchifora*, *Solenostemon monostachys*, *Carica papaya*, *Ipomea batatas*, *Musa sapientum*, *Myrianthus arboreus*, *Allium cepa*, *Allium sativum* and *Zingiber officinale* (Table 1). The twenty-one Nigerian medicinal plant with antihypertensive properties include *Hibiscus sabdariffa*, *Vitex domeina*, *Manihot esculent*, *Persea Americana*, *Combretodendron macrocarpum*, *Tetrapleura tetraptera*, *Nuclear latifolia*, *Paretta crassipes*, *Vitex dodiana*, *Phyllanthus amarus*, *Lepidium latifolium*, *Rhaptopetalum coriaceum*, *Musanga cecropioides*, *Vernonia amygdalina*, *Parinari curatellifolia*, *Psidium guajava*, *Bryophyllum pinnatum*, *Persea Americana*, *Loranthus micranthus*, *Acalypha wilkesiana hoffmannii* and *Allium sativum* (Table 2).

4. DISCUSSION

Hypertension which is also called arterial hypertension is a chronic disease in which the blood pressure in the arteries increases while Diabetes mellitus is a metabolic disorder of multiple etiology characterized by chronic hyperglycaemia (high blood sugar) with

Table 1. Nigerian medicinal plants with anti-diabetic properties

Medicinal plants	Dosage/Form	Experimental subject	Physiological effects	References
1. <i>Dioscorea dumetorum tuber</i>	125 mg/kg	Rabbits	Hypoglycaemic	[25]
2. <i>Anthocleista vogelii (Planch) roots</i>	Aqueous extracts 800 mg/kg	Mice, Rats, Rabbits	Induced significant hypoglycaemic activity in a dose related fashion at 2hrs after oral administration in mice and rats	[26]
3. <i>Larantus begwensis African mistletoe</i>	Oral administration of the decoctions, unstandardized	Rats	Anti-diabetic with no tissue side effect	[27]
4. <i>Catharantus roseus</i>	Methanolic leaf extracts	Rats	Hypoglycemic	[28]
5. <i>Ceiba pentandra</i>	Aqueous bark extract, unstandardized	Rats	Hypoglycemic	[29]
6. <i>Musa paradisiaca</i>	Methanolic extracts of mature, green fruit, 100 – 800 mg/kg	Rats	Induce significant dose related reductions in the blood glucose concentration, possess hypoglycemic activity	[30]
7. <i>Emilia sonchifora</i>	Crude extract, unstandardized	Rats	Hypoglycemic	[31]
8. <i>Solenostemon monostachys leaves</i>	Aqueous extracts orally, 130 mg/kg	Rats	Hypoglycemic	[32]
9. <i>Carica papaya pawpaw</i>	Aqueous extracts with unripe but mature fruit of pawpaw, unstandardized	Rats	Effectively lowered blood glucose	[33]
10. <i>Picralima nitida</i>	Aqueous extracts, unstandardized	Rabbits	Hypoglycemic by a mechanism independent of the availability of insulin from pancreatic β cell	[34]
11. <i>Ipomea batatas (sweet potato)</i>	Alcoholic extracts of sweet potato, unstandardized	unknown	Exhibit potent oral anti-diabetic property	[35]
12. <i>Musa sapientum sucker</i>	Methanolic extracts 5 and 10 mg/kg	Rats	Showed anti-diabetic properties	[36]
13. <i>Myrianthus arboreus stem</i>	Unstandardized	unknown	Hypoglycemic	[37]
14. <i>Allium cepa (onions)</i>	Aqueous extracts 300 mg/kg	Rats	Reduced blood glucose level, total serum lipids and total serum cholesterol in dose-dependent manner	[38]
15. <i>Allium sativum (Garlic)</i>	Aqueous extracts 300 mg/kg	Rats	Reduced blood glucose level, total serum lipids and total serum cholesterol in dose-dependent manner	[39]
16. <i>Zingiber officinale (ginger)</i>	Aqueous extracts 300 mg/kg	Rats	Reduced blood glucose level, total serum lipids and total serum cholesterol in dose-dependent manner	[40]

Table 2. Nigerian medicinal plants with anti-hypertensive properties

Medicinal plants	Dosage/Form	Experimental subject	Physiological effects	References
1. <i>Hibiscus sabdariffa</i>	Aqueous extracts, 20 mg/kg body weight	Rats	Anti-hypertensive caused a dose-dependent decrease in mean arterial pressure of rats.	[41]
2. <i>Vitex domeina</i> Stem bark	Oral intravenous extract, Unstandardized	Rats	Produce a dose-dependent hypotensive effect.	[42]
3. <i>Manihot esculenta</i> Crantz (Cassava)	Crude juice extracts, 100 mg/kg	Rats	Blood pressure and heart rate when injected intravenously significantly reduced systolic and diastolic pressures as well as heart rate.	[43]
4. <i>Persea americana</i> leaf	aqueous extract, Unstandardized.	Unknown	Induced a marked fall in mean arterial blood pressure.	[44]
5. <i>Combretodendron macrocarpum</i>	1-3 mg/kg, aqueous extracts	Rats	Hypotensive	[45]
6. <i>Tetrapleura tetraptera</i>	Unstandardized	Cat	Hypotensive inhibits the indirect electrical stimulation- evoked contractions of the cat nictitating membrane in vivo.	[46]
7. <i>Nuclear latifolia</i> Leaves/roots	Crude extracts, Unstandardized.	Unknown	Antihypertensive, contracts the aorta in a dose- dependent fashion.	[47]
8. <i>Pareta crassipes</i>	Ethanollic Extracts, Unstandardized.	Cats, Rats	Hypotensive lowers blood pressure of cats and rats in a dose-dependent manner.	[48]
9. <i>Vitex dodiana</i>	Unknown	Rats	Both the systolic and diastolic blood pressure were significantly reduced	[49]
10. <i>Phyllanthus amarus</i>	5, 80 mg/kg	Rabbits	Produced significant fall in the diastolic, systolic and mean arterial pressure	[50]
11. <i>Lepidium latifolium</i>	50, 100 mg/kg	Rats	Produced significant and dose dependent diuretic and hypotensive activities	[51]
12. <i>Rhaptopetalum coriaceum</i> oliv	Unknown	Rats	Blood pressure lowering effects	[52]
13. <i>Musanga cecropioides</i>	10, 40 mg/kg	Rabbits	Hypotensive effects	[53]
14. <i>Vernonia amygdalina</i>	5, 10 mg/kg	Rats	Caused a biphasic alteration of blood pressure	[54]
15. <i>Parinari curatellifolia</i>	150 mg/kg	Rats	Dose- dependent reduction in systolic and diastolic blood pressure	[55]
16. <i>Psidium guajava</i>	50, 800 mg/kg	Animal model	Produced dose-dependent significant reduction in systemic arterial blood pressures and heart rates of hypertensives.	[56]
17. <i>Bryophyllum pinnatum</i>	50, 800 mg/kg	Rats	Produced a dose-dependent significant reduction in arterial blood pressure and heart rates	[57]
18. <i>Persea americana</i>	240, 260, 280 mg/kg	Rats	Significantly reduced mean arterial pressure from baseline values	[58]
19. <i>Loranthus micranthus</i>	1.32 g/kg	Rats	Mean arterial pressure was significantly reduced in both normotensive and spontaneous hypertensive rats	[59]
20. <i>Acalypha wilkesiana</i> hoffmannii	20 mg/kg	Rats	Produced a significant decrease in systolic, diastolic and mean arterial pressure	[60]
21. <i>Allium sativum</i>	5, 20 mg/kg	Rabbits	Caused a significant, dose dependent decrease in mean arterial pressure and heart rate in both the normotensive and two kidney one chip (2K1C) induced hypertensives	[61]

disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both. In this study, the sixteen species of Nigerian medicinal plants discovered with anti-diabetic properties are *Dioscorea dumetorum*, *Anthocleista vogelii*, *Loranthus begwensis*, *Catharantus roseus*, *Ceiba pentandra*, *Musa paradisiaca*, *Emilia sonchifora*, *Solenostemon monostachys*, *Carica papaya*, *Ipomea batatas*, *Musa sapientum*, *Myrianthus arboreus*, *Allium cepa*, *Allium sativum* and *Zingiber officinale* (Table 1) while the twenty-one Nigerian medicinal plant with anti-hypertensive properties include *Hibiscus sabdariffa*, *Vitex domeina*, *Manihot esculent*, *Persea Americana*, *Combretodendron macrocarpum*, *Tetrapleura tetraptera*, *Nuclear latifolia*, *Pareta crassipes*, *Vitex dodiana*, *Phyllanthus amarus*, *Lepidium latifolium*, *Rhaptopetalum coriaceum*, *Musanga cecropioides*, *Vernonia amygdalina*, *Parinari curatellifolia*, *Psidium guajava*, *Bryophyllum pinnatum*, *Persea Americana*, *Loranthus micranthus*, *Acalypha wilkesiana hoffmannii* and *Allium sativum*. Inclusion of these medicinal plants in the diet of diabetics and hypertensives are recommended after their clinical trials on patients to determine their safety and toxicity profile. Further works on the medicinal plants are required to pinpoint and characterize their active ingredient and mechanism of action as a prerequisite for diabetes mellitus and hypertension drug development. The medicinal plants could have possibly acted by antioxidant action to bring about their anti-diabetic and anti-hypertensive properties more so as antioxidants have been well established and documented to have beneficial effects in various health disorders.

5. CONCLUSION

Considering the enormous medicinal plants in Nigeria, the high incidence of diabetes mellitus and hypertension, medicinal plants with anti-diabetic and anti-hypertensive properties as revealed from this study should be explored for development into potent drugs or as dietary adjuncts to existing therapies in the management of diabetes mellitus and hypertension. This is more so as many modern pharmaceuticals used in conventional medicine today have natural plant origin. The findings of this study have also presented many medicinal plants that can be pursued for their clinical relevance in the management diabetes mellitus and hypertension in Nigeria.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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