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Cyathula prostrata: A Potential Herbal Hope for Hypertensives, an Animal Model Study and Its Secondary Metabolites Assessment via GC-MS

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Authors' contributions

This work was carried out in collaboration between all authors. Author ABO designed the study and wrote the manuscript. Authors OAL and MOL did the experiments. Author ABO wrote the first draft, with authors MOL and OAL. Author OAL analysed data with author MOL. Literature searches were done by author MOL. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The use of folkloric therapy in the management of ailments such a hypertension is a global phenomena. Extracts of *Cyathula prostrata* are used as alternate antihypertensive in Nigeria. This paper evaluated the scientific basis for such use.
Study Design: The study involved using rat model. High blood pressure was simulated in the rat via induction with adrenaline, while another group of rats was used without adrenaline administration. Aqueous and ethanolic extracts of the *Cyathula prostrata* were administered to the different rat sets. The work was carried out in Lagos, Nigeria in the second half of 2015.
Methodology: *Cyathula prostrata* extracts was administered in graded doses of 50, 100 and 150 mg/kg body weight to the different groups of animals. The presence of secondary metabolites in the extracts was assessed using standard phytochemistry techniques and verified using GC-MS.
Results: A total of 13 plant secondary metabolites were identified by GC-MS. *Cyathula prostrata* extracts effected a marked decrease in the measured blood pressure parameters of adrenaline induced hypertensive rats evaluated in this study.

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Conclusion: In this study, orally administered *Cyathula prostrata* extracts reduced high blood pressure parameters in adrenaline induced hypertensive rats, with the most likely effectors being the secondary metabolites present in this extract. The outcome of this baseline study potentially validates the folkloric use of the extract as antihypertensives.

Keywords: Cyathula prostrate; blood pressure; hypertension; GC-MS; secondary metabolites.

1. INTRODUCTION

Elevated blood pressure (BP) remains an extraordinarily common and significant risk factor for cardiovascular and renal diseases; including heart failure, coronary heart disease, stroke, and kidney failure [1]. One of the leading causes of death in developing countries is cardiovascular disease (CVD). It is said to have claimed as many lives as HIV, malaria and tuberculosis [2]. The rising occurrence of cardiovascular disease puts tremendous pressure on already overburdened resources in developing nations and reflects the high prevalence of cardiovascular disease [3]. Observational studies have reported that the lower the level of blood pressure, the lower the risk of cardiovascular events and death. Among hypertensive individuals, lowering of blood pressure level reduces the risk of occurrence of cardiovascular events [4]. Hypertension is one of the leading causes of cardiovascular disease and premature mortality in the world [5], and it is an increasingly important global medical and public health issue. High blood pressure is estimated to have caused 7.6 million premature deaths (13.5% of the total), and contributed 92 million disability-adjusted life years (DALYs) worldwide in 2001 [6]. In Nigeria, the prevalence of hypertension and its associated complications are increasing at an alarming rate. Factors including a rise in the volume of body fluid, the resistivity of blood vessels, and other factors can elevate blood pressure. These factors either alone or in combination can induce abnormality in the increase of blood pressure [2,7].

Recent advances in the diagnosis and treatment of hypertension have played important roles in the recent dramatic observed decline of coronary heart disease and stroke mortality in industrialized countries. The ultimate goal in the treatment of the hypertensive patient is to achieve the maximum reduction in the total long-term risk of cardiovascular morbidity and mortality. The adoption of healthy lifestyles by individuals is critical in the prevention of high blood pressure, and a means of management for those with hypertension. Lifestyle modifications decrease blood pressure, enhance antihypertensive drug efficacy and decrease cardiovascular events occurrence [8]. Pharmacological therapy for hypertension includes the use of the following classes of drug; angiotensin-converting enzyme (ACE) inhibitors (or angiotensin II receptor antagonists), thiazide diuretics, and calcium channel blockers [4].

Traditional medicine plays a significant role among the population of most developing countries, as over half of the population depends on it. The current trend of research is in the investigation of medicines of plant origin because of their affordability, availability and accessibility with minimal side effects [9]. Herbal preparation of *Cyathula prostrata* is one of the folkloric therapies for hypertension among the Yoruba's of South west Nigeria. Despite the widespread use of medicines with plant origin, only a few of these plants have been scientifically explored [10]. *Cyathula prostrata* has been reported to possess anti-inflammatory, analgesic [9], analgesic [11], antioxidant [9,12,13], cardioprotective [14], hepatoprotective [15], anticancer [16], and antimicrobial effects [12,13,17]. This study was designed to evaluate the antihypertensive potentials of aqueous extract of *Cyathula prostrata* on adrenaline induced hypertensive rats.

2. MATERIALS AND METHODS

2.1 Collection of Plant Materials

The whole plants of *Cyathula prostrata* were collected from a farmland around the Department of Botany, University of Lagos (UNILAG), Lagos State, Nigeria during the months of June - July 2015. The plant was identified by the Botany Department of the University, courtesy of the Herbarium section, and given a voucher number (LUH 6498).

2.2 *Cyathula prostrata*

The leaves and stems of *C. prostrata* were washed thoroughly, separated and air-dried to

crispiness. The dried materials were shredded and further pulverized to very fine powder with an electrical blender (Kenwood blender BL 335). The powdered leaves and stem samples obtained were stored separately in airtight containers until needed.

2.3 Extraction for *Cyathula prostrata* Leaf and Stem

The powdered leaves and stem (100 g each) were extracted with 1000 ml of water or with 60% ethanol using a Soxhlet extractor. The extracts were filtered to obtain particulate free filtrates. The filtrates obtained were concentrated using a Rotary vacuum evaporator. The resulting dark semisolid material obtained was stored at a temperature (4ºC), until use [16].

2.4 Phytochemical Analysis of *Cyathula prostrata* Aqueous Extract

The different extracts of *C prostrata* were tested for the presence of phytochemicals such as alkaloids, flavonoids, tannins, cardiac glycosides, cyanogenic glycosides, terpenoids, anthraquinones glycosides, saponins, anthocyanosides, phlobatannins and reducing sugars [18].

2.5 Phytoconstituent Analysis of *Cyathula prostrata* Aqueous Extract via (GC-MS)

The identification of chemical components of ethanol extract of *Cyathula prostrata* was performed using a gas chromatograph-mass spectrograph (GC-MS) fitted with electron impact (EI) mode [19]. Briefly, 2.0 µL of the ethanol extract of *Cyathula prostrata* was injected with a Hamilton syringe into the GC-MS manually for total ion chromatographic analysis in split mode. In quantitative analysis, selected ion monitoring (SIM) mode was employed during the GC/MS analysis. SIM plot of the ion current resulting from very small mass range with only compounds of the selected mass were detected and plotted according to [20,21].

2.6 Experimental Animals and Treatment

Adult male rats (Wistar strain) weighing 112 - 159 g, were obtained and housed in the animal house of the Department of Physiology, College of Medicine, University of Lagos, Nigeria. The animals were kept in wire mesh cages under controlled light cycle (12 h light/12 h dark), fed with commercial rat chow *ad libitum*, and liberally supplied with water. All experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki [22]. The animals were orally administered with the crude extract at three (3) different concentrations, viz; 50, 100, and 150 mg/kg body weight. Nifedipine, (2 mg/kg/body weight) was used as a positive control, while distilled water was used as the negative control. The antihypertensive drug (nifedipine), water and crude extracts were orally administered [10]. Adrenaline administration was used to induce elevated blood pressure in the experimental animals. Administration route and dosage used in this study were based on documented literature [23].

Two sets of experiments were carried out using the filtered crude extracts of *Cyathula prostrata*:

(a). Effect of extract on normotensive rats.
(b). Effect of extract on adrenaline induced hypertensive rats.

Group I: Negative control group, administered with distilled water (1 mL/kg)
Group II: Positive control group administered with (2 mg/kg) nifedipine
Group III: 50 mg/kg *Cyathula prostrata* aqueous extract
Group IV: 100 mg/kg *Cyathula prostrata* aqueous extract
Group V: 150 mg/kg *Cyathula prostrata* aqueous extract

Nifedipine, distilled water, or crude extract were administered to both the normotensive and adrenaline induced hypertensive rats on the same day. Animals were anaesthetized with a mixture of urethane (25%) and alpha-chlorase (1%) [20]. Animals were thereafter sacrificed, and blood collected through cardiac puncture. Sera collected were then prepared for biochemical evaluations.

2.7 Blood Pressure Measurement

This was done as previously reported [20].

2.8 Phytoconstituents of Aqueous Extracts of *Cyathula prostrata*

The GC-MS report of aqueous extract of *C. prostrata* leaf and stem shows that 13 types of

phytoconstituents were detected; the identified phytoconstituents are listed in Table 1.

3. RESULTS AND DISCUSSION

Phytochemical screening indicated the presence of alkaloids, flavonoids, tannins, cardiac glycosides, terpenoids, anthraquinones, glycosides, saponins, reducing sugars and phlobatannins. GC-MS analysis as seen in Table 1 validated by identifying some of the member components of the classes of secondary metabolites from above.

3.1 Bar Charts Showing Different Blood Pressure Parameters

Blood pressure parameters measured and estimated from both the normotensive and the adrenaline induced hypertensive rat groups were compared and represented in separate bar charts below.

4. DISCUSSION

Hypertension and its associated fatalities are on the increase globally. The management of hypertension using western medicine is to quickly and effectively lower blood pressure to reach target pressure as soon as possible [24]. A number of herbal remedies have been reported to posses' antihypertensive potentials [25-27], but with little or no scientific data to back these claims. There are quite a number of alternate therapies in use for management of high blood pressure in Nigeria. In the present study, adrenaline induced hypertensive rats administered with *Cyathula prostrata* aqueous extract had a marked decrease in the systolic and diastolic pressure, mean arterial blood pressure, pulse rate and heart rate compared to the negative control group (distilled water treated). The extracts (both water and ethanolic) reduced systolic and diastolic blood pressure of the adrenaline induced hypertensive rat in a dose dependent (Figs. 1 and 2) manner comparable with the Ca^{2+} channel blocker (nifedipine) used as a control in this study. The impact of the extracts on blood pressure parameters is further shown in Figs. 3 – 5 depicting the extract's effects on heart rate, pulse pressure and mean arterial pulse pressure. Predictably, the ethanolic extract appears more effective.

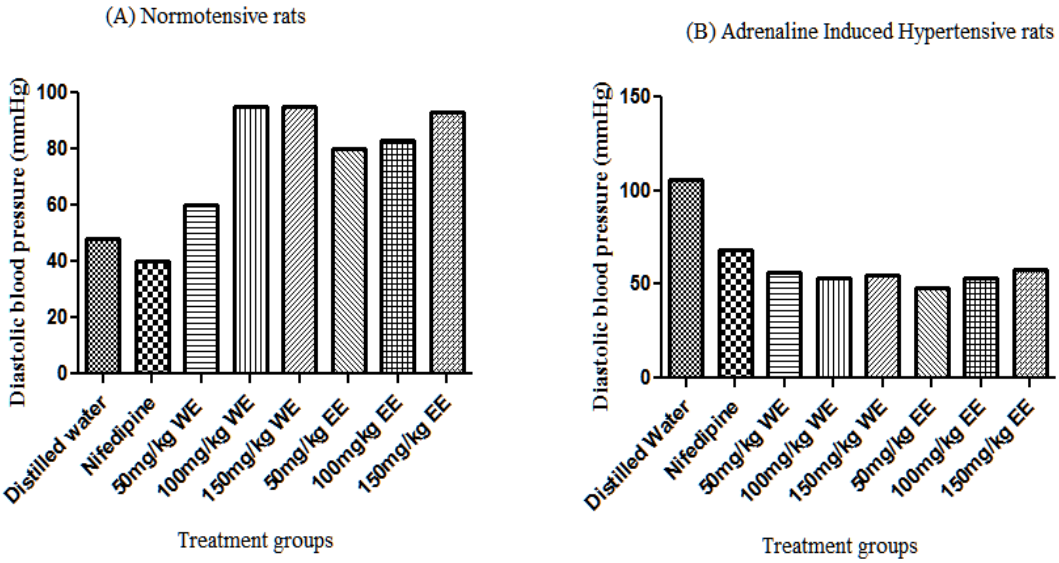

Fig. 1. Bar charts showing the effect of *Cyathula prostrata* aqueous extract on the diastolic blood pressure of (a) Normotensive and (b) Adrenaline induced hypertensive rats

WE = Water extract, EE = Ethanolic extract

Table 1. Secondary metabolites of aqueous extracts of *Cyathula prostrata* as detected by GC-MS and their documented uses

S/N	Chemical constituent	Molecular formula	Class of compound	Pharmacological activity	Reference
1	1,2,4a,5,8,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)- naphthalene	$C_{15}H_{24}$	Essential oils	Osteoblastic activity	[28]
2	1,1'-(1,3-propanediyl)bis benzene	$C_{15}H_{16}$			
3	2,2'-Paracyclophane	$C_{16}H_{16}$	Terpenes	Anti-inflammatory	[29]
4	Trans-1,1'-(1,2-cyclobutanediyl)bis-benzene	$C_{16}H_{16}$			
5	Hexadecanoic acid methyl ester	$C_{18}H_{36}O_2$	Palmitic acid Ester	Antioxidant, hypocholesterolemic nematicide, pesticide, lubricant, antiandrogenic, flavor, hemolytic 5-alpha-reductase inhibitor	[30]
6	Phytol	$C_{20}H_{40}O$	Diterpene	Antimicrobial, Anti-inflammatory Anticancer, Diuretic.	[31]
7	Cyclohexane, 1-(1,5-dimethylhexyl)-4-(4-methylpentyl)	$C_{20}H_{40}$		Antimicrobial, Antioxidant, antibacterial	[32-34]
8	Cyclohexanecarboxylic acid, undecyl ester	$C_{18}H_{34}O_2$			
9	Eicosene	$C_{20}H_{40}$	Terpenes	Antioxidant, Antibacterial	[32, 34]
10	Pentatricontene	$C_{35}H_{72}$		Antioxidant	[35]
11	1,2-Propanediol, 3-benzyloxy-1,2-diacetyl	$C_{14}H_{18}O_5$			
12	1-Propene,3-(2-cyclopentenyl)-2-methyl-1,1-diphenyl-	$C_{21}H_{22}$			
13	2-Methyl-7-phenylindole	$C_{15}H_{13}N$		Antimicrobial, Antiparasitic	[36]

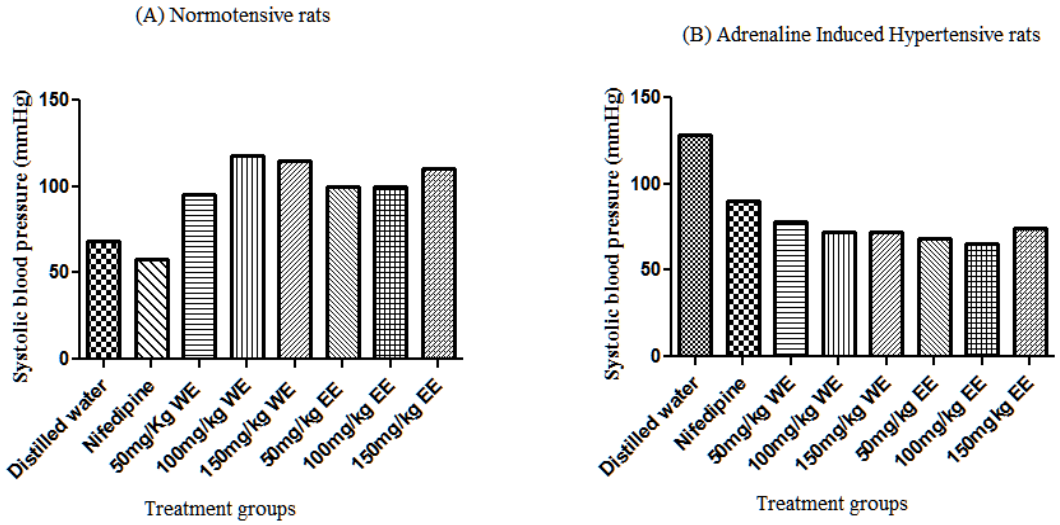

Fig. 2. Bar charts showing the effect of *Cyathula prostrata* aqueous extract on the systolic blood pressure of (a) Normotensive rats and (b) Adrenaline induced hypertensive rats

WE = Water extract, EE = Ethanolic extract

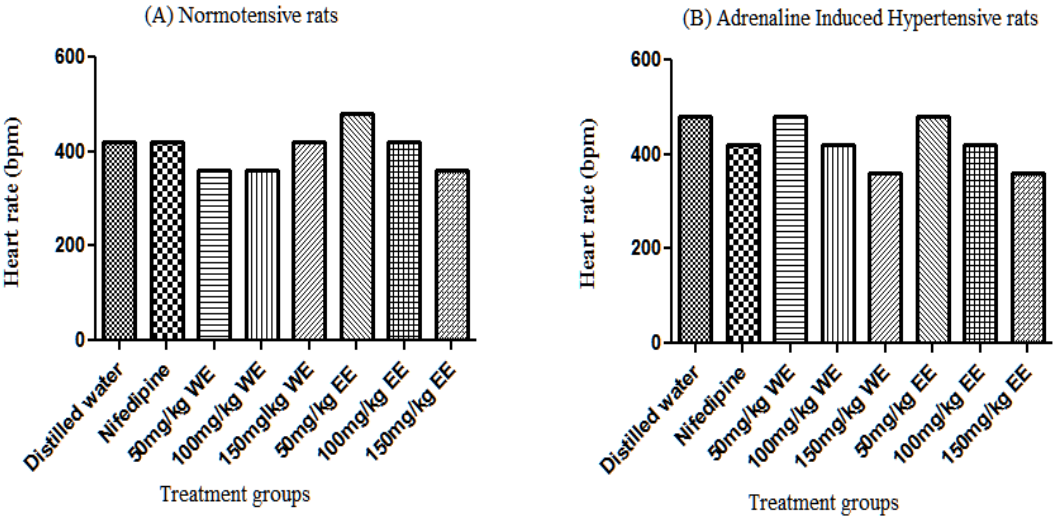

Fig. 3. Bar charts showing the effect of *Cyathula prostrata* aqueous extract on the heart rate (beats per minute) of (a) Normotensive rats and (b) Adrenaline induced hypertensive rats

WE = Water extract, EE = Ethanolic extract

The observed blood pressure decrease may be possibly due to the presence of secondary metabolites like alkaloids, flavonoids, tannins, cardiac glycosides, terpenoids, anthraquinone glycosides, phlobatannins, reducing sugars and saponins. The presence of these secondary metabolites corroborate an earlier report [37]. Specific metabolites in some of these groups were further identified (Table 1), throwing up some possibilities as some of these metabolites have anti-inflammatory activities [37-39] and, antioxidants, in addition to hepatoprotective potentials [14]. Alkaloid presence in plant extracts have also been associated with antihypertensive antifebrile, antispasmodic and antilipidemic possibilities [40]. A member of the cardiac glycosides (present in *C.prostrata*) family had been reported to inhibit Na+/K+-ATPase resulting in an ionotropic activity that has proven useful in the treatment of heart conditions, e.g., atrial tachyarrhythmia, and also used to produce positive ionotropic effect in congestive heart

failure. This activity is enhanced several-fold due to the presence of the sugars in these compounds [41]. *Cyathula prostrata* extract also contains phenolic compounds and flavonoids, two classes of secondary metabolites known to exhibit lipid peroxidation, antioxidant, free radical scavenging properties and the possibility of hepatoprotective activity [14]. Both the stem and leaves extracts of *Cyathula prostrata* have a lot of secondary metabolites in common (table 1). Phytoconstituents compositional divergence are observed in the leaf and stem of *Cyathula prostrate* with metabolites like, 2-methyl-7-phenylindole, a notable constituent of the stem extract that was not detected in the leaves extract, while, cyclohexane, 1-(1,5-dimethylhexyl)-4-(4-methylpentyl) was absent in the stem extract.

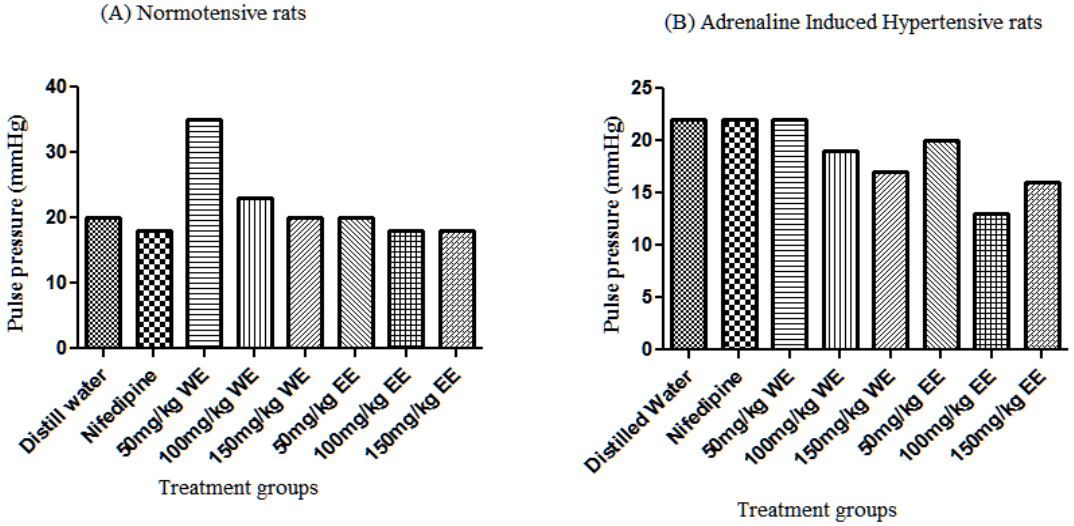

Fig. 4. Bar charts showing the effect of *Cyathula prostrata* aqueous extract on the pulse pressure (mmHg) of (a) Normotensive rats and (b) Adrenaline induced hypertensive rats

WE = Water extract, EE = Ethanolic extract

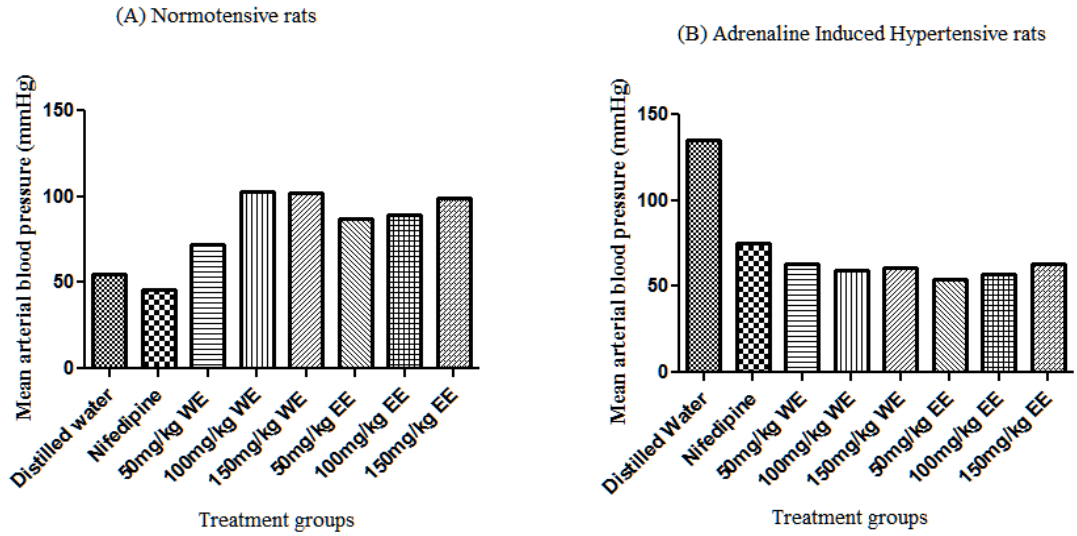

Fig. 5. Bar charts showing the effect of *Cyathula prostrata* aqueous extract on the mean arterial blood pressure (mmHg) of (a) Normotensive rats and (b) Adrenaline induced hypertensive rats

Water extract, EE = Ethanolic extract

Although, both the water and ethanolic extracts exhibited a blood pressure lowering effect when compared to nifedipine, a pronounced effect was observed at the dose of 100 mg/kg body weight of ethanolic extract, hence the effect cannot be described as dose dependent [42]. The extract of *Cyathula prostrata* had earlier being reported nontoxic [10] up to a concentration of 100mg/kg body weight with no adverse consequences. The blood pressure lowering effect of *Cyathula prostrata* observed in this study is possibly due to the presence of a combination of bioactive plant components present in the plant extract possibly acting in sync and/or in synergy. The data from this study adds to the growing league of plant data reports validating folkloric medicine.

5. CONCLUSION

From the results obtained, we conclude that *C. prostrata* aqueous extract possess certain bioactive components which conferred blood pressure lowering potentials to adrenaline induced hypertensive rats, thereby potentially justifying the usage of the extracts as traditional antihypertensive herbal medicine.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Appel LJ. Lifestyle modification as a means to prevent and treat high blood pressure. Journal of the American Society of Nephrology. 2003;14(suppl 2):S99-S102.
2. James RKW, Achilles Katamba, Elli Leontsini, Fred Nuwaha. Hypertension awareness, treatment and control in Africa: A systematic review. BMC Cardiovascular Disorders; 2013.
3. Afolabi SNC, Emeka EJ Iweala, Olubanke O Ogunlana, Dominic E Azuh. Body mass index and blood pressure in a semi-urban community in Ota, Nigeria Food and Public Health. 2014;5(5):157-163
4. Australia HFO. Guide to management of hypertension. Journal of Heart Foundation. 2010;1-30.
5. Agyemang BAO-D. Factors associated with hypertension awareness, treatment, and control in Ghana, West Africa. Journal of Human Hypertension. 2006;20:67-71.
6. Addo LSADAL. Hypertension In Sub-Saharan Africa: A systematic review. Journal of The American Heart Association. 2007;50:1012-1018.
7. Adeoye B, Adebiyi Tayo. Prevalence of hypertension and association with increased body mass in a semi-urban settlement in Nigeria. Journal of Hypertension; 2014.
8. Organization WH. Clinical guidelines for the management of hypertension; 2005.
9. Bolanle IAS, Anzel van Rooyen, Maryna Van de Venter. Antiinflammatory, analgesic and antioxidant activities of *Cyathula prostrata* (Linn.) Blume (Amaranthaceae). Journal of Ethno-pharmacology. 2012;141:282–289.
10. Priya KKSS. Toxicity assessment of the medicinal plant *Cyathula prostrata*. Journal of Applied Biosciences. 2009;13:681-687.
11. Forestieri A, et al. Antiinflammatory, analgesic and antipyretic activity in rodents of plant extracts used in African medicine. Phytotherapy Research. 1996;10(2):100-106.
12. Olawale HOCOUEEA. Novel anti-oxidant activity of *Cyathula prostrata* (L.) blume, in bulletin of environment, pharmacology and life sciences. 2013;91-98.
13. Sonibare MA, Olatubosun OV. Pharma-cognostic and free radical scavenging evaluation of Cyathula prostata (Blume) L. Phrmacogn J. 2015;7(2):107-116.
14. Ramadoss SKKBKJNAMR. Cardio-protective Effect of *Cyathula prostrata* Linn on Isoproterenol Induced Myocardial Infarction in Rat. 2012;3.
15. Ramadoss SKKBKJNSMR. Hepatoprotective effects of *Cyathula Prostrata* Linn. in paracetamol induced liver injury in rats. Journal of Pharmaceutical Research and Opinion, 2011;1(7):178–180.
16. Vijayakumar MPKKSANA. Anticancer activity of *Cyathula prostrata* (Linn) Blume against Dalton's lymphomae in mice model. 2014;27:1911-1917.
17. Ogu GI, et al. Antimicrobial and phytochemical evaluation of the leaf, stem bark and root extracts of *Cyathula prostrata* (L) Blume against some human

pathogens. Journal of Intercultural Ethnopharmacology. 2012;1(1):35-43.
18. Sofowora A. Medicinal plants and traditional medicine in Africa. John Wiley and sons LTD; 1982.
19. Lawal OA, et al. Chemical composition and antibacterial activity of essential oil from the leaves of Aframomum melegueta (Roscoe) K. Schum from Nigeria. Journal of Essential Oil Bearing Plants. 2015;18(1): 222-229.
20. Anthony BOUAADWPIJAJAO. Adrenaline induced elevated blood pressure in wistar rats is not reversed by oral administration of Archachatina marginata hemolymph. British Journal of Medicine & Medical Research. 2015;7(4):318-326.
21. Sarumathy KMSDRTV, Jayakanthi J. Evaluation of phytoconstituents, nephro-protective and antioxidant activities of Clitoria ternatea. Journal of Applied Pharmaceutical Science. 2011;1(5):164-172.
22. Association WM. World Medical Association Declaration of Helsinki. Ethical principles for medical research involving human subjects. Bulletin of the World Health Organization, 2001;79(4):373.
23. Erhirhie EOE, Nwoke E, Ajaghaku Daniel Lotanna. Guidelines on dosage calculation and stock solution preparation in experimental animals' studies. Journal of Natural Sciences Research. 2014;4.
24. Chen Z, et al. Chinese herbal medicine combined with conventional therapy for blood pressure variability in hypertension patients: A systematic review of randomized controlled trials. Evidence-Based Complementary and Alternative Medicine; 2015.
25. Duarte J, et al. Antihypertensive effects of the flavonoid quercetin in spontaneously hypertensive rats. British Journal of Pharmacology. 2001;133(1):117-124.
26. Kwan C-Y, et al. Endothelium-dependent vasorelaxant effects of the aqueous extracts of the Eucommia ulmoides Oliv. leaf and bark: implications on their antihypertensive action. Vascular Pharmacology. 2003;40(5):229-235.
27. Liu J-C, et al. Antihypertensive effects of tannins isolated from traditional Chinese herbs as non-specific inhibitors of angiontensin converting enzyme. Life Sciences. 2003;73(12):1543-1555.
28. Wu Y-BW, Jian-Guo Yi, Jun Chen, Ti-Qiang Lin, Xiong-Hao Wu, Jin-Zhong. Osteoblastic activity of ethanolic extract and volatile compounds from Er-Zhi-Wan, a famous traditional Chinese herbal formula. African Journal of Pharmacy and Pharmacology. 2012;6(24):1733-1740.
29. Lämmerhofer MI, Lindner WP. Direct high-performance liquid chromatographic enantiomer separation of anti-inflammatory planar chiral [2.2] paracyclophane-4-acetic acid. Chromatographia. 2004;60(1):S13-S17.
30. Jegadeeswari N, Muthukumarasamya, Mohan. GC-MS analysis of bioactive components of aristolochia krysagathra (aristolochiaceae). Journal of current chemical and Pharmaceutical sciences, 2014;2(4):226-232.
31. Jananie R, Priya V, Vijayalakshmi K. Determination of bioactive components of Cynodon dactylon by GC-MS analysis. NY Sci J. 2011;4:16-20.
32. Bhardwaj A, et al. Screening of nutritional, phytochemical, antioxidant and antibacterial activity of underutilized seeds of Scirpus articulatus: The basis of Khubahi Ramdana industry. Journal of Pharmacognosy and Phytochemistry. 2014;3(4):11-20.
33. Gilani J, Ghayur, Janbaz, Akhtar. Studies on the antihypertensive, antispasmodic, bronchodilator and hepatoprotective activities of the Carum copticum seed extract. Journal of Ethnopharmacology. 2005;98:127–135.
34. Khatoon N, Gupta RK. Probiotics beverages of sweet lime and sugarcane juices and its physiochemical, microbiological & shelf-life studies. Journal of Pharmacognosy and Phytochemistry. 2015;4(3):25-34.
35. Fernandes A, et al. Azadirachta; 2007.
36. Ajayi G, et al. Gas chromatography-mass spectrometry analysis and phytochemical screening of ethanolic root extract of Plumbago zeylanica, Linn. J Med Plants Res. 2011;5(9):1756-61.
37. Gideon IOWOTPUNBEI. Antimicrobial and phytochemical evaluation of the leaf, stem bark and root extracts of *Cyathula prostrata* (L) Blume against some human pathogens. Journal of Intercultural Ethnopharmacology. 2012;35-43.
38. Okwu J. Evaluation of the chemical composition of two Nigerian medicinal plants. African Journal of Biotechnology. 2006;5:357-361.

39. Savithramma LRAS. Screening of medicinal plants for secondary metabolites. Middle-East Journal of Scientific Research. 2011;8(3):579-584.
40. Asgary N, Sarrafzadegan Mohammadifard, Mostafavis Vakili. Antihypertensive and antihyperlipidemic effects of ACHILLEA WILHELMSII; 2000.
41. Sparg SGMELJVS. Biological activities and distribution of plant saponins. Journal of Ethnopharmacology. 2004;94:219–243.
42. Olayeriju OS, et al. Ethylacetate extract of red onion *(Allium cepa L.)* tunic affects hemodynamic parameters in rats. Food Science and Human Wellness. 2015;4(3): 115-122.

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