

COMPARATIVE EFFECTS OF GARCINIA KOLA AND GARLIC EXTRACTS ON SOMELIVER AND HEAMATOLOGICAL FUNCTIONS IN HIGH SALT DIET-INDUCED HYPERTENSIVE WISTAR RATS.

Abstract

Garcinia kolais commonly consumed in Nigeria in social ceremonies, while *Garlic* is commonly used as a spice in preparation of certain foods. In this study, the protective effects of extracts of the plants against high salt diet (8% NaCl) induced hypertension were investigated in rats. Extracts prepared from the plants were subjected to phytochemical screening for acute and sub-acute toxicity studies in rats. In the protective study against salt induced hypertension thirty five adult male rats assigned to seven groups of five rats were treated such that, group one serving as the normal control group, group two was the hypertensive control group. Group three to six were administered graded doses of extracts respectively after induction. While group seven received a combination of the two extracts after induction. Treatment commenced after confirmation of hypertension and lasted for two weeks before animals were sacrificed to collect blood for biochemical and hematological analysis. Results obtained showed that *G.kola* and *Garlic* feeding produced in rats following liver and hematological assays as values of these parameters in the test groups did not significantly differ from control values ($p < 0.05$).

Keywords: *Garcinia kola*, *Garlic*, Biochemical Functions, Hematological Parameters and Albino rats.

1.0 Introduction

Bitter kola (*Garcinia kola* Hackel) belongs to the genus *Garcinia* (Family: *Guttiferae*), is an indigenous medicinal tree that is often referred to as 'wonder plant' because all its parts have medicinal properties (Manourova et al. 2017). *Garcinia kola* is well branched, evergreen polygamous trees and is found in moist forests throughout West and Central Africa (Anegbeh et al.2006). This fruit tree has a regular fruiting cycle and produces fruits every year making it one of the most important trees valued in Nigeria (Anegbeh et al. 2006), West and Central Africa. The seeds, leaves and bark of *G. kola* are very pharmaceutical (Ashirue et al. 2018). The seeds have been reportedly used for the treatment of coughs, throat infections, bronchitis, hepatitis (inflammation of the liver), and liver disorders (Farombi et al. 2005 & Anegbeh et al. 2006). *G.kola* seeds have also been found to exhibit inhibitory effects on lipid peroxidation in rat liver homogenate (Manourova et al.2017). Antwi-Boasiako and Abubakari (2011) states that the seed's bitter stimulants are also used as snake repellent when they are placed around the compound. Other medicinal uses include: purgative, antiparasitic, antimicrobial. The seeds are used to prevent and relieve colic, cure head or chest colds (Ashieru et al. 2018). The seeds constituents include biflavonoids, xanthones and benzophenones and other anti-oxidant and protective properties which could be widely exploited (Antwi-Boasiako & Abubakari, 2011). The antimicrobial properties of this plant are attributed to the benzophenones, flavanones. According to Orié and Ekon, (1993) as cited by Anegbeh et al. (2006), this plant has shown bronchodilator effect, anti-inflammatory, antimicrobial, antibacterial and antiviral properties.

Garlic is a bulbous herbs used as food item, spice and medicine in different parts of the world (Salami et al., 2012). *Allium sativa* (garlic) is widely used as flavouring vegetables for its aroma and taste in various types of food worldwide (Salami et al., 2012). Garlic is widely recognized as a functional foodstuff that possesses a variety of beneficial effects on human health. (Tattelman, 2005). Since garlic especially possesses advantageous roles in blood circulation among its physiological effects on the human body, the prevention of cardiovascular disease and other metabolic syndromes by garlic has been well documented.(Rahman & Lowe, 2006 and Banerdee et al., 2002). Several studies have indicated that garlic and its preparation increased fibrinolytic activity (Andrianova et al., 2001) but inhibited platelet aggregation(Rahman, & Billington, 2000 and Allison et al., 2006) as well as lowering blood pressure(Qidwal et al., 2000 and Dhawan et al., 2004) and levels of cholesterol (Durak et al., 2004 and Thompson et al., 2006) in humans. These effects are advantageous in preventing or ameliorating cardiovascular disorders such as acute myocardial infarction caused by

occlusion of blood circulation due to damage to or dysfunction of vascular endothelial cells (VECs), resulting in the formation of blood clot called thrombus (Hideharu et al., 2007).

The present study was therefore undertaken to investigate the comparative effects of *G. kola* seed and Garlic on some haematological and liver function indices of wistar albino rats.

2.0. Materials and Methods

2.1. Plant Materials: Fresh bulbs of *Garlic* and fruits of *Garcinia kola* were obtained from a local vegetable market in Umuahia North Local Government Area, Abia State and were authenticated at the Department of Forestry, College of Natural Resources and Environmental Management, Michael Okpara University of Agriculture, Umudike by Mr. Azuka.

2.2. Animal Materials: thirty five adult male rats of the wistar strain (130-180g) were obtained from the Animal House of the Department of Zoology and Environmental Biology, Michael Okpara University of Agriculture, Umudike, housed in Aluminum cages and allowed to acclimatize for two weeks to allow for proper adaptation to their new environment and living conditions before commencement of the study. The experimental rats were fed at liberty with vital finisher's mash (Vital feed, Nigeria) and clean water but starved for 12 hours prior to the commencement of experiment. All animal experiments were conducted in compliance international guidelines for care and use of laboratory animals (Orieko *et al.*, 2019). The study was conducted in the Department of Biochemistry, Michael Okpara University of Agriculture, Umudike.

2.3. Study Design

The animals used were divided into seven groups, each group consisting of five rats. Group I served as control and received normal feed and distilled water for 14 days. Group II rats received high salt diet for 14 days. Group III rats received high salt diet with 500mg/kg of Garlic extracts for 14 days. Group IV rats received high salt diet with 500mg/kg of *G.kola* extracts for 14 days. Group V rats received high salt diet with 1000mg/kg of Garlic extracts for 14 days. Group VI received high salt diet with 1000mg/kg of *G.kola* extracts for 14 days. While group VII received high salt diet with 500mg/kg of each Garlic and *G.kola* extracts for 14 days

All the animals in groups I to VII were allowed access to water and rat diet ad libitum throughout the duration of the experiment. At the end of the, animals were sacrificed and Blood samples were collected by cardiac puncture into EDTA and Plane bottles for hematological and serum biochemical analysis respectively. All biochemical tests were carried out using Randox commercial test kit in

accordance with the protocols outlined by the kit producer, as repeated by Chabra 2018 and Brain et al., 2012.

3.0. Statistical analysis

All values were expressed as mean±standard error of mean (SEM). Statistical comparisons between group means were performed using analysis of variance (ANOVA), followed by student t'test. The group means were considered to be significantly different at $p<0.05$.

4.0. Results

Table 1: EFFECT OF TREATMENT ON TOTAL PROTEIN

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	7.17±0.39 ^a	7.40±0.45 ^a	7.11±0.14 ^a
2	Induction only	7.52±0.35 ^b	5.99±0.19 ^c	6.01±0.10 ^c
3	Induction + garlic extract 500mg/kg	6.64±0.38 ^a	6.32±0.40 ^b	6.76±0.17 ^b
4	Induction + G. kola extract 500mg/kg	6.58±0.35 ^a	6.06±0.25 ^b	6.82±0.08 ^{bc}
5	Induction + garlic extract 1000mg/kg	6.86±0.58 ^b	6.34±0.42 ^b	6.98±0.19 ^b
6	Induction + G. kola extract 1000mg/kg	6.60±0.57 ^b	6.08±0.47 ^b	6.84±0.10 ^b
7	Induction + Garlic 500 + G.kola 500	6.84±0.72 ^b	6.11±0.57 ^b	6.93±0.13 ^{bc}

Values are means ± standard deviation for N=5.

Values with different superscripts down the column differ significantly ($p< 0.05$).

Table 2: EFFECT OF TREATMENT ON ALBUMIN

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	3.87±0.34 ^a	4.36±0.06 ^a	3.99±0.15 ^a
2	Induction only	3.89±0.37 ^b	3.46±0.31 ^c	3.05±0.05 ^b
3	Induction + garlic extract 500mg/kg	3.34±0.33 ^a	3.37±0.27 ^b	3.63±0.07 ^b

4	Induction + G. kola extract 500mg/kg	3.99±0.15 ^{bc}	3.39±0.27 ^b	3.58±0.09 ^b
5	Induction + garlic extract 1000mg/kg	3.56±0.35 ^b	3.59±0.29 ^b	3.85±0.09 ^b
6	Induction + G. kola extract 1000mg/kg	3.40±0.37 ^b	3.40±0.29 ^b	3.60±0.10 ^b
7	Induction + Garlic 500 + G.kola 500	3.97±0.15 ^{bc}	4.34±0.06 ^a	3.92±0.10 ^b

Values are means ± standard deviation for N=5.

Values with different superscripts down the column differ significantly (p< 0.05).

Table 3: EFFECT OF TREATMENT ON ALT (U/L)

GROUP	TREATMENT	PRE-INDUCTION	POST-INDUCTION	POST-TREATMENT
1	Normal Control	28.33±1.53 ^a	14.33±3.22 ^a	30.33±1.53 ^a
2	Induction only	30.33±1.53 ^a	51.33±6.11 ^b	62.00±7.55 ^c
3	Induction + garlic extract 500mg/kg	38.00±2.00 ^b	56.33±4.73 ^b	47.33±2.31 ^b
4	Induction + G. kola extract 500mg/kg	42.33±3.22 ^b	56.00±2.65 ^b	44.33±3.22 ^b
5	Induction + garlic extract 1000mg/kg	40.00±3.00 ^b	58.35±4.75 ^b	49.35±2.33 ^b
6	Induction + G. kola extract 1000mg/kg	43.35±3.24 ^b	58.00±4.87 ^b	46.35±3.24 ^b
7	Induction + Garlic 500 + G.kola 500	30.33±1.53 ^a	58.00±2.65 ^b	44.33±2.52 ^b

Values are means ± standard deviation for N=5.

Values with different superscripts down the column differ significantly (p< 0.05).ALP, Alanine amino transferase

Table 4: EFFECT OF TREATMENT ON AST

GROUP	TREATMENT	PRE-INDUCTION	POST-INDUCTION	POST-TREATMENT
1	Normal Control	18.33±2.52 ^a	18.00±5.00 ^a	20.33±2.52 ^a
2	Induction only	75.00±6.56 ^d	81.00±7.00 ^b	77.00±6.56 ^d

3	Induction + garlic extract 500mg/kg	48.33±1.53 ^{bc}	74.67±6.03 ^b	50.33±1.53 ^{bc}
4	Induction + G. kola extract 500mg/kg	45.67±2.52 ^a	82.00±2.00 ^b	47.67±2.51 ^b
5	Induction + garlic extract 1000mg/kg	48.55±2.55 ^{bc}	76.69±6.05 ^b	50.35±2.55 ^{bc}
6	Induction + G. kola extract 1000mg/kg	47.69±2.54 ^b	84.00±2.00 ^b	49.89±2.53 ^b
7	Induction + Garlic 500 + G.kola 500	43.33±1.16 ^{bc}	84.00±2.00 ^b	45.33±1.16 ^b

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly ($p < 0.05$). AST, Aspartate amino transferase

Table 5: EFFECT OF TREATMENT ON ALP

GROUP	TREATMENT	PRE-INDUCTION	POST-INDUCTION	POST-TREATMENT
1	Normal Control	76.33±3.51 ^a	76.67±4.16 ^a	79.00±3.61 ^a
2	Induction only	134.33±4.73 ^d	128.67±9.45 ^b	136.33±4.73 ^d
3	Induction + garlic extract 500mg/kg	109.33±7.77 ^c	119.67±10.50 ^b	111.33±7.77 ^c
4	Induction + G. kola extract 500mg/kg	106.33±4.51 ^{bc}	138.67±13.65 ^b	108.33±4.51 ^{bc}
5	Induction + garlic extract 1000mg/kg	109.35±7.79 ^c	139.69±10.52 ^b	113.35±7.79 ^c
6	Induction + G. kola extract 1000mg/kg	108.35±4.53 ^{bc}	138.69±13.67 ^b	108.35±4.53 ^{bc}
7	Induction + Garlic 500 + G.kola 500	97.00±4.58 ^b	140.67±13.65 ^b	99.00±4.58 ^b

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly ($p < 0.05$). ALP, Alkaline phosphatase

Table 6: EFFECT OF TREATMENT ON TOTAL BILIRUBIN

GROUP	TREATMENT	PRE-INDUCTION	POST-INDUCTION	POST-TREATMENT
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1	Normal Control	0.48±0.08 ^a	0.50±0.2 ^a	0.51±0.04 ^a
2	Induction only	0.64±0.13 ^{ab}	1.63±0.12 ^b	1.40±0.08 ^c
3	Induction + garlic extract 500mg/kg	0.80±0.05 ^b	1.52±0.08 ^b	0.77±0.04 ^b
4	Induction + G. kola extract 500mg/kg	0.72±0.05 ^b	1.46±0.07 ^b	0.74±0.05 ^b
5	Induction + garlic extract 1000mg/kg	0.82±0.07 ^b	1.54±0.08 ^b	0.79±0.06 ^b
6	Induction + G. kola extract 1000mg/kg	0.73±0.07 ^b	1.68±0.09 ^b	0.76±0.07 ^b
7	Induction + Garlic 500 + G.kola 500	0.73±0.06 ^b	1.52±0.08 ^b	0.75±0.03 ^b

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly (p< 0.05).

From the results above, the functionality of the liver was confirmed by assessing the plasma levels of alanine (ALT), aspartate (AST), ALP, total protein, albumin and total bilirubin levels. The markers of hepatic values as depicted in Tables above shows a significant (p<005) difference in the ALT,AST,ALP, total protein, albumin and total bilirubin levels were observed in the plasma of high salt induced hypertensive rats when compared with the control rats. Oral treatment of High salt induced hypertensive rats with G.kola and garlic extracts significantly restored the levels of these biomarkers to near normalcy. Administration of G.kola and garlic alone did not affect the liver and kidney function parameters during this study.

Table 7: EFFECT OF TREATMENT ON RBC (x10³/mm³)

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	4.86±0.18 ^a	5.07±0.24 ^a	6.94±0.12 ^a
2	Induction only	3.68±0.17 ^a	3.94±0.13 ^b	5.70±0.10 ^b
3	Induction + garlic extract 500mg/kg	4.38±0.10 ^b	4.03±0.17 ^b	6.40±0.10 ^b
4	Induction + G. kola	4.48±0.18 ^a	3.86±0.12 ^b	6.50±0.18 ^c

	extract 500mg/kg			
5	Induction + garlic	4.40±0.12 ^b	4.25±0.19 ^b	6.62±0.12 ^c
	extract 1000mg/kg			
6	Induction + G. kola	4.50±0.20 ^b	3.88±0.14 ^b	6.62±0.18 ^c
	extract 1000mg/kg			
7	Induction + Garlic	4.59±0.90 ^b	5.96±0.12 ^b	6.61±0.09 ^c
	500 + G.kola 500			

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly ($p < 0.05$). RBC, Red blood cells

Table 8: EFFECT OF TREATMENT ON HB (g/dl)

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	13.27±0.31 ^a	14.37±1.48 ^a	15.37±0.40 ^a
2	Induction only	11.93±0.93 ^c	13.80±0.29 ^b	13.47±0.25 ^b
3	Induction + garlic	14.07±0.12 ^b	13.33±1.15 ^b	14.27±0.12 ^b
	extract 500mg/kg			
4	Induction + G. kola	14.20±0.36 ^b	13.43±0.37 ^b	14.37±0.40 ^a
	extract 500mg/kg			
5	Induction + garlic	14.09±0.15 ^b	13.35±1.17 ^b	14.29±0.14 ^b
	extract 1000mg/kg			
6	Induction + G. kola	14.22±0.38 ^b	13.45±0.39 ^b	14.39±0.42 ^b
	extract 1000mg/kg			
7	Induction + Garlic	14.30±0.36 ^b	15.50±0.62 ^c	14.50±0.36 ^b
	500 + G.kola 500			

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly ($p < 0.05$). HB, Hemoglobin

Table 9: EFFECT OF TREATMENT ON PCV (%)

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	13.967±0.51 ^a	44.00±1.00 ^b	15.10±0.52 ^a
2	Induction only	38.50±1.15 ^c	37.00±1.00 ^a	39.60±1.15 ^b
3	Induction + garlic	41.93±0.50 ^b	37.67±1.52 ^a	43.00±0.50 ^d

	extract 500mg/kg			
4	Induction + G. kola	42.30±0.30 ^d	36.00±1.00 ^a	43.40±0.30 ^d
	extract 500mg/kg			
5	Induction + garlic	42.95±0.52 ^d	37.69±1.53 ^a	43.02±0.52 ^d
	extract 1000mg/kg			
6	Induction + G. kola	42.32±0.52 ^d	36.02±1.22 ^a	43.42±0.32 ^d
	extract 1000mg/kg			
7	Induction + Garlic	42.60±0.46 ^d	38.00±1.00 ^a	43.67±0.42 ^d
	500 + G.kola 500			

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly ($p < 0.05$). PCV, Packed cell volume.

Table 10: EFFECT OF TREATMENT ON WBC ($\times 10^3/\text{mm}^3$)

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	8.07±0.37 ^a	7.90±0.26 ^a	8.82±0.12 ^a
2	Induction only	8.39±0.23 ^a	9.70±0.36 ^c	9.43±0.27 ^b
3	Induction + garlic	7.85±0.16 ^a	8.33±0.15 ^{ab}	8.89±0.21 ^a
	extract 500mg/kg			
4	Induction + G. kola	7.91±0.17 ^a	8.90±0.44 ^b	8.98±0.21 ^a
	extract 500mg/kg			
5	Induction + garlic	7.87±0.18 ^a	8.35±0.17 ^{ab}	8.89±0.23 ^a
	extract 1000mg/kg			
6	Induction + G. kola	7.93±0.19 ^a	8.92±0.46 ^b	8.98±0.23 ^a
	extract 1000mg/kg			
7	Induction + Garlic	7.95±0.20 ^a	9.00±0.26 ^b	8.99±0.21 ^a
	500 + G.kola 500			

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly ($p < 0.05$). WBC, White blood cells

Table 11: EFFECT OF TREATMENT ON PLT ($\times 10^3/\text{mm}^3$)

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	212.33±10.69 ^{ab}	158.00±15.72 ^a	220.00±14.73 ^{ab}

2	Induction only	234.33±4.73 ^c	177.67±14.97 ^a	244.33±4.73 ^c
3	Induction + garlic extract 500mg/kg	203.00±2.00 ^a	188.00±2.00 ^a	215.67±3.05 ^{ab}
4	Induction + G. kola extract 500mg/kg	210.67±5.03 ^{ab}	188.67±2.08 ^a	215.67±5.86 ^{ab}
5	Induction + garlic extract 1000mg/kg	205.02±2.02 ^a	188.22±2.02 ^a	215.69±3.07 ^{ab}
6	Induction + G. kola extract 1000mg/kg	211.69±5.05 ^{ab}	188.69±2.08 ^a	217.69±5.88 ^{ab}
7	Induction + Garlic 500 + G.kola 500	205.33±4.51 ^a	181.00±18.24 ^a	207.33±4.5 ^a

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly (p< 0.05). PLT, Platelets

Table 12: EFFECT OF TREATMENT ON MCV (pg)

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	23.18±0.95 ^a	29.22±4.42 ^a	21.74±0.51 ^a
2	Induction only	27.33±1.66 ^a	52.86±22.69 ^b	69.47±0.61 ^d
3	Induction + garlic extract 500mg/kg	22.66±2.52 ^a	56.54±2.29 ^b	67.19±0.83 ^{bc}
4	Induction + G. kola extract 500mg/kg	44.62±16.50 ^b	61.10±6.87 ^b	66.76±1.68 ^{bc}
5	Induction + garlic extract 1000mg/kg	24.68±2.54 ^a	58.56±2.49 ^b	69.19±0.85 ^{bc}
6	Induction + G. kola extract 1000mg/kg	46.63±18.52 ^b	62.12±6.89 ^b	68.78±1.88 ^{bc}
7	Induction + Garlic 500 + G.kola 500	60.66±0.50 ^c	66.93±1.32 ^b	66.03±0.41 ^b

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly (p< 0.05).

Table 13: EFFECT OF TREATMENT ON MCH (fl)

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	23.18±0.95 ^{ab}	21.86±0.31 ^a	22.12±0.21 ^a

2	Induction only	27.33±1.66 ^{bc}	23.45±0.68 ^a	23.63±0.35 ^b
3	Induction + garlic extract 500mg/kg	22.66±2.51 ^{ab}	23.33±0.76 ^a	22.27±0.27 ^a
4	Induction + G. kola extract 500mg/kg	22.50±3.02 ^{ab}	23.18±1.07 ^a	21.72±0.10 ^a
5	Induction + garlic extract 1000mg/kg	22.68±2.53 ^{ab}	23.35±0.78 ^a	22.29±0.29 ^a
6	Induction + G. kola extract 1000mg/kg	22.52±3.24 ^{ab}	23.38±1.29 ^a	21.74±0.12 ^a
7	Induction + Garlic 500 + G.kola 500	20.83±0.53 ^a	21.86±0.31 ^a	22.50±0.57 ^a

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly (p< 0.05).

Table 14: EFFECT OF TREATMENT ON MCHC (g/dl)

GROUP	TREATMENT	PRE- INDUCTION	POST- INDUCTION	POST- TREATMENT
1	Normal Control	57.00±9.53 ^b	64.82±0.83 ^a	101.76±1.70 ^b
2	Induction only	31.66±0.95 ^a	65.46±1.11 ^a	34.01±0.38 ^a
3	Induction + garlic extract 500mg/kg	31.16±0.63 ^a	65.12±1.13 ^a	33.18±0.64 ^a
4	Induction + G. kola extract 500mg/kg	31.08±0.70 ^a	65.26±1.24 ^a	33.10±0.70 ^a
5	Induction + garlic extract 1000mg/kg	31.38±0.65 ^a	65.14±1.15 ^a	33.20±0.86 ^a
6	Induction + G. kola extract 1000mg/kg	31.20±0.72 ^a	65.28±1.26 ^a	33.32±0.72 ^a
7	Induction + Garlic 500 + G.kola 500	30.85±0.01 ^a	64.90±0.81 ^a	33.20±0.57 ^a

Values are means ± standard deviation.

Values with different superscripts down the column differ significantly (p< 0.05).

4.1. Discussion

Hypertension is a reliable indicator of premature death (ingale et al., 2014). It is a risk factor for stroke, coronary heart disease and renalvascular diseases (Airaodion et al., 2019). The control of

blood pressure through diet has been the focal point of public health and mass media attention. The method in practice to control high blood pressure is “long-term” drug therapy. Drugs have side effects that can create more clinical problems than are solved (Airaodion et al., 2019). That is why medical professionals worldwide are seeking non-drug treatment and preventative strategies.

Garcinia kola contains dimeric flavonoids (Eleyinmi et al, 2006), which is believed to have many healing benefits. The biological activities of flavonoids include action against allergies, inflammation, free radicals, hepatoxins (Terashima et al., 2002).

Garlic contains several bioactive compounds, including allicin, which has antioxidant activity (Prasad et al., 1995). Some studies showed that allicin could lower BP (Ali et al., 2000) & (Dubey et al., 2017). Therefore, garlic supplements may ameliorate hypertension by its antioxidant effect. Garlic might also elicit its antihypertensive effects by inhibition of angiotensin-converting enzymes (ACEs). Sharifi et al.2007 reported that garlic and allicin could decrease ACE activity in a hypertensive rat model.

The significant increase observed in the serum of animals fed with salt feed diet without treatment with garlic and Garcinia juice showed that salt causes hypertension. This is in agreement with the report of Alamegeer et al., 2013, who reported the antihypertensive activity of aqueous methanol extract of Berberis Orthobotrys Bien Ex Aitch in rats. Salts have been reported to contain high sodium concentration (Grassi et al., 2002) and (Cook N.R. 2014). Excessive sodium consumption (defined by the World Health Organization as >5 g sodium per day World health Organisation 2012) has been shown to produce a significant increase in BP and has been linked with onset of hypertension and its cardiovascular complications (Weinberger, 1996 & Strazzullo et al., 2009) This might be responsible for the sustained increase in blood pressure of animals fed with high salt diet without treatment with garlic and Garcinia kola juice. This is also consistent with the reports of Airaodion et al, 2019 and Spence et al. 2012.

This study examined the effects of Garcinia kola and garlic on high salt induced hypertensive rats on some liver and hematological function parameters. In the case of the liver function parameters, rats fed with G. kola and garlic extracts was found to exhibit a significant differences ($p>0.05$) in serum total bilirubin concentration and activities of AST, ALT, and ALP as compared with control, which indicates thehepatoprotective effect of the extracts in rat. These results are in accord with those of Jan T et al., 2023 who had shown that G.kolahas a hepatoprotective effect.

The population of defensive white blood cells (WBC) can be significantly increased by certain substances which have the ability to boost the immune system (Frandsen, 1981). *G. kola* and Garlic appears to be one of such substances as it was found in this study to induce a remarkable increase ($p < 0.05$) in WBC count of rats (Table 10). The other haematological parameters investigated, notably haemoglobin (Hb) concentration, percentage packed cell volume (PCV) and red blood cell (RBC) count, were, however, found to be non-significantly affected ($p > 0.05$) by *G. kola* and Garlic extracts fed to the rats. This result is in agreement with the report of Esomonu et al. (2005) in which the mean Hb, percentage PCV and RBC count of rats fed *G. kola* extract were found to be non-significantly different ($p > 0.05$) from control. This explained that *G. Kola* and Garlic extract exerted no influence on Hb concentration, percentage PCV and RBC count indicated that the test material did not adversely interfere with the functions of the haematopoietic system. However there are controversial reports about the effects of *Garcinia Kola and Garlic* on RBC count, Hb, MCV and MCH as positive haematological effects through increasing RBC or induction of macrocytic normochromic anaemia or haemolytic anaemia in some animal species (Abdel Gadir, 2006; Olaniyan, 2013; Banerjee & Maulik, 2002). The ethanolic extract of *G. kola* and garlic has hematological, stimulating, and enhancing effects due to its antioxidant qualities (Atsukwei et al., 2015). These findings suggest that it has no harmful effects on the liver's function and may have a beneficial effect, as indicated by its capacity to drastically lower total serum cholesterol and increase WBC count (Tamuno-Emine et al., 2015).

5.0. Conclusion

The results of this study indicated that high salt diet causes significant hypertension; these findings were reversed by ethanolic *G. kola* and garlic extract administration. Taken together, the findings from the present investigation demonstrated that administration of *G. kola* and Garlic extracts significantly ameliorated hypertension-mediated Liver and Hematological functions in high salt-induced hypertensive rats. From this study, it can, thus, be suggested that extract of *Garcinia kola* and Garlic, possesses antihypertensive effect possibly due to its antioxidant.

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