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.

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, Laranthus begwensis, Catharantus roseus, Ceiba pentandra, Musa paradisiaca, Emilia sonchifora, Solenostemon monostachys, Carica papaya, Ipomoea 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 sabdarifia, Vitex domeina, Manihot esculent, Persea americana, Combretodendron macrocarpum, Tetrapleura tetraptera, Nuclear latifolia, Paretta crassipes, Vitex dodiana, Phyllanthus amarus, Lepidium latifolium, Rhaetpetalum 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 action.

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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 order 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, methyldopa 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-relation 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, Catharanthus 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 domineia, Manihot esculent, Persea Americana, Comretodendron macrocarpum, Tetrapleura tetraperta, Nuclear latifolia, Paretta crassipes, Vitex dodiana, Phyllanthus amarus, Lepidium latifolium, Rhaptopytatum 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>
<thead>
<tr>
<th>Medicinal plants</th>
<th>Dosage/Form</th>
<th>Experimental subject</th>
<th>Physiological effects</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dioscorea dumetorum tuber</td>
<td>125 mg/kg</td>
<td>Rabbits</td>
<td>Hypoglycaemic</td>
<td>[25]</td>
</tr>
<tr>
<td>2. Anthocleista vogelii (Planch) roots</td>
<td>Aqueous extracts 800 mg/kg</td>
<td>Mice, Rats, Rabbits</td>
<td>Induced significant hypoglycaemic activity in a dose related fashion at 2hrs after oral administration in mice and rats</td>
<td>[26]</td>
</tr>
<tr>
<td>3. Laranthus begwensis African mistletoe</td>
<td>Oral administration of the decoctions, unstandardized</td>
<td>Rats</td>
<td>Anti-diabetic with no tissue side effect</td>
<td>[27]</td>
</tr>
<tr>
<td>4. Catharanthus roseus</td>
<td>Methanolic leaf extracts</td>
<td>Rats</td>
<td>Hypoglycemic</td>
<td>[28]</td>
</tr>
<tr>
<td>5. Celba pentandra</td>
<td>Aqueous bark extract, unstandardized</td>
<td>Rats</td>
<td>Hypoglycemic</td>
<td>[29]</td>
</tr>
<tr>
<td>6. Musa paradisiaca</td>
<td>Methanolic extracts of mature, green fruit, 100 – 800 mg/kg</td>
<td>Rats</td>
<td>Induce significant dose related reductions in the blood glucose concentration, possess hypoglycemic activity</td>
<td>[30]</td>
</tr>
<tr>
<td>7. Emilia sonchifora</td>
<td>Crude extract, unstandardized</td>
<td>Rats</td>
<td>Hypoglycemic</td>
<td>[31]</td>
</tr>
<tr>
<td>8. Solenostemon monostachys leaves</td>
<td>Aqueous extracts orally, 130 mg/kg</td>
<td>Rats</td>
<td>Hypoglycemic</td>
<td>[32]</td>
</tr>
<tr>
<td>9. Carica papaya pawpaw</td>
<td>Aqueous extracts with unripe but mature fruit of pawpaw, unstandardized</td>
<td>Rats</td>
<td>Effectively lowered blood glucose</td>
<td>[33]</td>
</tr>
<tr>
<td>10. Picralima nitida</td>
<td>Aqueous extracts, unstandardized</td>
<td>Rabbits</td>
<td>Hypoglycemic by a mechanism independent of the availability of insulin from pancreatic β cell</td>
<td>[34]</td>
</tr>
<tr>
<td>12. Musa sapientum sucker</td>
<td>Methanolic extracts 5 and 10 mg/kg</td>
<td>Rats</td>
<td>Showed anti-diabetic properties</td>
<td>[36]</td>
</tr>
<tr>
<td>13. Myrianthus arboreus stem</td>
<td>Unstandardized</td>
<td>unknown</td>
<td>Hypoglycemic</td>
<td>[37]</td>
</tr>
<tr>
<td>14. Allium cepa (onions)</td>
<td>Aqueous extracts 300 mg/kg</td>
<td>Rats</td>
<td>Reduced blood glucose level, total serum lipids and total serum cholesterol in dose-dependent manner</td>
<td>[38]</td>
</tr>
<tr>
<td>15. Allium sativum (Garlic)</td>
<td>Aqueous extracts 300 mg/kg</td>
<td>Rats</td>
<td>Reduced blood glucose level, total serum lipids and total serum cholesterol in dose-dependent manner</td>
<td>[39]</td>
</tr>
<tr>
<td>16. Zingiber officinale (ginger)</td>
<td>Aqueous extracts 300 mg/kg</td>
<td>Rats</td>
<td>Reduced blood glucose level, total serum lipids and total serum cholesterol in dose-dependent manner</td>
<td>[40]</td>
</tr>
<tr>
<td>Medicinal plants</td>
<td>Dosage/Form</td>
<td>Experimental subject</td>
<td>Physiological effects</td>
<td>References</td>
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</tr>
<tr>
<td>1. Hibiscus sabdariffa</td>
<td>Aqueous extracts, 20 mg/kg</td>
<td>Rats</td>
<td>Anti-hypertensive caused a dose-dependent decrease in mean arterial pressure of rats.</td>
<td>[41]</td>
</tr>
<tr>
<td>2. Vitex domeina Stem bark</td>
<td>Oral intravenous extract, Unstandardized</td>
<td>Rats</td>
<td>Produce a dose-dependent hypotensive effect.</td>
<td>[42]</td>
</tr>
<tr>
<td>3. Manihot esculenta Crantz</td>
<td>Crude juice extracts, 100 mg/kg</td>
<td>Rats</td>
<td>Blood pressure and heart rate when injected intravenously significantly reduced systolic and diastolic pressures as well as heart rate.</td>
<td>[43]</td>
</tr>
<tr>
<td>(Cassava)</td>
<td>Crude aqueous extract, Unstandardized</td>
<td>Unknown</td>
<td>Induced a marked fall in mean arterial blood pressure.</td>
<td>[44]</td>
</tr>
<tr>
<td>4. Persea americana leaf</td>
<td>Unstandardized</td>
<td>Unknown</td>
<td>Hypotensive</td>
<td>[45]</td>
</tr>
<tr>
<td>5. Combretodendron macrocarpum</td>
<td>1-3 mg/kg, aqueous extracts</td>
<td>Rats</td>
<td>Hypotensive inhibits the indirect electrical stimulation-evoked contractions of the nictitating membrane in vivo.</td>
<td>[46]</td>
</tr>
<tr>
<td>6. Tetrapleura tetraptera</td>
<td>Unstandardized</td>
<td>Cat</td>
<td>Hypotensive, contracts the aorta in a dose-dependent fashion.</td>
<td>[47]</td>
</tr>
<tr>
<td>7. Nuclear latifolia Leaves/roots</td>
<td>Crude extracts, Unstandardized</td>
<td>Unknown</td>
<td>Antihypertensive, contracts the aorta in a dose-dependent manner.</td>
<td>[48]</td>
</tr>
<tr>
<td>8. Paretta crassipes</td>
<td>Ethanolic Extracts, Unstandardized</td>
<td>Cats, Rats</td>
<td>Hypotensive lowers blood pressure of cats and rats in a dose-dependent manner.</td>
<td>[49]</td>
</tr>
<tr>
<td>9. Vitex dodiana</td>
<td>Unknown</td>
<td>Rats</td>
<td>Both the systolic and diastolic blood pressure were significantly reduced.</td>
<td>[50]</td>
</tr>
<tr>
<td>10. Phyllanthus amarus</td>
<td>5, 80 mg/kg</td>
<td>Rabbits</td>
<td>Produced significant fall in the diastolic, systolic and mean arterial pressure.</td>
<td>[51]</td>
</tr>
<tr>
<td>11. Lepidium latifolium</td>
<td>50, 100 mg/kg</td>
<td>Rats</td>
<td>Produced significant and dose dependent diuretic and hypotensive activities.</td>
<td>[52]</td>
</tr>
<tr>
<td>12. Raphidopetalum coriaceum oliv</td>
<td>Unknown</td>
<td>Rats</td>
<td>Blood pressure lowering effects</td>
<td>[53]</td>
</tr>
<tr>
<td>13. Musanga cecropioides</td>
<td>10, 40 mg/kg</td>
<td>Rabbits</td>
<td>Hypotensive effects</td>
<td>[54]</td>
</tr>
<tr>
<td>14. Vernonia amygdalina</td>
<td>5, 10 mg/kg</td>
<td>Rats</td>
<td>Caused a biphasic alteration of blood pressure</td>
<td>[55]</td>
</tr>
<tr>
<td>15. Parinari curatellifolia</td>
<td>150 mg/kg</td>
<td>Rats</td>
<td>Dose-dependent reduction in systolic and diastolic blood pressure.</td>
<td>[56]</td>
</tr>
<tr>
<td>16. Psidium guajava</td>
<td>50, 800 mg/kg</td>
<td>Animal model</td>
<td>Produced dose-dependent significant reduction in systemic arterial blood pressures and heart rates of hypertensives.</td>
<td>[57]</td>
</tr>
<tr>
<td>17. Bryophyllum pinnatum</td>
<td>50, 800 mg/kg</td>
<td>Rats</td>
<td>Produced a dose-dependent significant reduction in arterial blood pressure and heart rates</td>
<td>[58]</td>
</tr>
<tr>
<td>18. Persea americana</td>
<td>240, 260, 280 mg/kg</td>
<td>Rats</td>
<td>Significantly reduced mean arterial pressure from baseline values</td>
<td>[59]</td>
</tr>
<tr>
<td>19. Loranthus micranthus</td>
<td>1.32 g/kg</td>
<td>Rats</td>
<td>Mean arterial pressure was significantly reduced in both normotensive and spontaneous hypertensive rats.</td>
<td>[60]</td>
</tr>
<tr>
<td>20. Acalypha wilkesiana hoffmannii</td>
<td>20 mg/kg</td>
<td>Rats</td>
<td>Produced a significant decrease in systolic, diastolic and mean arterial pressure and heart rate in both the normotensive and two kidney one chip (2KIC) induced hypertensives</td>
<td>[61]</td>
</tr>
<tr>
<td>21. Allium sativum</td>
<td>5, 20 mg/kg</td>
<td>Rabbits</td>
<td>Caused a significant, dose dependent decrease in mean arterial pressure and heart rate in both the normotensive and two kidney one chip (2KIC) induced hypertensives</td>
<td>[62]</td>
</tr>
</tbody>
</table>
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, Catharanthus roseus, Ceiba pentandra, Musa paradisiaca, Emilia sonchiflora, Solenostemon monostachys, Carica papaya, Ipomoea batatas, Musa sapientum, Myrianthus arboreus, Allium ceph, 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, Paretta crassipes, Vitex dodina, Phyllanthus amarus, Lepidium latifolium, Rhapotpetalum coriaceum, Musanga cecropioideae, Vernonia amygdalina, Parinari curatellifolia, Psidium guajava, Bryophyllum pinnatum, Persea Americana, Loranthus micranthus, Accalypha 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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