



An Overview of Some Medicinal Plants Used In Northern Nigeria for the Treatment of Hypertension

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ABSTRACT

Hypertension is one of the diseases that require long-term therapy and most of the drugs used for the treatment of hypertension in Nigeria are expensive. The exorbitant drug price, coupled with recent economic challenges, forced many people in Nigeria to resort to using plants they believe to have antihypertensive activity due to their affordability and availability without proper knowledge of their functions and toxicity to the body. The study aimed to identify and document plant species, plant products and method of preparations used by people in Northern Nigeria to control hypertension with the view of preserving the knowledge and providing basis for pharmacological investigations. Data for the study were generated from scientific databases using specific keywords such as “medicinal plants”, “hypertension” and “Northern Nigeria”. The data generated were collated and analyzed in Microsoft Excel spreadsheet. A total of 59 medicinal plant species belonging to 39 families used by the people of Northern Nigeria to manage hypertension were documented. Out of the 39 families, Fabaceae (7), Apocynaceae (3), Lamiaceae (3), and Malvaceae (3) were the most represented. Among the 59 plant species documented *Allium sativum* (5), *Hibiscus sabdariffa* (4) and *Carica papaya* (4) were the most reported. The most used plant parts are leaves (36) and the least used are rhizomes (1), fruit water (1), kernel and gel (1). Decoction (46) was the most common method of preparation while the least was powder used in food (2). In addition, the antihypertensive properties of 50 of the 59 medicinal plants were previously experimentally tested and confirmed. Though the antihypertensive activity of most of the plants used were experimentally verified and validated, further studies are required to identify toxicity and appropriate dosage regimen of the plants.

Keywords: Hypertension; Medicinal plants; Northern-Nigeria; Validated

INTRODUCTION

Since time immemorial people have been using traditional medicines for the treatment of many diseases. The practice is more common in developing countries where the cost of synthetic drug is unaffordable to a large size of the populace (Agrawal *et al.*, 2010). A hospital based study conducted in Nigeria puts the frequency of utilization of medicinal plants among hypertensive patients to treat their ailment at 70.9% (Sylver-Francis, 2022). The exorbitant drug price, coupled with recent economic challenges probably forced these people to

resort to using plants they believe to have antihypertensive activity due to their affordability and availability without proper knowledge of their function and toxicity to the body, where some have the idea that combining it with conventional treatment works better (Abubakar *et al.*, 2015).

In the last 2 decades population growth, poverty and changes in lifestyle including diet and physical inactivity increased the prevalence of hypertension among the Nigerian population.



According to Nigerian Heart Foundation (NHF), from 1995 to 2021 the number of Nigerians living with hypertension has increased from 4 million to 76.2 million, with the rate increasing faster in women than men (Muanya and Edward, 2021; The University of Edinburg, 2021). Hypertension (high blood pressure) is diagnosed when pressure in blood vessels is too high when measured (140/90 mmHg or higher) (WHO, 2023) and it is one of the leading causes of cardiovascular disease and preventable death worldwide (Muanya and Edward, 2021). Findings of the study uploaded by Digital Health Information System 2 (DHIS2, 2023) shows hypertension-related complications accounts for up to 25% of emergency admissions in urban hospitals in Nigeria.

A study conducted by The University of Edinburg (2021) involving 80,000 people with hypertension in Nigeria indicates that only 12 per cent took medication for the condition. Similarly, NHF stated that out of the 76.2 million hypertensive Nigerians only 23 million are on treatment (Muanya and Edward, 2021). Hypertension treatment involves lifestyle changes and lifelong/prolong drug combination therapy (Lagnika *et al.*, 2016; Oguanobi, 2021), however, most of the drugs used for the treatment of hypertension in Nigeria are costly and have variable quality, thus, the high cost of the drugs makes the treatment out of reach of many people living in Nigeria. Oamen and Osemene (2021) affirms rising antihypertensive medication

cost as a major cause of noncompliance to the therapy in their study.

Literature searches showed that comprehensive reports of antihypertensive plants used by people in Nigeria were skewed towards the Southern part of the country (Obode *et al.*, 2020). The study therefore, was aimed at identifying and documenting plant species, plant products and method of preparations used by people in Northern Nigeria to control hypertension with the view of preserving the knowledge and providing basis for pharmacological investigations.

METHODOLOGY

The study is a product of desktop research. Data for the study were sourced from secondary sources namely: PubMed/Medline, Science direct, Google Scholar, newspapers, thesis, and any other vital document dealing with the subject matter using the search term “medicinal plants”, “hypertension”, “hausa + ethnomedicine”, “plant + hypertension”, “Northern Nigeria”, and “plant + validated” following preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines (Moher *et al.*, 2009). Plants of the world online portal (<http://www.worldfloraonline.org/>), plant repository (<http://aceprd.unijos.edu.ng/plant-info/>) and hausa name for plant and trees by Blench (2007) were used for the validation of botanical and hausa name of the plants. The data generated were collated and analyzed in Microsoft Excel spreadsheet using descriptive statistics.



RESULTS AND DISCUSSION

Table 1: Medicinal plants used for the Treatment of Hypertension in Northern Nigeria (2023)

S/N	Family	Scientific Name	Local Name	Part(s) Used	Method of Preparation	Antihypertensive Validation	References
1.	Amaryllidaceae	<i>Allium cepa</i>	Albasa	Bulb	Maceration	Validated	Hamza (2002); Sani and Aliyu (2011)
2.	Amaryllidaceae	<i>Allium sativum</i>	Tafarnuwa	Bulb	Decoction/ Maceration	Validated	Hamza (2002); Olisa and Oyelola (2009); Raji <i>et al.</i> (2013); Kutama <i>et al.</i> (2015); Agunu <i>et al.</i> (2017)
3.	Amonaceae	<i>Xylopi aethiopica</i>	Kímbáá	Fruit	Infusion	Validated	Agunu <i>et al.</i> (2017)
4.	Anacardiaceae	<i>Anarcadium occidentale</i>	Kashu	Leaves	Decoction	Validated	Atawodi <i>et al.</i> (2014);
5.	Apocynaceae	<i>Calotropis procera</i>	Tumfafiya	Leaves	Infusion	Validated	Atawodi <i>et al.</i> (2014); Agunu <i>et al.</i> (2017)
6.	Apocynaceae	<i>Leptadenia hastata</i>	Yààdǎíyáá	Whole plant	Decoction/ Maceration/ Infusion	Validated	Sani and Aliyu (2011)
7.	Apocynaceae	<i>Rauwolfia vomitoria</i>	Wada	Root	Decoction	Validated	Agunu <i>et al.</i> (2017); Atawodi <i>et al.</i> (2014)

8.	Arecaceae	<i>Hyphaene thebaica</i>	Gòdriḃà	Fruit	Decoction	Validated	Olisa and Oyelola (2009)
9.	Arecaceae	<i>Cocos nucifera</i>	Kwakwa	Leaves, stem, fruit-water	Decoction/ Cold infusion	Validated	Raji <i>et al.</i> (2013)
10.	Asphodelaceae	<i>Aloe vera</i>	Izabar giwa	Gel, whole plant	Decoction/ Infusion	Validated	Olisa and Oyelola (2009)
11.	Asteraceae	<i>Vernonia amygdalina</i>	Shiwáákáá	Leaves	Decoction	Validated	Agunu <i>et al.</i> (2017); Raji <i>et al.</i> (2013)
12.	Bignoniaceae	<i>Kigelia africana</i>	Rawuya	Whole plant	Decoction/ Cold infusion	Validated	Raji <i>et al.</i> (2013); Atawodi <i>et al.</i> (2014)
13.	Bignoniaceae	<i>Newbouldia laevis</i>	Aduruuku	Root, stem, bark, leaves	Decoction	Validated	Raji <i>et al.</i> (2013); Atawodi <i>et al.</i> (2014)
14.	Boraginaceae	<i>Heliotropium indicum</i>	Kárákshín Kòòràràà	Leaves	Powder used in food	Validated	Agunu <i>et al.</i> (2017)
15.	Burseraceae	<i>Commiphora kerstingii</i>	Árárráḃíí	Stem	Decoction	Not Validated	Raji <i>et al.</i> (2013)
16.	Caricaceae	<i>Carica papaya</i>	Gwandar gida	Leaves, unripe fruits	Decoction	Validated	Olisa and Oyelola (2009); Raji <i>et al.</i> (2013); Ibrahim <i>et al.</i> (2016); Agunu <i>et al.</i> (2017)
17.	Clusiaceae	<i>Garcinia kola</i>	Góórò	Seed	Decoction	Validated	Olisa and Oyelola (2009)

18.	Colchicaceae	<i>Gloriosa superba</i>	Báurээрèè	Leaves, seeds	Maceration/ Concoction	Not validated	Raji <i>et al.</i> (2013)
19.	Combretaceae	<i>Combretum micranthum</i>	Géézà	Leaves	Decoction	Validated	Adelanwa and Mohammed (2014)
20.	Curcubitaceae	<i>Citrullus lanatus</i>	Kankana	Fruit	Concoction/ Raw	Validated	Yusuf and Adelanwa (2020)
21.	Cucurbiaceae	<i>Cucurbita pepo</i>	Kabewa	Seed	Tisane	Validated	Adelanwa and Tijjani (2013)
22.	Dioscoreaceae	<i>Tacca involucrata</i>	Sàndán bírí	Leaves	Decoction	Not validated	Raji <i>et al.</i> (2013)
23.	Euphorbiaceae	<i>Jatropha curcas</i>	Bini da zugu	Kernel, leaves	Decoction/ Infusion	Validated	Olisa and Oyelola (2009)
24.	Fabaceae	<i>Acacia nilotica</i>	Bagaruwa	Leaves	Decoction	Validated	Adelanwa and Tijjani (2013); Raji <i>et al.</i> (2013)
25.	Fabaceae	<i>Daniellia oliveri</i>	Kàdàuráá/ Maje	Roots	Decoction/ Tisane	Not validated	Agunu <i>et al.</i> (2017); Sadiq <i>et al.</i> (2019)
26.	Fabaceae	<i>Prosopis africana</i>	Kíryà	Leaves	Decoction	Validated	Raji <i>et al.</i> (2013)
27.	Fabaceae	<i>Tamarindus indica</i>	Tsamiya	Fruit	Decoction	Validated	Olisa and Oyelola (2009)
28.	Fabaceae	<i>Piliostigma reticulatum</i>	Kálgóó	Leaves	Decoction	Not validated	Olisa and Oyelola (2009)
29.	Fabaceae	<i>Albizia chevalieri</i>	Katsari	Stem, bark, leaves	Decoction	Not validated	Adelanwa and Tijjani (2013)
30.	Fabaceae	<i>Cassia alata/ Senna alata</i>	Fíláskóó	Leaves	Decoction	Not validated	Olisa and Oyelola (2009); Raji <i>et al.</i> (2013); Agunu <i>et al.</i> (2017)

31.	Lamiaceae	<i>Ocimum basilicum</i>	Daddoya	Leaves	Decoction	Validated	Olisa and Oyelola (2009)
32.	Lamiaceae	<i>Mentha piperita</i>	Na'ana'a	Leaves	Infusion/ Decoction	Validated	Hamza (2002)
33.	Lamiaceae	<i>Vitex doniana</i>	Dínyáá	Leaves	Decoction	Validated	Raji <i>et al.</i> (2013)
34.	Lauraceae	<i>Persea americana</i>	Avocado/ Fiya	Leaves, fruit, seeds, stem	Decoction/ Tisane/ Raw	Validated	Raji <i>et al.</i> (2013) Atawodi <i>et al.</i> (2014)
35.	Lecythidaceae	<i>Rhaptopetalum coriaceum</i> Oliv.	-	Stem	Decoction	Validated	Raji <i>et al.</i> (2013)
36.	Linaceae	<i>Linum usitatissimum</i>	Agushi	Leaves, Seeds	Decoction/ Infusion	Validated	Raji <i>et al.</i> (2013)
37.	Loranthaceae	<i>Englerina gbonansis</i>	Kauci	Leaves	Decoction	Not validated	Adelanwa and Tijjani (2013); Raji <i>et al.</i> (2013)
38.	Malvaceae	<i>Adansonia digitata</i>	Kuka	Stem, bark, fruit	Decoction/ Tisane	Validated	Olisa and Oyelola (2009)
39.	Malvaceae	<i>Corchorus olitorius</i>	Láálò	Seeds	Infusion	Validated	Raji <i>et al.</i> (2013)
40.	Malvaceae	<i>Hibiscus sabdariffa</i>	Zoborodo	Leaves, flower	Decoction	Validated	Hamza (2002); Raji <i>et al.</i> (2013); Musa (2019); Sadiq <i>et al.</i> (2019);
41.	Meliaceae	<i>Azadirachta indica</i>	Dalbejia	Leaves	Decoction/ Infusion	Validated	Olisa and Oyelola (2009)
42.	Meliaceae	<i>Melia azedarach</i>	Kúrnàr Másàr	Leaves	Decoction	Validated	Olisa and Oyelola (2009)
43.	Moraceae	<i>Ficus capensis</i>	Uwar yara	Leaves	Decoction	Validated	Atawodi <i>et al.</i> (2014)
44.	Moringaceae	<i>Moringa oleifera</i>	Zogale	Leaves, flower	Decoction/ Maceration/ Infusion/	Validated	Olisa and Oyelola (2009);

					Powder used in food/Tisane		
45.	Myrtaceae	<i>Psidium guajava</i>	Góóbàà	Leaves	Decoction/ Infusion	Validated	Adelanwa and Mohammed (2014) Agunu <i>et al.</i> (2017); Raji <i>et al.</i> (2013)
46.	Olacaceae	<i>Ximenia americana</i>	Tsada	Leaves	Decoction	Validated	Olisa and Oyelola (2009)
47.	Oleaceae	<i>Olea europea</i>	Zàitûn	Leaves	Decoction	Validated	Raji <i>et al.</i> (2013)
48.	Phyllanthaceae	<i>Hymenocardia acida</i>	Ján ice	Leaves, bark, root	Decoction/ Infusion	Validated	Olisa and Oyelola (2009)
49.	Phyllanthaceae	<i>Phyllanthus amarus</i>	Majiriyar kurmi	Leaves	Infusion	Validated	Raji <i>et al.</i> (2013)
50.	Poaceae	<i>Cymbopogon citratus</i>	Tsauri/Jema	Leaves	Decoction	Validated	Agunu <i>et al.</i> (2017); Olisa and Oyelola (2009)
51.	Rosaceae	<i>Crataegus specie</i>	Zarangadee	Fruits	Raw/ Tisane	Validated	Raji <i>et al.</i> (2013)
52.	Rosaceae	<i>Pyrus specie</i>	Fiya	Leaves	Decoction	Validated	Agunu <i>et al.</i> (2017); Raji <i>et al.</i> (2013)
53.	Rubiaceae	<i>Crossopteryx febrifuga</i>	Kasfiya	Leaves	Decoction	Not validated	Atawodi <i>et al.</i> (2014)
54.	Rutaceae	<i>Citrus aurantifolia</i>	Lemon-tsami	Flower	Infusion	Validated	Hamza (2002); Agunu <i>et al.</i> (2017)
55.	Sapindaceae	<i>Paullinia pinnata</i>	Furen amarya	Leaves, root	Decoction	Validated	Atawodi <i>et al.</i> (2014)
56.	Sapotaceae	<i>Vitellaria paradoxa</i>	Kádányà	Leaves	Decoction	Validated	Raji <i>et al.</i> (2013)
57.	Solanaceae	<i>Solanum lycopersicum</i>	Tumatir	Fruits	Concoction/ Raw	Validated	Raji <i>et al.</i> (2013)
58.	Zingiberaceae	<i>Aframomum melegueta</i>	Cittáá mài kwààýáá	Seeds	Tisane/ Tisane	Validated	Raji <i>et al.</i>

59.	Zingiberaceae	<i>Zingiber officinale</i>	Cittáá	Root, rhizome	Infusion Decoction	Validated	(2013) Agunu <i>et al.</i> (2017); Olisa and Oyelola (2009); Raji <i>et al.</i> (2013)
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Available literature consulted revealed that hypertensive patients in Northern Nigeria used a total of 59 medicinal plant species belonging to 39 families to manage their ailment. Out of the 39 families, Fabaceae (7), Apocynaceae (3), Lamiaceae (3) and Malvaceae (3) were the most represented (Table 1). Many plant materials are utilized for the treatment and management of hypertension in Northern Nigeria thereby affirming the assertion that several indigenous African plant species have potential to lower blood pressure by influencing the conventional renin-angiotensin system (RAS) pathway (Jacobs *et al.*, 2020). Most of the plants documented (e.g. *Allium cepa*, *Moringa oleifera*, *Hibiscus sabdariffa*, *Adansonia digitata*, *Calotropis procera*, *Leptadenia hastata*, *Commiphora kerstingii*, *Acacia nilotica*, *Psidium guajava*, *Hyphaene thebaica* and *Vitellaria paradoxa*) have many other medicinal uses and are widely distributed in Nigeria. The findings agree with that of Mensah *et al.* (2009) who reported that most of the plants used for managing hypertension in Nigeria possess other documented medicinal uses and are widely distributed in West Africa. The findings are also in line with the findings of Obode *et al.* (2020) who reported plants belonging to the families; Fabaceae, Malvaceae, and Apocynaceae as the most commonly used antihypertensive agents in Nigeria. Fabaceae, Malvaceae, Lamiaceae and Apocynaceae are the most common plant family found in Africa (Burnham and Johnson 2004; Encyclopedia Britannica, 2023) and are known to contain many bioactive compounds such as tannins, inulins, cardiac glycosides, flavonoids, proanthocyanidins, phenolic glycosides, alkaloids, oxalates, sesquiterpene lactones, anthocyanins, and saponins which are found to be medically useful (Mensah *et al.*, 2009; Atawodi *et al.*, 2014; Obode *et al.*, 2020). Another reason for their high fidelity index could be because most species (e.g. *Hibiscus sabdariffa*, *Ocimum basilicum*, *Persea americana*, *Rauwolfia vomitoria*) of these families have been reported by various researchers to be potent hypotensive agents (Tabassum and Ahmad, 2011; Muanya, 2018). Among the 59 plant species documented *Allium sativum* (5), *Hibiscus sabdariffa* (4), *Carica papaya* (4), *Senna alata* (3), and *Zingiber officinale* (3) were the most reported. These species has long been used for the treatment of a variety of cardiovascular conditions over the years and are one of the most extensively studied plants for antihypertensive properties (Tabassum and Ahmad, 2011). The plant parts used include leaves, roots, bark, stems, fruits, seed, bulb, fruit water, gel, rhizome, kernel as well as flower with leaves (36), fruits (9) and stem (7) being the most commonly used plant parts.



Leaves are known to be the most abundant plant part and accumulate biologically active chemicals such as; alkaloid, cardiac glycosides, flavonoids, proanthocyanins, sugar, amino acids, protein, steroids, saponins, etc. (Okoegwale and Omefezi, 2001). The findings are in conformity with the work carried out by Gbolade (2012) and Aumeeruddy and Mahomoodally (2020) who reported *A. sativum* as the most commonly cited antihypertensive plant and leaves as the most preferred plant parts in Nigeria and the world at large.

Decoction (46) was the main method of preparing plants that were taught to have antihypertensive effect in Northern Nigeria. Others include; infusion (17), tisane (7), maceration (5), raw (4), concoction (3) and powder used in food (2). Similar results were already being recorded previously in other parts of Nigeria and in parts of West Africa (Gbolade, 2012; Lagnika *et al.*, 2016; Daoudi *et al.*, 2016). The similarity could be attributed to the proximity of the region to the areas.

Also antihypertensive effect of 50 of the 59 medicinal plants reported in this review were previously experimentally verified (Eturk, 2006; Tabassum and Ahmad, 2011; Nsuadi *et al.*, 2013; Shah *et al.*, 2014; Abubakar *et al.*, 2015; Eghianruwa *et al.*, 2016; Jacobs *et al.*, 2020; Kamyab *et al.*, 2020; Obode *et al.*, 2020; Elmahdy *et al.*, 2022; Saeed *et al.*, 2022), though mechanism of action of some of them were not known (*Citrullus lanatus*, *Kigelia africana*, *Linum usitatissimum*, *Newbouldia laevis*, *Prosopis africana*, *Pyrus specie*, *Tamarindus indica*, *Vitex doniana*, *Ximenia americana*).

Plants whose antihypertensive mechanisms of action were known, display either angiotensin-converting enzyme (ACE) inhibition ability (*Allium sativum*, *Aloe vera*,

Anacardium occidentale, *Carica papaya*, *Citrus aurantifolia*, *Corchorus olitorius*, *Ficus capensis*, *Hibiscus sabdariffa*, *Hyphaene thebaica*, *Jatropha curcas*, *Mangifera indica*, *Mentha piperita*, *Ocimum basilicum*, *Olea europea*, *Persea americana*, *Phyllanthus amarus*, *Psidium guajava*, *Solanum lycopersicum*, *Vernonia amygdalina*, *Xylopi aethiopica*, *Zingiber officinale*), renin inhibition ability (*Allium cepa*, *Crataegus spp.*, *Hibiscus sabdariffa*, *Ocimum basilicum*, *Olea europea*, *Psidium guajava*), radical scavenging potentials (*Allium cepa*), calcium channel blocking effects (*Acacia nilotica*, *Allium cepa*, *Azadirachta indica*, *Cymbopogon citratus*, *Garcinia kola*, *Heliotropium indicum*, *Hibiscus sabdariffa*, *Melia azedarach*, *Moringa oleifera*, *Rhaptopetalum coriaceum* Oliv., *Zingiber officinale*), anti-inflammatory properties (*Adansonia digitata*, *Aframomum melegueta*, *Aloe vera*, *Calotropis procera*, *Cocos nucifera*, *Crataegus spp.*, *Cymbopogon citratus*, *Ficus capensis*, *Garcinia kola*, *Hibiscus sabdariffa*, *Leptadenia hastata*, *Moringa oleifera*, *Paullinia pinnata*, *Xylopi aethiopica*, *Zingiber officinale*), ability to increase nitric oxide production (*Allium cepa*, *Allium sativum*, *Crataegus spp.*, *Cymbopogon citratus*, *Hibiscus sabdariffa*, *Mangifera indica*), ability to increase vasodilation (*Aframomum melegueta*, *Crataegus spp.*, *Melia azedarach*; *Psidium guajava*, *Rauwolfia vomitoria*, *Xylopi aethiopica*, *Zingiber officinale*) (Eturk, 2006; Tabassum and Ahmad, 2011; Nsuadi *et al.*, 2013; Shah *et al.*, 2014; Abubakar *et al.*, 2015; Eghianruwa *et al.*, 2016; Jacobs *et al.*, 2020; Kamyab *et al.*, 2020; Obode *et al.*, 2020; Elmahdy *et al.*, 2022; Saeed *et al.*, 2022).



Ability to decrease proliferation of the vascular smooth muscle cells and promote vasorelaxation (*Adansonia digitata*, *Allium sativum*, *Azadirachta indica*, *Calotropis procera*, *Cocos nucifera*, *Combretum micranthum*, *Crataegus* spp., *Hymenocardia acida*, *Moringa oleifera*, *Ocimum basilicum*, *Paullinia pinnata* *Persea americana*, *Psidium guajava*, *Vernonia amygdalina*), ability to increase antioxidant enzymes (*Adansonia digitata*, *Aframomum melegueta*, *Citrus aurantifolia*, *Cucurbita pepo* *Crataegus* spp., *Cocos nucifera*, *Ficus capensis*, *Garcinia kola*, *Paullinia pinnata*, *Rauwolfia vomitoria*, *Solanum lycopersicum*, *Zingiber officinale*) or diuretic effect (*Carica papaya*, *Heliotropium indicum*, *Hibiscus sabdariffa*, *Olea europea*, *Phyllanthus amarus*, *Xylopi aethiopica*) (Eturk, 2006; Tabassum and Ahmad, 2011; Nsuadi *et al.*, 2013; Shah *et al.*, 2014; Abubakar *et al.*, 2015; Eghianruwa *et al.*, 2016; Jacobs *et al.*, 2020; Kamyab *et al.*,

2020; Obode *et al.*, 2020; Elmahdy *et al.*, 2022; Saeed *et al.*, 2022).

CONCLUSION

This review has successfully documented a wide range of medicinal plants used by the population of Northern Nigeria to treat hypertension, thus preventing the loss of knowledge and providing a basis for pharmacological research. However, the literature reviewed shows that there is a lack of published field studies on native antihypertensive plant in many States of Northern Nigeria. Therefore, there is a pressing need for ethnobotanical research in the remaining States. Since the mechanism of action of several of the experimentally tested antihypertensive plants were known, further studies are needed to determine toxicity, appropriate dosage regimen and mechanisms of action of these plants, as they have played and are likely to continue to play an important role in hypertension treatment in the region due to their low cost and local availability.

REFERENCES

- Abubakar, M. G., Ukwuani, A. N., and Mande, U. U. (2015). Antihypertensive activity of *Hibiscus Sabdariffa* aqueous calyx extract in Albino rats. *Sky Journal of Biochemistry Research*, **4** (3): 16 – 20.
- Adelanwa, E. B. and Mohammed, M. K. (2014). A study of medicinal herbs and spices used by the hausas in Zaria Local Government Area of Kaduna State. *Scientific African Journal of Food Science and Dietetics*, **1**: 8-13
- Adelanwa, E. B. and Tijjani, A. A. (2013). An ethno-medical survey of the flora of Kumbotso Local Government Area of Kano State. *Nigerian journal of Pharmaceutical Sciences*, **12**(1):7-13
- Agrawal, M., Nandini, D., Sharma, V. and Chauhan, N. S. (2010). Herbal remedies for treatment of hypertension. *International Journal of Pharmaceutical Sciences Research*, **1**(5): 1-21
- Agunu, A., Lawal, B. A. and Akande, A. A. (2017). A survey of plants used in the treatment of hypertension and diabetes mellitus in Illorin, Kwara State, Nigeria. *Nigerian Journal of Pharmaceutical Research*, **13**(1); 27-35



- Amira, O. C. and Okubadejo, N. U. (2007). Frequency of complementary and alternative medicine utilization in hypertensive patients attending an urban tertiary care center in Nigeria. *BioMed Central Complementary and Alternative Medicine*, **7**(30).
- Atawodi, S. E., Olowoniyi, O. D. and Daikwo, M. A. (2014). Ethnobotanical Survey of some Plants Used for the Management of Hypertension in the Igala Speaking Area of Kogi State, Nigeria. *Annual Research & Review in Biology*, **4**(24): 4535-4543, 2014
- Aumeeruddy, M. Z. and Mahomoodally, M. F. (2020). Traditional herbal therapies for hypertension: A systematic review of global ethnobotanical field studies. *South African Journal of Botany*, **135**:451-464.
<https://doi.org/10.1016/j.sajb.2020.09.008>
- Blench, R. (2007). Hausa names for plants and trees. <http://www.rogerblench.info/RBOP> (Accessed 6 June, 2023)
- Burnham, R. J. and Johnson, K. R. (2004). South American palaeobotany and the origins of neotropical rainforests. *Philosophical Transactions of the Royal Society B: Biological Sciences*, **359** (1450): 1595–1610.
<http://doi:10.1098/rstb.2004.1531>.
- Daoudi, A., Bammou, M., Zarkani, S., Slimani, I., Ibjibijen, J. and Nassiri, L. (2016). Ethnobotanical study of medicinal flora in rural municipality of Aguelmous. *Phytotherapie*, **14**(4):220-228
- Distric Health Information System 2 (DHIS2, 2023). Combating hypertension in Nigeria with decentralizing testing, real-time data analytics and a standardized patient centred treatment protocol. <https://dhis2.org/nigeria-hypertention-control/> (Accessed 1 June, 2023)
- Eghianruwa, K. I., Oridupa, O. A. and Saba, A. B. (2016). Medicinal Plants Used for Management of Hypertension in Nigeria. *Annual Research & Review in Biology*, **11**(3): 1-10
- Elmahdy, M. F., Adris, M. A. and O Belih, S. S. (2022). The effect of herbal treatment of *Hyphaene thebaica* (Doum) & *Nelumbo nucifera* (lotus) on induced hyperlipidemia & hypertension in male Wister Albino Rat. *Medico-Legal Update*, **22** (4): 18-25
- Encyclopædia Britannica (2023). Plant family. <https://www.britannica.com/plant/family> (Accessed 15 June, 2023)
- Etuk, E. U. (2006). A review of medicinal plants with hypotensive or antihypertensive effects. *Journal of Medical Sciences*, **6**(6); 894-900
- Gbolade, A. (2012). Ethnobotanical study of plants used in treating hypertension in Edo State of Nigeria. *Journal of Ethnopharmacology*, **144**(1):1-10
- Hamza, F. M. (2002). A review of some plants used in hausa ethnomedicine. Unpublished seminar paper presented to the Department of Biological Sciences, Bayero University, Kano, Nigeria
- Ibrahim, J. A., Egharevba, H. O., Jegede, A. I., Ugbabe, G. E., Muazzam, I., Kunle, O. F. and Gamaniel, K. S. (2016). Medicinal plants used and the perception of plant endangerment by the traditional medicine practitioners of Nasarawa State, Nigeria: A pilot study. *International Journal of Biodiversity Conservation*, **8**(1):8-20



- Jacobs, P. D., Kader, S., A., Thomas, B. and Nyakudya, T. T. (2020). An overview of the potential use of ehnomedicinal plants targeting the renin-angiotensin system in the treatment of hypertension. *Molecules*, **25**(9):2114
- Kamyab, R., Namdar, H., Torbati, M., Ghojazadeh, M. Aranj-khodaei, M. and Fazljou, S. M. B. (2020). *Advanced Pharmaceutical Bulletin*, **11**(4):601-617
- Kutama, A. S., Dangora, I. I., Aisha, W., Auyo, M. I., Sharif, U., Umma, M. and Hassan, K. Y. (2015). An overview of plant resources and their economic uses in Nigeria. *Global Ach. Research Journal of Agricultural Science*, **4**(2):042-067
- Lagnika, L., Adjileye, R. A. A., Yedomonhan, H., Amadou, B. S. K. and Sanni, A. (2016). Ethnobotanical survey on antihypertensive medicinal plants in municipality of Ouémé, Southern Benin. *Advanced Herbal Medicine*, **2**(3):20-32
- Mensah, J., Okoli, R., Turay, A. and Ogie-Odia, E. (2009). Phytochemical analysis of medicinal plants used for the management of hypertension by Esan people of Edo state, Nigeria. *Ethnobotanical Leaflets*, **13**:1273-87
- Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G. and the, P. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PloS Medicine*, **6**(7):e1000097
- Muanya, C. and Edward, O. (2021). 76.2m Nigerians are hypertensive but only 23 million on treatment. *The Guardian*. Retrieved from [https://guardian.ng/features/76-2m-nigerians-are-hypertensive-but-only-](https://guardian.ng/features/76-2m-nigerians-are-hypertensive-but-only-23-million-on-treatment/)
- [23-million-on-treatment/](https://guardian.ng/features/76-2m-nigerians-are-hypertensive-but-only-23-million-on-treatment/) (Accessed 1 June, 2023)
- Muanya, C. (2018). Reducing high blood pressure with local herbs. <https://guardian.ng/features/reducing-high-blood-pressure-with-local-herbs/> (Accessed 8 June, 2023)
- Musa, H. L. (2019). *Trade of Medicinal Plants Species in Local Markets within Kano Metropolis and its Implication for Plants Conservation*. B.Sc. Project, Department of Biological Sciences, Bayero University, Kano, Nigeria.
- Nsuadi M. F., El Khattabi, C., Fontaine, J., Berkenboom, G., Duez, P., Noyon, C., Van Antwerpen, P., Lami, N. J. and Pochet, S. (2013). Vasorelaxant and antihypertensive effects of methanolic extracts from *Hymenocardia acida* Tul. *The Journal of Ethnopharmacology*, **146**(2):623-31
- Oamen, T. E. and Osemene, K. P. (2021). Drug utilization evaluation of medications used by hypertensive patients in hospitals in Nigeria. *Hospital Topics* <https://doi.org/10.1080/00185868.2021.1916416>
- Obode, O. C., Adebayo, A. H., Omonhinmin, C. A. and Yakubu, O. F. (2020). A systematic review of medicinal plants used in Nigeria for hypertension management. *International Journal of Pharmaceutical Research*, **12**(4): 2231-2276
- Oguanobi, N. I. (2021). Management of hypertension in Nigeria: The barriers and challenges. *Journal of Cardiology and Cardiovascular Medicine*, **6**: 023-025



- Okoegwale, E. E. and Omefezi, J. U. (2001). Some herbal preparations among the people of Isoko Clan of Delta State, Nigeria. *Journal of Applied Sciences*, **4**: 2350-2371
- Olisa, N. S. and Oyelola, F. T. (2009). Evaluation of use of herbal medicines among ambulatory hypertensive patients attending a secondary health care facility in Nigeria. *International Journal of Pharmacy Practice*, **17**(2):101-105
- Raji, N. O, Adebisi, I. M. and Bello, S. O. (2013). Ethnobotanical survey of antihypertensive agents in Sokoto, North West Nigeria. *International Journal of Innovative Research and Development*, **2**(5):1820–1835
- Sadiq, I. Z., Abubakar, F. S., Ibrahim, B., Usman, M. A. and Kudan, Z. B. (2019). Medicinal plants for management and alternative therapy of common ailments in Dutsin-Ma (Katsina State) in Nigeria. *Herba Polonica*, **65**(4): 45-55
- Saeed, A., Bashir, K., Shah, A. J., Qayyum, R. and Khan, T. (2022). Antihypertensive activity in high salt-induced hypertensive rats and LC-MS/MS- based phytochemical profiling of *Melia azedarach* L. (Meliaceae) leaves. *BioMed Research International*, 2791874
- Sani H. D. and Aliyu, B. S. (2011). A survey of major ethno medicinal plants of Kano North, Nigeria, their knowledge and uses by traditional healers. *Bayero Journal of Pure and Applied Sciences*, **4**(2): 28 – 34.
- Shah, A. J., Gilani, A., Hanif, H. M., Ahmad, S., Khalid, S. and Bukhari, I. A. (2014). Neem (*Azadirachta indica*) lowers blood pressure through a combination of Ca⁺⁺ channel blocking and endothelium dependent muscarinic receptors activation. *International journal of pharmacology*, **10**(8): 418-428
- Sylver-Francis, R. A. (2022). *Medicinal plants use in Nigeria for the management of hypertension and diabetes*. Master's thesis. School of Pharmacy, University College London. 205 pp.
- Tabassum, N. and Ahmad, F. (2011). Role of natural herbs in the treatment of hypertension. *Pharmacognosy Reviews*, **5**(9): 30–40. <http://doi:10.4103/0973-7847.79097>
- The University of Edinburg (2021). High blood pressure puts one in three Nigerians at risk. www.ed.ac.uk/news/2021/high-blood-presure-puts-one-in-three-nigerians (Accessed 1 June, 2023)
- WHO (2023). Hypertension. www.who.int/news-room/fact-sheets/detail/hypertension (Accessed 1 June, 2023)
- Yusuf, R. J. and Adelanwa, E. B. (2020). Ethnobotanical survey of medicinal plants used in Makarfi Local Government Area of Kaduna State. *Katsina Journal of Natural and Applied Sciences*, **9**(1):131-143