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Toxicological evaluation of Lavandula stoechas on heart and blood of wistar rat.

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ABSTRACT

Background/Aim: Cardiovascular disease is any condition affecting the heart. It is one of the leading causes of death in most parts of the world. Lavandula stoechas L. is a medicinal plant commonly used for different medicinal purposes. The aim of this study is to determine the effect of Lavandula stoechas on the heart and other cardiovascular parameter.

Method: Animals of either sex were selected. Group 1 received distilled water (10 ml/kg), while group 2, 3 and 4 received Lavandula stoechas 50, 100 and 200 mg/kg respectively. Animals were kept in standard cages and given access to the extract, water and food orally for 28 days, after which they were weighed and sacrificed. Blood was collected by cardiac puncture and taken immediately for chemo- hematological and pathological analysis.

Result: There was significant ($P<0.05$) decrease in HGB, MCV, RBC while no change in the level of basophiles, neutrophiles, eosinophiles and platelets. There was no significant ($P<0.05$) change in the level of triglyceride, cholesterol and low density lipoprotein (LDL). Also,there was significant ($P<0.05$) increase in the level of high-density lipoprotein (HDL). Histological observation revealed no severe injury tissue of the heart.

Conclusion: Lavandula stoechas may possess no cardiovascular danger, when taken for a period of time. It may be of cardiovascular advantage as a preventive or therapeutic agents to people with the disease.

Keyword: Lavandula stoechas, blood, rats, heart

I. INTRODUCTION

Cardiovascular disease (CVD), is a diseases that involve the blood vessel and heart[1]. CVD includes coronary artery diseases, angina[2], stroke, heart failure, thromboembolic disease, hypertensive heart disease, rheumatic heart disease, cardiomyopathy, abnormal heart rhythms, congenital heart disease, valvular heart disease, carditis, aortic aneurysms, peripheral artery disease, and venous thrombosis[3].

Cardiovascular drugs reduce cardiovascular disease in people at risk[4], the baseline level of cardiovascular risk, or baseline blood pressure[5]. The commonly-used drug, regimens have similar efficacy in reducing the risk of all major cardiovascular events. There may be differences between drugs in their ability to prevent specific situation[6]. Higher reductions in blood pressure produce larger reductions in risk[7], and most high blood pressure individuals require more than one drug to adequately reduce blood pressure[8]. Adherence to medications is often poor and there is insufficient evidence that it alters secondary prevention of cardiovascular disease[9,10,11].

Lavender (Lavandula angustifolia), a member of the Labiatae family, is different use in herbal medicine[12]. Essential oils of lavender reduced cholesterol plaques in atherosclerotic disease in rabbits, but showed no effect on serum cholesterol levels[13]. Lavander showed lowering of lipidemic effect in rats[14]. In addition, lavender aromatherapy has displayed vasodilatory effects and enhanced coronary blood flow in human[15]. Extract of lavender flower, protected isolated rat hearts from ischemic reperfusion (IR) injury. In a recent study lavender oil showed neuroprotective

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activity and antioxidant properties in an experimental model of stroke[16]. In another study, treatment with essential oil of lavender after MI reduced ischemic injury in rats[17]. This study aimed to investigate the toxicity study of lavender plant at different doses on heart and lipid profile of wister rats.

II. MATERIAL AND METHOD

Male and female wistar rats were obtained from Bingham University, Animal House. They were
maintained on standard animal pellets and given water ad libitum. Permission and approval for animal studies were obtained from the College of Health Sciences Animal Ethics Committee of Bingham University.

Plant collection

Leaves of Lavandula stoechas were collected from its natural habitat from nearby Karu village, Nasarawa State, Nigeria. The plant was authenticated from Department of Botany, Bingham University, Nasarawa State Nigeria.

Plant extraction

The leaves were shadow dried for two weeks. The plant leave material was further reduced into small pieces and pulverized. The powdered material was macerated in 70% ethanol. The liquid filtrates were concentrated and evaporated to dryness at 40°C in vacuum using rotary evaporator. The ethanol extract was stored at -4°C until used.

Animal study

Twenty-four (24) rats of either sex (174-257g) were selected and randomized into four groups of six rats per group. Group 1 served as the control and received normal saline (10ml/kg) while the rats in groups 2, 3 and 4 were giving 50, 100, and 200 mg/kg of Lavandula angustifolia extract respectively. The weights of the rats were recorded at the beginning of the experiment and at weekly intervals. The first day of dosing was taken as D0 while the day of sacrifice was designated as D29.

Haematological analysis

The rats were sacrificed on the 29th day of experiment. Blood samples were collected via cardiac puncture. One portion of the blood was collected into sample bottles containing EDTA for hematological analysis such as Hemoglobin concentration, white blood cell counts (WBC), differentials (neutrophils, eosinophils, basophils, lymphocyte and monocyte), red blood cell count (RBC), platelets and hemoglobin (Hb) concentration using automated Haematology machine (Cell-Dyn, Abbott, USA).

Chempathology analysis

Second portion of the blood was collected into plain bottle, allowed to clot and centrifuged at 300rpm for 10 minutes. The serum collected was used to estimate biochemical parameters such as cholesterol, triglyceride, high density lipopolysaccharide (HDL) and low-density lipopolysaccharide (LDL).

Histological study

The heart of the animals were surgically removed and weighed and a part of each was fixed in 10% formaldehyde for histological processes.

Statistical analysis

Data were expressed as the Mean ±Standard Error of the Mean (SEM). Data were analyzed statistically using one-way Analysis of Variance (ANOVA) followed by Dunnett's post hoc test for multiple comparisons between the control and treated groups. Values of $P \leq 0.05$ were considered significant.

III. RESULTS

Effect of 28 days oral administration of Lavandula stoechas on hematological parameters in rats

Lavandula stoechas caused significant ($p<0.05$) decrease in the level of red blood cell, hemoglobin, platelet at 100 mg/kg dose and significantly ($p<0.05$) caused an increase in mean corpuscular hemoglobin concentration in the rats at the dose level of 50 mg/kg compared to the control. The level of basophiles, neutrophiles, eosinophils and lymphocytes were however not significantly ($p<0.05$) affected by mean corpuscular hemoglobin concentration (Table 1).

Effect of 28 days oral administration of ethanol extract of Lavandula stoechas on lipid profile in Wistar rats

Significant ($p<0.05$) increases were observed in total cholesterol and HDL levels at 100 mg/kg dose level of Lavandula angustifolia when comparedto the control. The extract did not produce significant changes in all other parameters (LDL, TRIG levels) studied when compared to the control (Table 2)

Effect of 28 days oral administration of ethanol extract of Lavandula stoechas on Histology of Heart in rats

Histopathological examination of heart showed slight necrosis of cardiac muscles at all doses and

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normal features at control (10 ml/kg). Study reveals normal elongated and rod-shaped cells, striated muscles and blood vessels (Figure 1).

Table 1: Effect of 28 days oral administration of ethanol leaf extract of Lavandula angustifolia on hematological parameters in wistar rats.

Hematological parameters	DW(10ml/kg)	Treatment (mg/kg) 50	100	200
WBC (×10^9/L)	8.17±0.772	6.74±1.419	3.70±0.67*	7.20±1.85
RBC (×10^12/L)	8.30±0.35	8.65±0.664	6.17±0.55*	7.74±0.25
HGB (g/dL)	15.90±0.557	15.24±0.662	11.36±0.87*	14.58±0.36
HCT (g/dL)	55.18±2.02	56.61±3.76	34.67±3.19*	53.40±1.80
MCV (fL)	66.67±0.94	65.44±1.435	57.17±0.30*	69.60±1.72
MCH (pg)	19.16±0.16	17.80±1.019	18.83±0.37	18.80±0.22
MCHC (g/dL)	29.15±0.16	27.43±1.23	32.51±0.60*	27.10±0.67
PLT (×10^9/L)	620.83±52.81	567.00±96.48	252.00±50.34*	670.45±55.78*
LYM (%)	86.81±4.61	85.00±4.13	82.83±5.82	86.41±3.14
NEUT (×10^9/L)	10.81±3.64	10.82±3.67	15.40±5.61	11.00±3.23
EOSI (×10^9/L)	1.50±0.32	2.40±0.78	1.800±0.44	1.25±0.21
BASO (×10^9/L)	1.00±0.28	2.00±0.54	2.50±1.50	3.30±2.20

Data presented as Mean ± SEM: n = 6, One way ANOVA, followed by Dunnett's post hoc for multiple comparison *significantly different from the distilled water (DW) control at $p<0.05$. DW = distilled water (WBC = white blood cells, RBC = red blood cells, HGB = hemoglobin, HCT = hematocrit, MCV = mean corpuscular volume, MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular hemoglobin concentration, PLT = platelet, LYM = lymphocyte, NEUT = neutrophils, EOSI = eosinophils, BASO = basophils).

Table 2: Effect of 28 days oral administration of Lavandula angustifolia **on serum lipid profile in rats.**

Lipid profiles	DW(10ml/kg)	Treatment (mg/kg) 50	100	200
CHOL (mmol/L)	45.01±8.46	62.80±4.26*	43.40±4.42	55.75±9.22
HDL (mmol/L)	38.20±3.18	55.00±3.24*	38.200±1.11	46.71±3.72
LDL (mmol/L)	7.42±1.86	7.14±1.802	8.22±4.24	4.54±2.17
TRIG (mmol/L	56.40±2.79	52.40±8.65	67.61±10.99	61.02±3.84

*Significantly different from the distilled water (DW) control at $p<0.05$. (CHOL = total cholesterol, HDL = high density lipoprotein, LDL = low density lipoprotein, TRIG = triglycerides).

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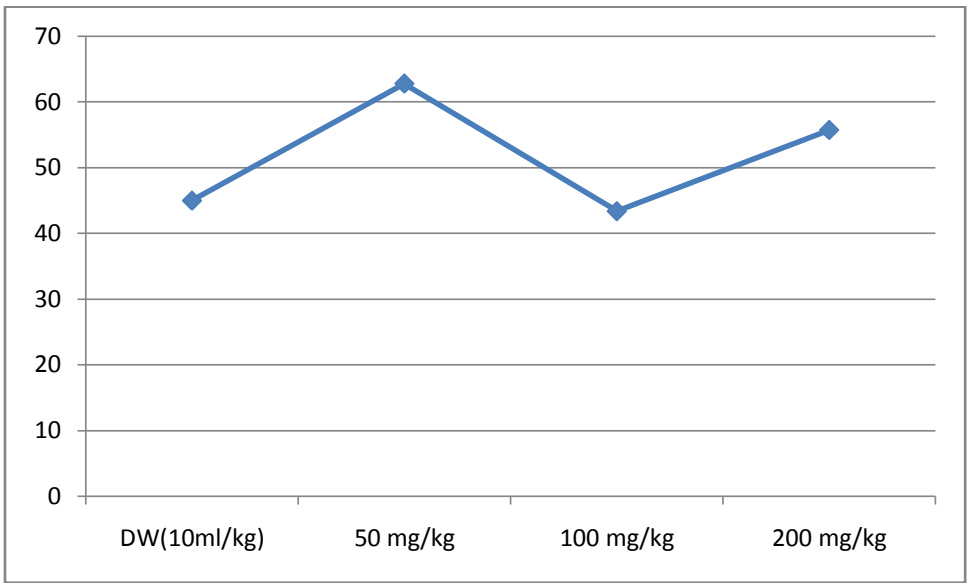

Figure 1: effect of L.A on cholesterol of rats

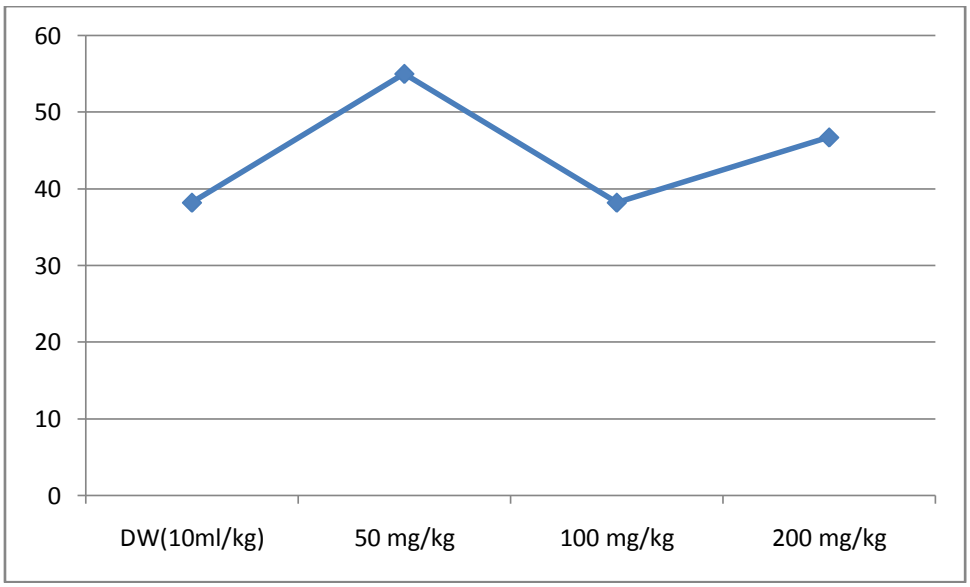

Figure 2: effect of plant extract of L.A on HDL of rats

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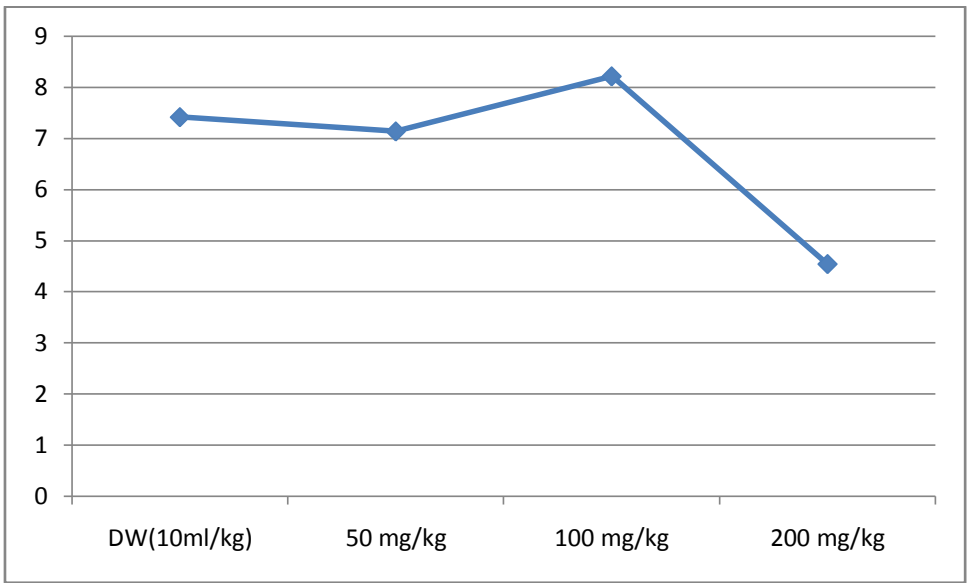

Figure 3: effect of L.A on LDL of rats

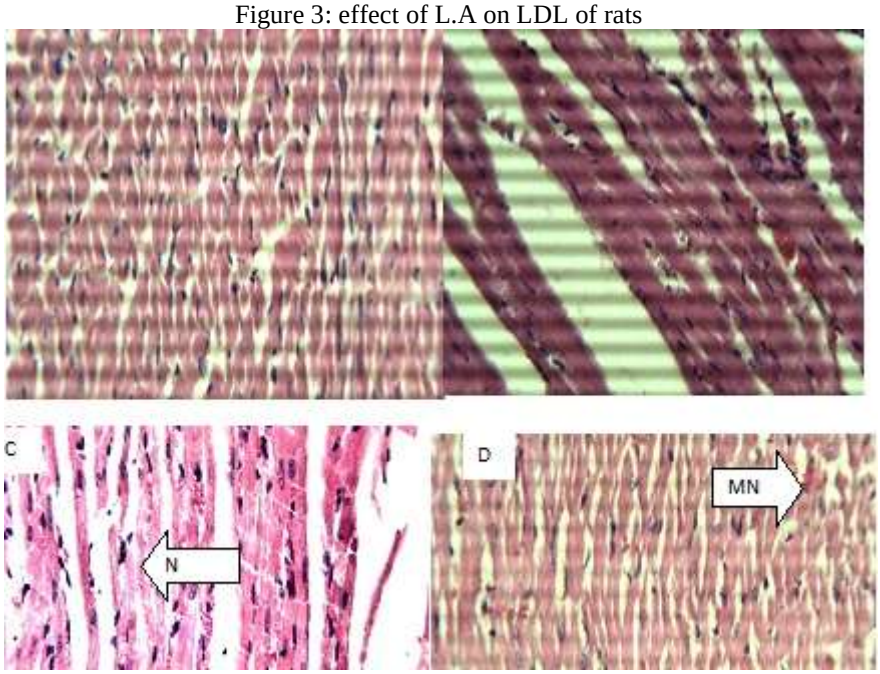

Figure 4: Photomicrograph of the heart (Hematoxylin and eosin. H and E ×100). (A) Control group (B) 50 mg/kg L.A (C) 100 mg/kg L.A (D) 200 mg/kg, slight L.A

IV. DISCUSSION

The use of plant for different purposes is as old as man[18]. Medicinal plants are usually consumed without a graded dose or expected duration of use[19,20]. This can result in unexpected side effects on the body[21,22]. In this study the effect of Lavandula stoechas plant on the heart and vascular parameters were studied. Lavandula stoechas resulted in significant (*p<0.05) decrease in the red blood cell, hemoglobin and platelet when compared to the control group of rats, which indicates that the plant may either suppress the production of red blood cells, decrease the lifespan of red blood cells or causes problems with how the body uses iron. Anemia or low red blood count can cause feelings of fatigue and weakness[23,24]. A lower red blood count than inormal causes the body to work harder to get enough oxygen to the cells[25]. low red blood cell (RBC) count cause variety of symptoms and health complications[26,27]. Hemoglobin is important for carrying oxygen from the lungs to blood and body tissues. Myoglobin, in muscle cells, accepts, transport, stores and releases oxygen[28]. The level of basophiles, neutrophiles,

lymphocytes and eosinophils were not affected by the extract. This suggests that the plant may not affect the body immune system. It could also suggest that the plant have immunomodulatory potential. In this work, the effect of Lavandula angustifolia on lipid profile of rat was also evaluated. The level of most of the parameters such as low density lipoprotein (LDL), triglyceride and cholesterol remain same when compared to the normal saline group. Increase in the level of high density lipoprotein (HDL) was recorded. HDL helps remove excess cholesterol so that it does not end up in arteries[29,30]. LDL is commonly referred to as "bad cholesterol" because it takes cholesterol to the arteries, where it can be collected in the arterial walls[31]. Too much cholesterol in the arteries, may lead to a buildup of plaque known as atherosclerosis[32,33]. High triglycerides, may contribute to hardening of the arteries or thickening of the artery walls (arteriosclerosis) — which increases the risk of cardiovascular disease. Extremely high triglycerides can also cause acute inflammation of the pancreas (pancreatitis) a high triglyceride level combined with high LDL cholesterol or low HDL (good) cholesterol is associated with fatty buildups within the artery walls, which increases the risk of heart cardiovascular diseases[34,35]. HDL, exerts part of its antiatherogenic action by counteracting LDL oxidation. Recent studies reveal that HDL promotes the reverse cholesterol transport pathway by inducing removal of excess accumulated cellular cholesterol resulting in prevention of the generation of an oxidative modified LDL[36,37]. Furthermore, HDL does not only inhibits the oxidation of LDL by transition metal ions, but also prevents 12-lipooxygenase-mediated formation of lipid hydroperoxides[38,39,40]. Oral administration of extract of Lavandula stoechas for a 28 days period in wistar rats resulted in no significant change in the level of LDL, triglyceride and cholesterol suggesting, that the plant has fewer tendencies to induce atherosclerotic plague, while high level of HDL were observed which indicates that it may be useful in treating cardiovascular diseases. Previous phytochemical screening revealed abundance of flavonoids, tannins, alkaloid, phenol, terpenes, glycosides and steroids were observed to be present in the extract of this plant[41,42]. This compound may be responsible for some of these observations. Histological evaluation revealed that there was little to no damage to the membrane and anatomical property of the heart. This agrees with biochemical parameters that the plant maybe of cardiovascular benefit to human.

V. CONCLUSION

The study suggests that Lavandula stoechas does not possess toxic cardiovascular potential. Further study should be carried out to evaluate the extent of it cardiovascular usefulness in human

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Authors' Contribution
Joseph OS and Joseph OT designed the protocol, while Joseph OS, Joseph OT and Sebastine AZ analyzed data and wrote and edited the manuscript

Conflict of Interest
Authors declare that there is no conflict of interest

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