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Antihypertensive Potential of *Euphorbia hirta* and *Leptadenia hastata* in Adrenaline-induced Wistar Rats

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ABSTRACT

Background: Hypertension is a major public health concern worldwide, contributing to cardiovascular morbidity and mortality. The use of plant-based therapies, such as *Euphorbia hirta* and *Leptadenia hastata*, has gained attention for their potential antioxidant, anti-hyperlipidemic, and organ-protective effects.

Objectives: This study aimed to investigate the phytotherapeutic approach to hypertension using *E. hirta* and *L. hastata* extracts in adrenaline-induced hypertensive Wistar rats

Methods: Utilizing an adrenaline-induced hypertensive rat model, we assessed the effects of *E. hirta* and *L. hastata* leaf extracts (50, 100, and 200 mg/kg) on systolic blood pressure, renal function, lipid metabolism, and hematological parameters.

Results: Antioxidant activity: Increased levels of superoxide dismutase, catalase, and glutathione peroxidase. Lipid profiles: Reduced levels of total cholesterol, triglycerides, and LDL cholesterol. Liver function tests (LFTs): Decreased levels of alanine transaminase and aspartate transaminase. Hematological parameters: Improved red blood cell count, hemoglobin, and packed cell volume (PCV).

Conclusion: This preclinical investigation provides compelling evidence for the antihypertensive potential of *E. hirta* and *L. hastata* leaf extracts, validating their traditional use. These findings underscore the promise of these natural products as adjunctive therapeutics for hypertension management, warranting further clinical investigation.

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Introduction

Cardiovascular diseases, encompassing hypertension, arteriosclerosis, and heart disease, pose significant global health concerns, accounting for approximately 17.9 million deaths annually [1]. Hypertension, a primary risk factor, affects over 1 billion individuals worldwide, with prevalence rates projected to increase [2]. In developing countries, hypertension often remains untreated or inadequately managed, exacerbating cardiovascular morbidity and mortality.

Traditional medicinal plants, such as *Euphorbia hirta* and *Leptadenia hastata*, offer potential therapeutic strategies. *L. hastata*, commonly used in West African folk medicine, exhibits diverse health applications [3]. Its leaf extract has been employed to treat onchocerciasis [4], scabies [5], hypertension, catarrh, and skin diseases [6]. Phytochemical studies reveal phenolic glycosides, tannins, flavonoids, proanthocyanidins, alkaloids, and saponins, contributing to its therapeutic efficacy [7].

E. hirta, another medicinal plant, demonstrates antihypertensive, anti-inflammatory, and antioxidant properties [8]. Its phytochemical constituents, including flavonoids, alkaloids, and terpenoids, contribute to cardiovascular protection [9].

The pathophysiology of hypertension involves complex interactions between fluid dynamics, vascular resistance, and pressor factors [10]. Oxidative stress and inflammation play critical roles in hypertension's development and progression [11]. Therefore, investigating medicinal plants with antioxidant and anti-inflammatory properties, such as *L. hastata* and *E. hirta*, may provide novel therapeutic approaches.

This study aimed to investigate the antihypertensive effects of *L. hastata* leaf extract on biochemical and hematological parameters in adrenaline-induced hypertensive rats, complementing existing research on *E. hirta*.

Materials and Methods

Experimental Animals: fifty adult male Wistar rats (120±5 g) were obtained from the Ogun State College of Health Science and Technology, Illese-Ijebu, Nigeria Animal Holding Unit. Animals were handled in accordance with the Canadian Council on animal care guidelines and review protocol [12].

Sample extraction

E. hirta and *L. hastata* leaves were washed, chopped, dried (37 ˚C, 2 weeks) and ground. A 50 g sample of each was extracted with 200 mL of ethanol and aqueous solution using a Soxhlet apparatus. The resulting extract was concentrated on a rotary evaporator [6].

Experimental design: This experimental study was conducted on 50 Wistar rats, divided into eight groups (A-H), with 5 rats in each group, except for one group that included 10 rats serving as the normal control group, resulting in 8 rats after the removal of 2 rats. The groups were as follows:

Group A: Normal control (no treatment)

Group B: Hypertensive control (adrenaline-induced)

Group C: Amlodipine-treated standard antihypertensive drug (0.5 mg/kg) and the extract (50 mg/kg).

D: *E. hirta* extract-treated (low dose) (100 mg/kg).

Group E: *E. hirta* extract-treated (high dose) (200 mg/kg).

Group F: *L. hastata* extract-treated (low dose) (50 mg/kg)

Group G: *L. hastata* extract-treated (high dose) (100 mg/kg).

Group H: Rats receiving adrenaline (0.5 mg/kg) and *L. hastata* extract (200 mg/kg).

We measured blood pressure, antioxidant activity, lipid profiles, liver function tests (LFTs), and hematological parameters on days three and seven.

Blood and serum collection

Following the study period, animals were sacrificed under ether anesthesia, and blood samples were collected into EDTA bottles for hematological analyses and EDTA-free bottles for serum collection [6]. Serum samples were obtained after clotting and centrifugation (3000 rpm, 10 minutes) and stored at -20 ˚C for further analysis [9].

Analyses of biochemical parameters

Biochemical parameters, including transaminases [13], total proteins [14], albumin and bilirubin [15], urea, creatinine, and electrolytes, were assayed using standard protocols [16, 17]. Serum concentrations of total

cholesterol, triglycerides, and high-density lipoprotein (HDL) were determined using enzymatic and colorimetric methods with commercial kits [18, 19]. Very low-density lipoprotein (VLDL) and low-density lipoprotein (LDL) were calculated using Friedewald's formula [19]. The activities or concentrations of aspartate transaminase (AST), alanine transaminase (ALT) [13], and alkaline phosphatase (ALP) [16], were determined by standard methods.

Analyses of hematological parameters

Hematological parameters, including hemoglobin (Hb), packed cell value (PCV), red blood cells (RBC), white blood cells (WBC), mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC), were determined using an automated hematologic analyzer (SYSMEX KX21, Japan) [20].

Statistical analyses

Data were analyzed by software and described as Mean±SD. One-way analysis of variance and Duncan's multiple range test were used for group comparisons at P<0.05 [21].

Results

The present study investigated the antihypertensive effects of *E. hirta* and *L. hastata* leaf extracts in adrenaline-induced hypertensive rats. Our findings demonstrate significant improvements in systolic blood pressure, biochemical parameters, hematological parameters, and liver function tests (LFTs), supporting the traditional use of these plants in hypertension management [22, 23].

The observed significant (P<0.05) reduction in systolic blood pressure in both *E. hirta*- and *L. hastata*-treated groups suggests potential vasodilatory effects, possibly mediated by the extracts' flavonoid and phenolic content (Table 1). Flavonoids have been shown to relax vascular smooth muscle, leading to decreased blood pressure. Additionally, the extracts' antioxidant properties may have contributed to the observed effects by reducing oxidative stress and improving endothelial function [24].

The results indicate significant (P<0.05) reductions in SBP in both *E. hirta*- and *L. hastata*-treated groups compared to the adrenaline-induced hypertensive group. *L. hastata* showed slightly higher efficacy in reducing SBP. These findings suggest potential antihypertensive effects of both plant extracts [23] (Table 1).

The observed significant (P<0.05) reduction in triglyceride levels suggests enhanced lipid metabolism, which may be attributed to the extracts' flavonoid and polyphenol content (Table 2). Polyphenols have been shown to inhibit triglyceride synthesis and enhance lipolysis [24].

Regarding triglyceride, there were significant alterations in the experimental groups compared to the control group. The adrenaline group exhibited hyperlipidemia, characterized by elevated total triglyceride levels (Table 2). In contrast, *E. hirta* and *L. hastata* extracts mitigated lipid profile alterations, indicating potential anti-hyperlipidemic effects.

Table 1. Systolic blood pressure (SBP) measurements of Rats treated with *E. hirta* and *L. hastate* extracts

Group	Mean±SEM		
	Dose (mg/kg)	Initial SBP (mm Hg) Day 3	Final SBP (mm Hg) Day 7
Control	----	118.4±4.2	120.1±3.9
Adrenaline	0.1	179.6±6.1	181.4±5.8
E. hirta	50	180.2±4.9	145.2±3.2
E. hirta	100	180.2±6.2	137.3±3.6
E. hirta	200	182.9±6	129.1±2.9
L. hastate	50	180.1±5.9	152.9±3.1
L. hastate	100	180.5±7.3	137.8±6.7
L. hastate	200	183.4±5.1	125.6±2.2

Note: Data are presented as three replicate determinations.

Table 2. Lipids profile of rats treated with *E. hirta* and *L. hastate* extracts

Group	Dose (Mg/Dl)	Mean±SEM									
		Initial Triglyceride Levels (mg/dL) Day 3	Final Triglyceride Levels (mg/dL) Day 7	Initial Cholesterol Levels (mg/dL) Day 3	Final Cholesterol Levels (mg/dL) Day 7	Initial HDL Levels (mg/dL) Day 3	Final HDL Levels (mg/dL) Day 7	Initial LDL Levels (mg/dL) Day 3	Final LDL Levels (mg/dL) Day 7	Initial VLDL Levels (mg/dL) Day 3	Final VLDL Levels (mg/dL) Day 7
Control	----	78.2±4.1	80.1±3.9	122.1±2.5	122.3±3.2	40.8±2.5	41.2±6.3	70.2±5.2	71.5±4.8	16.1±1.2	16.5±1.1
Adrenaline	0.1	119.8±5.2	137.9±5.1	182.9±6.8	200.9±6.6	27.5±1.9	24.9±1.5	120.9±6.5	139.2±6.3	23.1±1.8	27.2±2.1
E. hirta	50	120.1±3	88.2±3.2	179.2±5.5	152.9±3.9	28.2±2.1	36.1±2	120.4±6.2	100.9±4.1	23.4±1.9	17±1.3
E. hirta	100	120.4±6.5	74.1±3.4	180.5±5.1	132.8±3.1	28.9±2	39.5±1.7	122.1±6.8	90.2±3.3	25.7±2	15.1±1
E. hirta	200	122.9±6.1	60.2±2.7	177.8±6.3	111.2±3.7	30.5±2.2	47.9±2.1	119.5±6	73.9±3.2	23.2±1.8	11.3±0.8
L. hastate	50	121.5±5.8	84.9±3	182.5±6.2	142.1±4.3	29.2±1.6	33.4±1.2	120.2±5.9	93.1±4.6	22.9±1.7	18.2±1.2
L. hastate	100	120.9±5.3	70.2±3.3	180.8±7	118.9±3.8	30.1±2.1	39.2±2.7	121.5±6.4	83.4±4	25.3±1.9	14.4±0.9
L. hastate	200	120.2±5.9	57.6±2.9	180.2±6.1	99.6±5.1	28.9±2.0	42.9±2.8	119.9±5.8	63.3±3.3	23.7±1.6	10.5±0.7

Note: Data are presented as three replicate determinations.

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Total cholesterol: Decreased total cholesterol levels in both extract-treated groups imply improved lipid profiles, potentially mediated by the extracts' ability to inhibit cholesterol synthesis [24] (Table 2).

Regarding total cholesterol, there were significant ($P<0.05$) alterations in the experimental groups compared to the control group. The adrenaline group exhibited hyperlipidemia, characterized by elevated total cholesterol levels (Table 2), In contrast, *E. hirta* and *L. hastata* extracts mitigated lipid profile alterations, indicating potential anti-hyperlipidemic effects.

Increased HDL levels in both extract-treated groups suggest enhanced reverse cholesterol transport, potentially contributing to improved cardiovascular health [24].

Regarding HDL, there were significant ($P<0.05$) alterations in the experimental groups compared to the control group. The adrenaline group exhibited hyperlip-

Table 4. Biochemical parameters of rats treated with *E. hirta* and *L. hastate* extracts

Group	Dose (mg/dL)	Mean±SEM									
		Initial Urea Levels (mg/dL) Day 3	Final Urea Levels (mg/dL) Day 7	Initial Creatinine Levels (mg/dL) Day 3	Final Creatinine Levels (mg/dL) Day 7	Initial Sodium Levels (mmol/L) Day 3	Final Sodium Levels (mmol/L) Day 7	Initial Potassium (mmol/L) Day 3	Final Potassium Levels (mmol/L) Day 7	Initial Chloride (mmol/L) Levels Day 3	Final Chloride (mmol/L) Levels Day 7
Control	----	29.2±2.1	31.1±2	0.8±0.1	0.9±0.1	139.5±2.5	141.2±3.3	4.5±0.2	4.6±0.2	96.2±2.1	97.1±2
Adrenaline	0.1	44.6±2.2	53.9±3.3	1.5±0.2	1.6±0.3	149.9±3.4	155.1±2.4	3.8±0.2	3.2±0.1	102.5±2.5	113.9±2.6
E. hirta	50	44.1±3.4	37.4±2.6	1.4±0.2	1.1±0.1	150.2±3.3	145.1±2.7	3.9±0.2	4.9±0.2	106.8±2.6	100.2±2.1
E. hirta	100	45.9±3.3	31.9±2.2	1.6±0.3	0.9±0.1	150.5±3	140.4±2.4	3.8±0.2	4.6±0.2	105.2±2.4	93.5±1.8
E. hirta	200	45.5±3.3	28.4±1.8	1.5±0.2	0.8±0.1	149.2±2.7	135.9±2.1	3.9±0.2	4.8±0.2	104.9±2.3	93.1±1.7
L. hastate	50	44.8±3.2	36.9±2.6	1.5±0.2	1.1±0.1	139.8±3.2	141.9±2.5	3.8±0.2	4.1±0.2	105.1±2.4	98.5±2
L. hastate	100	47.2±3.5	29.8±2.1	1.5±0.3	0.9±0.1	149.1±3.4	138.3±2.1	3.8±0.2	4.8±0.2	105.6±2.6	94.8±1.8
L. hastate	200	46.6±3.1	24.9±1.7	1.5±0.2	0.7±0.1	149.4±3	130.2±2	3.9±0.2	5±0.2	105.8±2.2	89.2±1.5

Note: Data are presented as three replicate determinations.

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Table 3. LFT of rats treated with *E. hirta* and *L. hastate* extracts (day 7)

Group	Dose (IU/L)	Mean±SEM		
		ALT (IU/L)	AST (IU/L)	ALP (IU/L)
Control	----	44.2±3.7	31.5±2.8	148.8±10.1
Adrenaline	0.1	63.1±5.2*	49.8±3.2*	198.2±12.3*
E. hirta	50	39.8±5.2	30.4±2.1	142.2±11.5
E. hirta	100	37.2±2.8	23.9±1.9	131.8±8.5
E. hirta	200	35.6±2.6	24.4±1.7	122.6±7.7
L. hastate	50	41.1±3.2	30.2±2.2	143.1±10.2
L. hastate	100	40.5±3.3	25.9±4	137.6±9.1
L. hastate	200	35.3±2.9	24.9±1.9	125.4±9.7

*Significant difference between different parameters P<0.05.
Note: Data are presented as three replicate determinations.

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idemia, characterized by elevated HDL (Table 3). Also, HDL levels increased significantly in *E. hirta* (200 mg/kg) and *L. hastata* (200 mg/kg) groups (Table 2), suggesting enhanced reverse cholesterol transport.

The significant (P<0.05) decreased LDL levels indicate reduced atherogenic risk, potentially mediated by the extracts' antioxidant and anti-inflammatory properties [22].

Regarding LDL, there were significant (P<0.05) alterations in the experimental groups compared to the control group. The adrenaline group exhibited hyperlipidemia, characterized by elevated LDL levels (Table 2), In contrast, *E. hirta* and *L. hastata* extracts mitigated lipid profile alterations, indicating potential anti-hyperlipidemic effects.

The significant (P<0.05) decreased VLDL levels indicate reduced atherogenic risk, potentially mediated by the extracts' antioxidant and anti-inflammatory properties [22].

Regarding VLDL, there were significant (P<0.05) alterations in the experimental groups compared to the control group. The adrenaline group exhibited hyperlipidemia, characterized by elevated LDL levels (Table 2). In contrast, *E. hirta* and *L. hastata* extracts mitigated lipid profile alterations, indicating potential anti-hyperlipidemic effects.

Adrenaline induced significant electrolyte imbalances (P<0.05), including hypochloremia (Table 4). *E. hirta* and *L. hastata* extracts normalized electrolyte levels.

LFT parameters are essential indicators of liver health and function. In this study, the assessed LFT parameters included:

ALT: Decreased ALT levels in both extract-treated groups suggest improved hepatocellular integrity [22]. ALT is a liver enzyme involved in amino acid metabolism.

AST: Reduced AST levels indicate enhanced liver function [23]. AST is a liver enzyme involved in amino acid metabolism.

ALP: Decreased ALP levels suggest improved hepatic function [24]. ALP is a liver enzyme involved in bile acid synthesis.

Adrenaline administration induced hepatotoxicity, evidenced by elevated ALT, AST, and ALP levels. *E. hirta* and *L. hastata* extracts demonstrated hepatoprotective effects, as indicated by significant (P<0.05) reduced liver enzyme levels (Table 3).

RBC: Increased RBC count in both extract-treated groups suggests improved erythropoiesis [22]. RBCs are responsible for oxygen transport, and increased counts may indicate enhanced oxygen-carrying capacity.

Adrenaline caused anemia, characterized by decreased hemoglobin (Hb), packed cell volume (PCV), and MCH levels in adrenaline and amlodipine-induced untreated rats (Table 5). *E. hirta* and *L. hastata* extracts

Table 5. Hematological parameters of rats treated with *E. hirta* and *L. hastat*e extracts

Group	Dose	Mean±SEM											
		Initial RBC ($\times10^{12}$/L) Day 3	Final RBC ($\times10^{12}$/L) Day 7	Initial MCV (fL) Day 3	Final MCV (fL) Day 7	Initial MCHC (g/dL) Day 3	Final MCHC (g/dL) Day 7	Initial WBC ($\times10^{9}$/L) Day 3	Final WBC ($\times10^{9}$/L) Day 7	Initial PCV (%) Day 3	Final PCV (%) Day 7	Initial Hb (Hb) Day 3	Final Hb (Hb) Day 7
Control	----	7.2±0.3	7.4±0.3	80.2±2.1	81.1±2.0	34.5±1.2	34.8±1.1	6.2±0.3	6.4±0.3	40.2±2.1	40.8±2	13.8±0.7	14±0.6
Adrenaline	0.1	6.3±0.2	5.8±0.2	75.77±1.9	72.2±1.8	31.9±1	30.5±0.6	8.5±0.4	10.2±0.5	35.9±1.9	33.5±1.7	12.2±0.6	11.4±0.5
E. hirta	50	6.5±0.3	7±0.2	75.8±2	78.5±1.6	32.1±1.1	31.4±1	8.2±0.4	7.4±0.3	35.2±2.2	38.4±2	12.4±0.7	13.1±0.6
E. hirta	100	6.4±0.2	7.1±0.3	75.8±1.5	80.3±2.1	31.8±1	35.2±1.2	8.6±0.3	6.8±0.3	35.8±1.8	40.1±2.5	11.1±0.5	14.8±0.6
E. hirta	200	6.5±0.2	7.2±0.3	77.1±1.9	81.1±2.2	32±1	35.1±1.7	8.3±0.3	6.2±0.4	36.1±1.9	42.3±3.3	11.3±0.6	13.5±0.8
L. hastate	50	6.4±0.2	6.9±0.2	75.6±1.5	76.4±1.7	31.7±0.9	32.9±2	8.5±0.4	7.7±0.3	35.6±1.7	37.3±1.8	12±0.5	12.9±0.4
L. hastate	100	6.3±0.2	7±0.3	75.9±1.6	79.2±2.2	31.9±1	35.8±1.1	8.2±0.4	6.9±0.3	35.7±1.9	38.4±2	11.2±0.6	12.5±0.7
L. hastate	200	6.4±0.2	7.3±0.3	75.8±1.8	81.5±4.3	31.8±1	35.5±1.4	8±0.3	6±0.2	36±1.9	41.7±2.3	12.1±0.5	14.2±0.8

Group	Dose	Mean±SEM											
		Initial MCH (pg) Day 3	Final MCH (pg) Day 7	Initial Urea (mg/dL) Day 3	Final Urea (mg/dL) Day 7	Initial Creatinine (mg/dL) Day 3	Final Creatinine (mg/dL) Day 7	Initial Sodium (mmol/L) Day 3	Final Sodium (mmol/L) Day 7	Initial Potassium (mmol/L) Day 3	Final Potassium (mmol/L) Day 7	Initial Chloride (mmol/L) Day 3	Final Chloride (mmol/L) Day 7
Control	----	27.5±1.2	28.1±1.1	29.2±2.1	31.1±2	0.8±0.1	0.9±0.1	139.5±2.5	141.2±3.3	4.5±0.2	4.6±0.2	96.2±2.1	97.1±2
Adrenaline	0.1	24.9±1	23.4±0.9	44.6±2.2	53.9±3.3	1.5±0.2	1.6±0.3	149.9±3.	155.1±2.4	3.8±0.2	3.2±0.1	102.5±2.5	113.9±2.6
E. hirta	50	25.2±1.1	25.5±1	44.1±3.4	37.4±2.6	1.4±0.2	1.1±0.1	150.2±3.3	145.1±2.7	3.9±0.2	4.9±0.2	106.8±2.6	100.2±2.1
E. hirta	100	24.8±1	25.9±1.2	45.9±3.3	31.9±2.2	1.6±0.3	0.9±0.1	150.5±3	140.4±2.4	3.8±0.2	4.6±0.2	105.2±2.4	93.5±1.8
E. hirta	200	25.1±1	30.2±1.3	45.5±3.3	28.4±1.8	1.5±0.2	0.8±0.1	149.2±2.7	135.9±2.1	3.9±0.2	4.8±0.2	104.9±2.3	93.1±1.7
L. hastate	50	28.7±0.9	26.9±1.3	44.8±3.2	36.9±2.6	1.5±0.2	1.1±0.1	139.8±3.2	141.9±2.5	3.8±0.2	4.1±0.2	105.1±2.4	98.5±2
L. hastate	100	25±1	28.2±1.3	47.2±3.5	29.8±2.1	1.5±0.3	0.9±0.1	149.1±3.4	138.3±2.1	3.8±0.2	4.8±0.2	105.6±2.6	94.8±1.8
L. hastate	200	24.9±1	28.5±1.4	46.6±3.1	24.9±1.7	1.5±0.2	0.7±0.1	149.4±3.0	130.2±2	3.9±0.2	5±0.2	105.8±2.2	89.2±1.5

Note: Data are presented as three replicate determinations.

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improved hematological parameters in extract-treated groups (Table 5).

MCV and MCHC (Table 5): Improved MCV and MCHC values indicate enhanced erythrocyte health [24]. MCV measures the average size of RBCs, while MCHC measures the average Hb concentration within RBCs.

WBC: Normalized WBC count in both extract-treated groups implies enhanced immune function [23]. WBCs play a crucial role in immune defense, and normalized counts may indicate improved immune response.

PCV): Improved PCV values indicate enhanced erythrocyte production and/or reduced erythrocyte destruction [24]. PCV is a measure of the proportion of blood volume occupied by RBCs.

Hb: Increased Hb levels in both *E. hirta*- and *L. hastata*-treated groups suggest improved erythropoiesis, potentially due to the extracts' iron-chelating properties

[23]. Hb is essential for oxygen transport, and increased levels may indicate enhanced oxygen delivery to tissues.

Discussion

The present study demonstrated the antioxidant, anti-hyperlipidemic, hepatoprotective, renoprotective, and hematological-enhancing effects of *E. hirta* and *L. hastata* extracts. The findings suggest that these plant extracts may be useful in managing hypertension and related complications. Our findings corroborate existing scientific literature on the antioxidant and protective effects of these plant extracts [23, 25].

The observed anti-hyperlipidemic effects are consistent with research demonstrating the lipid-lowering properties of *E. hirta* [26] and *L. hastate* [27]. The hepatoprotective and renoprotective effects can be attributed to their antioxidant activity, reducing oxidative stress and inflammation in liver and kidney tissues [28].

Notably, our study provides novel insights into the combined antioxidant, anti-hyperlipidemic, hepatoprotective, renoprotective, and hematological-enhancing properties of *E. hirta* and *L. hastata* extracts. These findings suggest potential therapeutic applications in managing oxidative stress-related disorders, such as atherosclerosis, hepatotoxicity, and nephrotoxicity.

Studies have demonstrated the antioxidant and protective effects of various plant extracts [7, 25]. However, our study provides a comprehensive evaluation of the antioxidant, anti-hyperlipidemic, hepatoprotective, renoprotective, and hematological-enhancing effects of *E. hirta* and *L. hastata* extracts.

Our findings are consistent with existing scientific literature on the antioxidant and protective effects of plant extracts [7, 25]. However, our comprehensive evaluation of *E. hirta* and *L. hastata* extracts provides novel insights into their therapeutic potential.

Conclusion

The study highlights the potential of *E. hirta* and *L. hastata* extracts as a phytotherapeutic approach to hypertension. Further studies are needed to elucidate the mechanisms of action and to translate these findings to human studies.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by Ogun State College of Health Science and Technology, Illese-Ijebu, Nigeria (Code: OG/CHT/2023/011). The animal study was approved by the University's Animal Ethics Committee (Code: AEC/2024/022).

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Authors' contributions

All authors contributed to preparing this article.

Conflict of interest

The authors declared no conflict of interest.

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