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Research Article
Assessment of Bioactive Compositions of Selected Plants Used in Managing Hypertension Conditions in Osun State, Nigeria

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Abstract

Background and Objective: The traditional use of plant in managing disease conditions by people has been found effective and diseases resistance. About 75-80% of the world population used herbal medicines for primary health care as against the conventional hypertensive drugs. This study was aimed to determine the phytochemical and antioxidant potential in some selected medicinal plants used to manage hypertension conditions. **Materials and Methods:** The seeds of *Arachis hypogea*, *Piper guineense, Parkia biglobosa*, rhizomes of *Curcuma longa*, *Zingiber officinale*, fruits of *Tetracarpidium conophorum*, *Musa paradisiaca* and the leaves of *Tapinanthus begwensis* plants were collected in various villages in Osun state. Then, sample processing and chemical group detection was carried out. Local people were interviewed with the aid of semi-structural questionnaires. The plants that were used traditionally for the management of hypertension were documented. Phytochemical screening and quantitative analysis of the plants were determined. Also, the antioxidant assay was carried out using the 2,2-Diphenyl-1-picrylhydrazyl (DPPH). **Results:** Alkaloids, saponins, tannins, phenol and flavonoids were relatively found present. Also, the antioxidant assay carried out using the 2,2-Diphenyl-1-picrylhydrazyl (DPPH) shown the percentage inhibition potential of the plants. *Curcuma longa* showed highest percentage inhibition while *Arachis hypogaea* has the least. **Conclusion:** The findings of phytochemical constituent and antioxidant potential of the selected medicinal plants supported their use for managing hypertension conditions.

Key words: Phytochemical screening, antioxidant, medicinal plants, hypertension, antihypertensive, herbal medicine

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The traditional use of plant as therapeutic to alleviate or managing disease conditions by people of different cultures and regions started with life and has been found cheaper, diseases resistance, minimal side effects and highly effective[1]. Conventional antihypertensives are usually associated with many side effects. About 75-80% of the world population use herbal medicines for primary health care because of their better acceptability with human body and lesser side effects. There are a lot of medicinal plants that is responsible for the healing and curing of various ailments as a result of curative potentials plants possessed. Various parts of the plants are used by traditional medicine practitioners in the management and treatment of several and infectious diseases such as; diabetes, arthritis, dysentery, cardiovascular diseases and hypertension in Nigeria and the tropical island of Mauritius[2-4]. Also, Reactive Oxygen Species (ROS) have been implicated in many diseases and aging process. These free radicals, which cause tissue damage are generated by aerobic respiration, inflammation and liquid peroxidation. Antioxidant systems minimize or prevent deleterious effects of the ROS[5]. Phytochemicals are bioactive compounds called secondary metabolites found in plants. They contain nutrients and dietary fibers to protect against diseases[6-8]. Thus, plants has been reported as a basis in pharmaceutical industries to develop new drugs and use them as prevention and management of various diseases conditions, among which is hypertension. It was observed by Eddouks *et al.*[9] that a lot of people from different cultures and nations worldwide, particularly in Iran, China, Egypt and Greece used synthetic or conventional drugs as a means of handling their health challenges at different level of application. Unfortunately, these drugs have been demonstrated and reported having side effect, developing resistance to organisms caused diseases, expensive and not relatively available especially in the rural areas[10,11]. Therefore, people have opted for the use of medicinal herbs which have minimal or less side effects, cost effective and readily available especially by the people in the rural areas as a means of treating diseases. Incidentally there are many reports that revealed the effects of medicinal herbs for prevention and treatment of various health disorders such as gastrointestinal, respiratory, wounds, pains, migraine, diabetes, hypertension, skin problems, dysmenorrhea among others by impoverished peoples, villagers, various tribes and ethnic communities[12,13]. Also, antioxidant substances block the action of free radicals that have been implicated in various diseases and disease conditions such as; heart diseases, cancer, various skin infections and hypertension[14]. The increase in DPPH scavenging ability is proportional to the increase in the concentration of plant extracts.

Hypertension commonly known as high blood pressure is one of the most common and non-communicable diseases in the world which affects all races with variable prevalence[14]. Also, the findings of Kearney *et al.*[14] stated that, in Nigeria, hypertension is the commonest non-communicable disease affecting over 4.3 million Nigerians who are above the age of 15 years. Hypertension is highly prevalent in human communities; its mortality rate is twice higher than any other diseases. It was noted by Ejike *et al.*[15] that hypertension is the cause of one in every eight deaths worldwide, which makes it the third leading killer disease in the world. Hypertension occurs, when blood flows through the blood vessels with a force greater than normal, which causes the hardening of the arteries and thus predisposing individuals to various disease conditions such as; heart diseases, peripheral vascular diseases, stroke, heart failure or kidney failure[16-18]. Several factors predispose adults to hypertension. These factors include genetic factor (inherited from parents), age, obesity, wrong lifestyle, excessive salt intake, stress, elevated levels of plasma lipids particularly cholesterol, low potassium in the diet, excessive alcohol consumption and tobacco use or cigarette smoking[16-20]. According to Wofford and Hall[18] and Onyekwere *et al.*[20], the various signs and symptoms of hypertension include occipital headache, dizziness, restlessness, failing vision, shortness of breath and rapid/increased heartbeat.

However, there are several studies on naturally occurring medicinal plants having hypotensive potential because the phytotherapy is cheaper, less toxic, better resistance to disease caused organisms, effective and that plants are holistic in nature[6,9]. Examples are *Allium sativum*, *Annona muricata*, *Aristolochia manshuriensis*, *Artocarpus altilis*, *Cassia occidentalis*, *Daucus carota*, *Hibiscus sabdariffa*, *Lycopersicon esculentum* and others as reported earlier by Reinhart *et al.*[21], Hansawasdi *et al.*[22], Ajagbonna *et al.*[23], Gilani *et al.*[24] and Odigie *et al.*[25]. The seeds of *Arachis hypogaea,* rhizomes of *Curcuma longa,* fruits of *Musa paradisiaca,* seeds of *Parkia biglobosa,* seeds of *Piper guineense,* leaves of *Tapinanthus bengwensis,* fruits of *Tetracarpidium conophorum* and rhizomes of *Zingiber officinale* were observed commonly used traditionally in the study area to manage hypertension. Incidentally, in the last three decades, a lot of concerted efforts have been channeled into researching the local plants with hypotensive and antihypertensive effects. Therefore, this work was aimed to validate the traditional use of plants

to manage the various conditions associated with hypertension in the study area. Knowledge and treatment need to be coupled with modern medicine and more scientific research needs to be done to verify the effectiveness for their antihypertensive potential.

MATERIALS AND METHODS

Study area: The work was carried out in Osun state, South-West Nigeria between January, 2018 and June, 2019. Collection of plants was carried out in various villages in Osun state in 2018. Sample processing and chemical group detection were carried out at the chemistry laboratory in Afe Babalola University, Ekiti state, Nigeria. Local people were interviewed with the aid of semi-structural questionnaires. Its capital is Osogbo. It is bounded in the North by Kwara state, in the East partly by Ekiti state and partly by Ondo state, in the South by Ogun state and in the West by Oyo state.

Collection of plants materials: The plant materials were variously collected at different locations in the study area. The seeds of *Arachis hypogaea*, *Piper guineense, Parkia biglobosa* and rhizomes of *Curcuma longa*, *Zingiber officinale* were bought from Oja Tuntun, Ile Ife, while the fruits of *Tetracarpidium conophorum*, *Musa paradisiaca* and fresh leaves of *Tapinanthus begwensis* were collected at Promise land, Mokuro, Ile Ife, Osun state. The plants were identified and authenticated. The voucher specimens were prepared and deposited at the Herbarium unit of Plant Science and Biotechnology Laboratory, Ekiti state University, Nigeria.

Preparation of leaf samples: About 10 g of powdered samples was dissolved in 100 mL of distilled water, shaken regularly and left for three days to ensure deep extraction of the bioactive ingredients present in the various plant samples used. The residues were removed by filtering through eight layers of muslin clothe followed by Whatmann No. 1 filter paper, the filtrates was then centrifuged at 5000 g for 10 min. The supernatant was collected and further boiled till the volume was reduced to one-fourth of the original volume of the solvent used (that was 100 mL) giving the concentration[25] of 400 mg mL.

Phytochemical screening: The plant extracts of the powdered samples using aqueous solutions were assessed for the existence of the secondary metabolites by using the standard methods according to Odebiyi and Sofowora[26] and Trease and Evans[27].

- **Test for tannins:** About 2 mL of each of the plant extracted which was pipetted into different test tubes and 2 mL of 0.1 m ferric chloride in 0.1, formation of a dark blue or greenish black color showed the presence of tannins
- **Test for saponins:** About 2 mL of the plants extract was pipetted into different test tubes and was added with a 10 mL of sterile distilled water little modification and they were vigorously shaken. A foaming lather formation indicating the presence of saponins was observed
- **Test for flavonoids:** About 2 mL of the plant extract was put into different test-tubes followed by a few drops of diluted sodium hydroxide. A yellow orange color was produced, which becomes colorless on addition of few drops of diluted Hydrochloric
- **Test for alkaloids:** About 2 mL of the plant extract was drawn and pour into different test tubes and 2 mL of Mayer's reagent was added, a dull white precipitate revealed the presence of alkaloids

Determination of total phenol by folin-reagent method: Total phenol content was determined using gallic acid as a standard according to the previously described methods[28-30] using Folin-Ciocalteu reagent with modifications. About 10 mg pure standard gallic acid was mixed with 80 mL distilled water in a 100 mL volumetric flask and final volume (100 mL) was adjusted by drop wise addition of distilled water to get the standard gallic concentration 0.1 mg mL^{-1}. One miligram of crude extract was dissolved in methanol (1 mL). Three grams of 5% Na_2CO_3 was prepared by dissolving it in 50 mL of water. Each crude sample (200 µL) was taken into a test tube and 10% Folin-Ciocalteu reagent (1.5 mL) was added. Then all the test tubes were kept in a dark place for 5 min. Finally, 5% Na_2CO_3 (1.5 mL) was added to the solution and mixed well by hand and all the test tube was kept in the dark for 2 h. The absorbance was measured using UV-spectrophotometer at constant wavelength 750 nm. There was presence of blue colour intensity at 680 nm against the reagent blank. Finally, the content of total phenolic compound was determined by using a reference curve of gallic acid concentration.

Antioxidant

Estimation of Diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity: The principle of DPPH method was based on the reduction of DPPH in the presence of a hydrogen donating antioxidant. Changed in the colour of DPPH was observed due to the power of hydrogen donating ability[31-33].

DPPH is one of the compounds that possessed a proton free radical with a characteristic absorption, which decreases significantly on exposure to proton radical scavengers.

Procedure: The free radical scavenging ability of extract against DPPH (2,2-diphenyl-1-picryhydrazyl) using Gyamfi *et al.*[32] described method. One milliliter of the extract was mixed with 1 mL of the 0.4 mm methanolic solution of the DPPH, the mixture was left in the dark for 30 min before measuring the absorbance at 516 nm. Percentage inhibition was calculated using the following expression:

$$\text{Inhibition (\%)} = \frac{\text{A-B}}{\text{A}} \times 100$$

where, A is the absorbance of pure DPPH in oxidized form while B is the absorbance of sample taken after 30 min of reaction with DPPH.

Statistical analysis: The results obtained were analyzed by Statistical Package for the Social Science (SPSS) where mean and standard deviation were calculated using one way ANOVA of variance. Significant differences between data were tested using Duncan multiple range test and the significance of p-values was also determined.

RESULTS

Plants used in managing hypertension: The traditional use of plants to alleviate sicknesses has been from generation to generation through trial and error as a result of the effectiveness of plants on the various health challenges. Plant parts of various plants ranging from seeds of *Arachis hypogaea,* rhizomes of *Curcuma longa*, fruits of *Musa paradisiaca*, seeds of *Parkia biglobosa*, seeds of *Parkia biglobosa*, seeds of *Piper guineense*, leaves of *Tapinanthus bengwensis*, fruits of *Tetracarpidium conophorum* and rhizomes of *Zingiber officinale* were observed commonly used traditionally in the management of hypertension conditions (Table 1).

Phytochemical screening: The screening of the plants revealed the occurrence and availability of diverse kind of phytochemical components such as; alkaloids, saponins, tannins, phenols, flavonoids and glycoside with varying colours in the plants samples. It was observed that alkaloids, phenols, tannins and saponins were present in all the plants. However, flavonoids were absent in *Curcuma longa*, *Musa paradisiaca* and *Parkia biglobosa* (Table 2).

Total phytochemical contents: The quantitative analysis of the plants revealed the varying quantities of bioactive constituents that were present in the plants. The bioactive constituents that were present in the plants were significantly difference from one another while some were not significantly difference (Table 3).

Tetracarpidium conophorum, *Tapinanthus bengwensis, Zingiber officinale*, *Piper guineense* have the varying quantities. The quantity of alkaloids is lower in *Musa paradisiaca, Piper guineense, Curcuma longa* and *Parkia biglobosa*. Also, *Piper guineense* has the highest phenols followed by *Curcuma longa* and *Zingiber officinale*,

Table 1: List of the selected plants used in managing hypertension in the study area

Name of plants (authority)	Family name	Common name	Local name	Part used
Arachishy pogaea (Linn.)	Fabaceae	Groundnut	Epa	Seeds
Curcuma longa (Linn.)	Zingiberaceae	Turmeric	Ajo	Rhizomes
Musa paradisiaca (Linn.)	Musaceae	Plantain	Ogedeagbagba	Fruits
Parkia biglobosa (Linn.)	Fabaceae	Locust bean	Iru	Seeds
Piper guineense (Schumach. and Thonn.)	Piperaceae	Black pepper	Ata ijosi	Seeds
Tapinanthus bengwensis (England K Kraus)	Loranthaceae	Mistletoes	Afomo	Leaf
Tetracarpidium conophorum (Mull., Arg.) Hutch and Dalziel syn.	Euphorbiaceae	Walnut	Awusa	Fruits
Zingiber officinale (Roscoe)	Zingiberaceae	Ginger	Ginger	Rhizomes

Table 2: Phytochemical screening of the selected plants used in managing hypertension conditions in the study area

Name of plants	Alkaloids (mg L^{-1})	Phenols (mg L^{-1})	Tannins (mg L^{-1})	Saponins (mg L^{-1})	Flavonoids (mg L^{-1})
Arachis hypogaea	+	+	+	+	+
Curcuma longa	+	+	+	+	-
Musa paradisiaca	+	+	+	+	-
Parkia biglobosa	+	+	+	+	-
Piper guineense	+	+	+	+	+
Tapinanthus bengwensis	+	+	+	+	+
Tetracarpidium conophorum	+	+	+	+	+
Zingiber officinale	+	+	+	+	+

+: Present, -: Absent

Table 3: Quantitative analyses of plants used in treating hypertension in the study area

Name of plants	Alkaloids	Phenols	Tannins	Saponins	Flavonoids
Parkia biglobosa	1.28±0.00[b]	0.16±0.00[c]	0.07±0.00[d]	1.48±0.00[a]	0.01±0.00[e]
Musa paradisiaca	0.47±0.04[b]	0.13±0.00[c]	0.01±0.00[d]	0.70±0.00[a]	0.01±0.00[e]
Piper guineense	2.32±0.01[b]	0.52±0.01[d]	0.35±0.00[e]	3.51±0.06[a]	0.03±0.00[e]
Tapinanthus bengwensis	3.28±0.00[a]	0.38±0.00[d]	0.38±0.00[d]	0.09±0.00[e]	2.17±0.01[b]
Zingiber officinale	2.72±0.03[a]	0.47±0.01[d]	0.21±0.00[e]	0.79±0.00[c]	1.44±0.00[b]
Curcuma longa	1.10±0.02[b]	0.49±0.00[c]	0.16±0.00[d]	1.70±0.00[a]	0.05±0.00[e]
Arachis hypogaea	0.19±0.00[c]	0.17±0.01[d]	0.09±0.00[e]	1.60±0.00[a]	1.05±0.00[b]
Tetracarpidium conophorum	4.19±0.07[a]	0.15±0.00[d]	0.02±0.00[e]	0.95±0.01[c]	1.28±0.189[b]

Means with the same letter across the column are not significantly different at $p \leq 0.05$ from each other

Table 4: Antioxidant potential of the different plants samples in the study

Name of plants	Decolourisation of DPPH	Inhibition of DPPH (%)	TEAC
Curcuma longa	+++	29.98±24.45[a]	42.98±12.05[a]
Musa paradisiaca	0	24.17±12.10[a]	14.17±12.01[a]
Parkia biglobosa	0	11.86±10.34[a]	18.86±11.03a
Piper guineense	0	10.99±6.61[a]	08.99±02.61[a]
Tapinanthus bengwensis	0	11.74±11.03[a]	16.74±05.00[a]
Tetracarpidium conophorum	++	12.75±3.37[a]	22.75±13.03[a]
Zingiber officinale	0	11.71±9.56[a]	15.71±09.05[a]
Arachis hypogaea	+	05.61±1.34[b]	01.06±02.01[b]

+++: High, ++: Moderate, +: Low, Values are Mean±SD at $p<0.05$, n = 3, TEAC: Trolox equivalent antioxidant capacity, DPPH: 2,2-diphenyl-1-picryl hydrazyl, Means with the same letter across the column are not significantly different at $p \leq 0.05$ from each other

respectively. Phenol found in *Parkia biglobosa*, *Musa paradisiaca* and *Curcuma longa* are not significantly different from each other.

Also, *Tapinanthus bengwensis* and *Piper guineense* are observed had the highest present of Tannins while *Tetracarpidium conophorum* and *Musa paradisiaca* having lower quantities, respectively. Saponins was observed present in higher quantities in *Piper guineense* and *Curcuma longa* while *Musa paradisiaca* and *Tapinanthus bengwensis* have the lowest quantity of saponins. Similarly, *Tapinanthus bengwensis* and *Zingiber officinale* have the highest flavonoids, respectively as shown in the Table 3. Phenols are higher in *Piper guineense* and *Curcuma longa*, respectively while *Tetracarpidium conophorum* and *Musa paradisiaca* are having lower phenol, respectively (Table 3).

Antioxidant activity: The therapeutic values of medicinal plants are associated with their antioxidant properties. However, the free scavenging activities of the eight plants extracts were assessed through DPPH radical assay. There was disappearance of DPPH due to the activity of antioxidant of the various plants extracts. It revealed the potential of the plants to fight and guide against various conditions associated and resulted to hypertension. Groundnut (*Arachis hypogea*), Black pepper (*Piper guineense*), Locust bean (*Parkia biglobosa*), Mistletoe (*Tapinanthus bengwensis*), Ginger (*Zingiber officinale*), Plantain (*Musa paradisiaca*), Turmeric (*Curcuma longa*) and Walnut (*Tetracarpidium conophorum*) have relatively antioxidant potential which helps neutralizes the activities of free radicals in the body that prevent the outbreak of diseases. However, it was observed that *Curcuma longa* decolorized mostly and having the highest percentage inhibition while *Arachis hypogaea* has the least (Table 4).

DISCUSSION

There have been reports that medicinal plants contain diverse group of bioactive compounds called phytochemicals that have remedial properties to alleviate various disease conditions[34]. The secondary metabolites in plants are essential active ingredients that are naturally present in medicinal plants to manage various devastated health conditions resulted to hypertension[34-40]. The presence of bioactive ingredients in various medicinal plants are responsible for their effectiveness in the management of the various conditions such as; headaches, body pains, dizziness etc associated to hypertension. This study proved that *Tapinanthus bengwensis*, *Zingiber officinale*, *Parkia biglobosa*, *Curcuma longa*, *Piper guineense*, *Musa paradisiaca*, *Arachis hypogaea* and *Tetracarpidium conophorum* contain appreciable amount of bioactive ingredients such as; alkaloids, tannins, flavonoids, phenol, saponins (Table 1). This is suggested the possibility of using the plants as medicinal purposes in the management of hypertension[40-42]. The presence of Alkaloids serves as anti-inflammatory and antimicrobial agents. Also, alkaloids are powerful pain relief, having an antipyretic action, a stimulating effects and can act as tropical anesthetic[43,44]. Hence, its presence could inhibits

the growth of bacterial and manage hypertension and other related health challenges such as; Diabetes, CRD, Gastrointestinal disease and others[45]. The presence of saponins in the plant samples suggested an evidence of boosting the immune system and possessed cholesterol lowering potential as been demonstrated in human trial diseases such as malaria and intestinal diseases[41]. Similarly, tannins are useful in the treatment of intestinal disorders that resulted to diarrhoea, dysentery and urinary tract infections in both man and animals. Herbs that have tannins as their main components are astringent in nature and are used for treating intestinal disorders in diarrhea and dysentery. However, tannins denature proteins in the intestinal mucosa (mucous membrane) thereby reducing secretion, it also affects the wall of the stomach and contract the membrane thereby restrict secretions from the cells[26,27]. On the contrary however, the presence of tannins and spines inhibits the browsing capability of the plants which, if prolonged, may lead to the availability of the plant thus, leads to their conservation.

The increase in DPPH scavenging ability is proportional to the increase in the concentration of extracts. A stronger yellow color was observed indicating a greater antioxidant potential[12]. Phenolics substances have been shown to be responsible for the antioxidant activity of plant materials because they have the capacity of donating hydrogen atom or electron so as to show free radical scavenging activity. Phenols are secondary metabolites in plants and are known to possess a wide range of therapeutic uses[32,41]. The scavenging ability of the phenols is mainly due to the presence of hydroxyl groups in the plants tissues having inhibitory action thereby reducing oxidative stress experienced by plants during metabolism process and oxidative damage[41]. The strong relationship between total phenolic contents in plants, fruits, vegetables and grain products which are used in traditional medicine are usually attributed to their antioxidants compound, thus gives its therapeutic potential as reported by· antioxidant substances blocking the action of free radicals which have been implicated in the pathogenesis of various disease caused microorganisms. Also, flavonoids are hydroxylated phenolic compound that are synthesized by plants in response to microbial infections and they have been found to be antimicrobial substances against a wide array of microorganisms *in vitro*[42-44]. Similarly, flavonoids have enhanced great interest recently because of their potential beneficial effects on human health such as antiviral, anti-diabetic, anti-inflammatory, antitumor, anti-carcinogenic and anti-ageing properties[43-45]. Flavonoids exhibits biological activities via their strong antioxidant potential and have free radical scavenging and chelating ability, thus makes it performs its functions. Therefore, the results proved the validity of the plants as medicine and as an antioxidant that could serve as therapeutic agents as well as to prevent the outbreak of various diseases.

CONCLUSION

The tested plants species could be of great significance in the prevention and management of hypertension because of the availability of varying amounts of phytochemicals and antioxidants properties. Plants are naturally available, less toxic and diseases resistance. However, the mechanism of actions of these plants is not clear. Hence this could be subjected for further studies.

SIGNIFICANCE STATEMENT

It was found in this study that the tested plants possessed bioactive ingredients that enabled them active when used traditionally, thus proved their efficacies as herbal medicine and as an antioxidant. Also, the plants contained appreciable bioactive constituents that are called phytochemicals which could serve as precursors for the synthesis of useful drugs and can be beneficial in managing diseased conditions associated with hypertension in herbal and homeopathic medicine. Therefore, this study is recommending that there should be a further studies on the isolation, characterization and purification of the specific phytochemical and antioxidant compounds responsible for the management of hypertension as many people are advocating for complementary and alternative medicine because of the curative properties they possessed.

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REFERENCES

1. Sofowora, A., E. Ogunbodede and A. Onayade, 2013. The role and place of medicinal plants in the strategies for disease prevention. Afr. J. Tradit. Complement. Altern. Med., 10: 210-229.
2. Chintamunnee, V. and M.F. Mahomoodally, 2012. Herbal medicine commonly used against non-communicable diseases in the tropical island of Mauritius. J. Herbal Med., 2: 113-125.

3. Giday, M., Z. Asfaw, T. Elmqvist and Z. Woldu, 2003. An ethnobotanical study of medicinal plants used by the Zay people in Ethiopia. J. Ethnopharmacol., 85: 43-52.
4. Mahomoodally, M.F., 2013. Traditional medicines in Africa: An appraisal of ten potent African medicinal plants. Evidence-Based Complement. Altern. Med., 2013. 10.1155/2013/617459
5. Valko, M., D. Leibfritz, J. Moncol, M.T.D. Cronin, M. Mazur and J. Telser, 2007. Free radicals and antioxidants in normal physiological functions and human disease. Int. J. Biochem. Cell Biol., 39: 44-84.
6. Johns, T., 1996. Phytochemicals as evolutionary mediators of human nutritional physiology. Pharm. Biol., 34: 327-334.
7. Craig, W.J., 1999. Health-promoting properties of common herbs. Am. J. Clin. Nutr., 70: 491S-499S.
8. Charlton, M. and J.P. Thompson, 2015. Drugs acting on the heart: Antihypertensive drugs. Anaesthesia Intensive Care Med., 16: 227-231.
9. Eddouks, M., M. Ajebli and M. Hebi, 2017. Ethnopharmacological survey of medicinal plants used in Daraa-Tafilalet region (province of Errachidia), Morocco. J. Ethnopharmacol., 198: 516-530.
10. WHO., 1977. Resolution–Promotion and development of training and research in traditional medicine. WHO Document No. WHA30.49, World Health Organization, Geneva, Switzerland.
11. Ahmed, S.R., R. Roy, I.J. Romi, M. Hasan, M.K.H. Bhuiyan and M.M.H. Khan, 2019. Phytochemical screening, antioxidant and antibacterial activity of some medicinal plants grown in Sylhet region. IOSR J. Pharm. Biol. Sci., 14: 26-37.
12. Khan, M.A., M.K. Islam, M.A. Siraj, S. Saha and A.K. Barman *et al*., 2015. Ethnomedicinal survey of various communities residing in Garo Hills of Durgapur, Bangladesh. J. Ethnobiol. Ethnomed., Vol. 11, No. 1. 10.1186/s13002-015-0033-3.
13. Shao, H.B., L.Y. Chu, Z.H. Lu and C.M. Kang, 2008. Primary antioxidant free radical scavenging and redox signaling pathways in higher plant cells. Int. J. Biol. Sci., 4: 8-14.
14. Kearney, P.M., M. Whelton, K. Reynolds, P. Munter, P.K. Whelton and J. He, 2005. Global burden of hypertension: Analysis of worldwide data. Lancet, 365: 217-223.
15. Ejike, C.E.C.C., C.E. Ugwu and L.U.S. Ezeanyika, 2010. Variations in the prevalence of point (pre)hypertension in a Nigerian school-going adolescent population living in a semi-urban and an urban area. BMC Pediatr., Vol. 10. 10.1186/1471-2431-10-13
16. Polat, R., U. Cakilcioglu, K. Kaltalioglu, M.D. Ulusan and Z. Turkmen, 2015. An ethnobotanical study on medicinal plants in Espiye and its surrounding (Giresun-Turkey). J. Ethnopharmacol., 163: 1-11.
17. Ahmad, L., A. Semotiuk, M. Zafar, M. Ahmad and S. Sultana *et al*., 2015. Ethnopharmacological documentation of medicinal plants used for hypertension among the local communities of DIR Lower, Pakistan. J. Ethnopharmacol., 175: 138-146.
18. Wofford, M.R. and J.E. Hall, 2004. Pathophysiology and treatment of obesity hypertension. Curr. Pharmaceut. Des., 10: 3621-3637.
19. Lackland, D.T. and B.M. Egan, 2007. Dietary salt restriction and blood pressure in clinical trials. Curr. Hypertens. Rep., 9: 314-319.
20. Onyekwere, O.K., E.V. Okwuchi and E.S. Samuel, 2013. Knowledge of hypertension among adults in Owerri Senatorial Zone of Imo State, Nigeria. Mediterr. J. Social Sci., 4: 69-79.
21. Reinhart, K.M., C.I. Coleman, C. Teevan, P. Vachhani and C.M. White, 2008. Effects of garlic on blood pressure in patients with and without systolic hypertension: A meta-analysis. Ann. Pharmacother., 42: 1766-1771.
22. Hansawasdi, C., J. Kawabata and T. Kasai, 2000. α-Amylase inhibitors from roselle (*Hibiscus sabdariffa* Linn.) tea. Biosci. Biotechnol. Biochem., 64: 1041-1043.
23. Ajagbonna, O.P., F.B.O. Mojiminiyi and O.A. Sofola, 2001. Relaxant effects of the aqueous leaf extract of *Cassia occidentalis* on rat aortic rings. Afr. J. Biomed. Res., 4: 127-129.
24. Gilani, A.H., F. Shaheen, S.A. Saeed, S. Bibi, Irfanullah, M. Sadiq and S. Faizi, 2000. Hypotensive action of coumarin glycosides from *Daucus carota*. Phytomedicine, 7: 423-426.
25. Odigie, I.P., R.R. Ettarh and S.A. Adigun, 2003. Chronic administration of aqueous extract of *Hibiscus sabdariffa* attenuates hypertension and reverses cardiac hypertrophy in 2K-1C hypertensive rats. J. Ethnopharmacol., 86: 181-185.
26. Odebiyi, O.O. and E.A. Sofowora, 1978. Phytochemical screening of Nigerian medicinal plants II. Lloydia, 41: 234-246.
27. Trease, G.E. and W.C. Evans, 1989. Phenols and Phenolic Glycosides. In: Textbook of Pharmacognosy, Trease, G.E. and W.C. Evans (Eds.). Baillière-Tindall Publishers, London, UK., pp: 338-343.
28. Ciulci, I., 1994. Methodology for the analysis of vegetable drugs. Chemical Industries Branch, Division of Industrial Operations, United Nations Industrial Development Organization (UNIDO), Romania.
29. Fu, L., B.T. Xu, R.Y. Gan, Y. Zhang, X.R. Xu, E.Q. Xia and H.B. Li, 2011. Total phenolic contents and antioxidant capacities of herbal and tea infusions. Int. J. Mol. Sci., 12: 2112-2124.
30. Blois, M.S., 1958. Antioxidant determinations by the use of a stable free radical. Nature, 181: 1199-1200.
31. Esterbauer, H., R.J. Schaur and H. Zollner, 1991. Chemistry and biochemistry of 4-hydroxynonenal, malonaldehyde and related aldehydes. Free Radic. Biol. Med., 11: 81-128.

32. Gyamfi, M.A., M. Yonamine and Y. Aniya, 1999. Free-radical scavenging action of medicinal herbs from Ghana: *Thonningia sanguinea* on experimentally-induced liver injuries. Gen. Pharmacol.: Vasc. Syst., 32: 661-667.
33. Parivuguna, V., R. Gnanaprabhal, R. Dhanabalan and A. Doss, 2008. Antimicrobial properties and phytochemical constituents of *Rheo discolor* hance. Ethnobot. Leaflets, 12: 841-845.
34. Karou, S.D., T. Tchacondo, M.A.D. Tchibozo, S. Abdoul-Rahaman and K. Anani *et al*., 2011. Ethnobotanical study of medicinal plants used in the management of diabetes mellitus and hypertension in the Central region of Togo. Pharmaceut. Biol., 49: 1286-1297.
35. Bussmann, R.W. and D. Sharon, 2006. Traditional medicinal plant use in Northern Peru: Tracking two thousand years of healing culture. J. Ethnobiol. Ethnomed., Vol. 2. 10.1186/1746-4269-2-47.
36. Edeoga, H.O., D.E. Okwu and B.O. Mbaebie, 2005. Phytochemical constituents of some Nigerian medicinal plants. Afr. J. Biotechnol., 4: 685-688.
37. Woodward, A. and D.L. Coppock, 1995. Role of plant defense in the utilization of native browse in Southern Ethiopia. Agrofor. Syst., 32: 147-161.
38. Susanti, D., H.M. Sirat, F. Ahmad, R.M. Ali, N. Aimi and M. Kitajima, 2007. Antioxidant and cytotoxic flavonoids from the flowers of *Melastoma malabathricum* L. Food Chem., 103: 710-716.
39. Bhattacharya, S., J.P. Kamat, S.K. Bandyopadhyay and S. Chattopadhyay, 2009. Comparative inhibitory properties of some Indian medicinal plant extracts against photosensitization-induced lipid damage. Food Chem., 113: 975-979.
40. Li, H.B., C.C. Wong, K.W. Cheng and F. Chen, 2008. Antioxidant properties *In vitro* and total phenolic contents in methanol extracts from medicinal plants. LWT-Food Sci. Technol., 41: 385-390.
41. Slemmer, J.E., J.J. Shacka, M.I. Sweeney and J.T. Weber, 2008. Antioxidants and free radical scavengers for the treatment of stroke, traumatic brain injury and aging. Curr. Med. Chem., 15: 404-414.
42. Tahraoui, A., J. El-Hilaly, Z.H. Israili and B. Lyoussi, 2007. Ethnopharmacological survey of plants used in the traditional treatment of hypertension and diabetes in South-Eastern Morocco (Errachidia province). J. Ethnopharmacol., 110: 105-117.
43. Sies, H., 1997. Oxidative stress: Oxidants and antioxidants. Exp. Physiol., 82: 291-295.
44. Ebrahimabadi, A.H., A. Mazoochi, F.J. Kashi, Z. Djafari-Bidgoli and H. Batooli, 2010. Essential oil composition and antioxidant and antimicrobial properties of the aerial parts of *Salvia eremophila* Boiss. from Iran. Food Chem. Toxicol., 48: 1371-1376.
45. Lobo, V., A. Patil, A. Phatak and N. Chandra, 2010. Free radicals, antioxidants and functional foods: Impact on human health. Pharmacogn. Rev., 4: 118-126.