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NUTRIENT PROFILE AND DIETARY SUPPLEMENTATION OF *Ricinodendron Heudelotii* SEED ON SOME BIOCHEMICAL INDICES IN WISTAR RATS

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ABSTRACT

Medicinal plants in folklore medicine serves as food to meet the nutritional requirements as well as for therapy because of affordability and safety. The 28-day study investigated nutrient profile and dietary supplementation of *Ricinodendron heudelotii* seed on some biochemical indices using Wistar rats. Twenty-four Wistar rats divided into 4 parallel groups of 6 rats each: Group 1 which served as the control received only 125g of stock diet + 63ml of water; Group 2 received 125g of rat pellet + 7ml of garlic oil + 63ml of water; Group 3 was fed with 125g of rat pellet + 7ml of garlic oil + 7ml of extract + 63ml of water while Group 4 had 125g of rat pellet + 7ml of extract + 63ml of water. Results obtained from biochemicals assays showed that rats in group 4 indicated significant ($P < 0.05$) increase in ALT activity compared to the other groups. Similarly, the LDL-c and HDL-c in groups 2 and 3 rats were higher ($P < 0.05$) than those of groups 1 and 4. Comparatively, the activities of glutathione peroxidase (GPx) enzyme did not differ significantly ($p>0.05$) among groups, however glutathione (GSH) in group 1 shows a statistically significant difference relative to the other groups.The study therefore conclude that the seed extract possesses antioxidant and hepatoprotective function with no deleterious effects on blood cell counts and hemoglobin concentration.

KEYWORDS: *Ricinodendron heudelotii*, Nutrient Profile, Dietary Supplementation, Biochemical Indices.

Competing Interest: The authors have declared that no competing interest exists.

BACKGROUND

Many medicinal plants fall under the food-medicine gamut as resources that meet both medicinal and nutritional needs. Globally, Africa has the poorest nutritional indices,[1] with medicinal plants extensively used to maintain health and well-being in sub-Saharan African, especially among vulnerable populations including children, pregnant women and the aged.[2] Although, there is an international consensus that diets and foods may promote health and prevent chronic diseases relative to the growing problem associated with several nutritional deficits (e.g., low intake of iron, zinc, vitamin A, folate, and other micronutrients). However, the adoption of healthy food choices remains significant and is limited by many barriers such as economic constraints, poverty, monotonous (non-diverse) diets and lack of nutritional knowledge especially in resource limited settings including Nigeria.

Although, most vegetables are known for their nutraceutical potentials and relevance to mankind as food,[3] however, there are several nutritional gaps underpinned by an interdependent association between food components, nutrition and health. Therefore, *Ricinodendron heudelotii*, a local plant rich in micronutrients, fiber, and bioactive compounds, in addition to being better adapted to local conditions and a culturally appropriate delicacy which is affordable, accessible, and a good form of nourishment tends to fill this nutritional gap.[4,5] The plant is a member of the Euphorbiaceae family and grows rapidly in secondary forest native to West and Central Africa and its fruits manually shelled to collect the oil seeds.[6] The therapeutic potential of this plants includes an antidote against poison and treatment of as cough, malaria, yellow fever, stomach pain, rheumatism, infertility and menstrual pain and also the almond of the seed is well-known for its unique taste, as a thickener or condiment in soup and stews.[7-9] Phytochemical screening of the plants shows that the plants contain tannins, flavonoid, alkaloids, cardiac glycoside, terpenoid, carotenoids, saponins, thus suggesting anti-inflammatory, antioxidants and aphrodisiac properties.

The current high cost of food rich in nutritional content, coupled with the rapidly depleting immune system occasioned by nutritional deficiencies is driving scientists to investigate the

use of an alternative products to address this hydra headed burden. It has been hypothesized that the high content of crude fibre, protein, calcium, iron, potassium in *Ricinodendron Heudelotii* makes it rich in nutrients and it can serve as a potential nutritious food supplement to improve the health status of its consumers. Therefore, it is against this background that this study investigates nutrient profile and dietary supplementation of *Ricinodendron heudelotii* seed on some biochemical indices in Wistar rats.

MATERIALS AND METHODS

Place and duration of study: This study was conducted at the Department of Biochemistry, Faculty of Physical Sciences, University of Cross River State, Calabar, Nigeria., from February-November, 2020.

Reagents and chemicals: All reagents and chemicals used were of good analytical grades and quality.

Collection and identification of plant material

The seeds of Ricinodendron heudelotii were sourced within local markets in Calabar Metropolis, Cross River State, Nigeria and then identified and authenticated to be Ricinodendron heudelotii seeds by Professor Johesephat Udoh, a botanist in the department of Plant and Biotechnology, Faculty of Biological Sciences, University of Cross River State, Nigeria.

Preparation of plant extracts

The seeds were washed and allowed to dry at room temperature (25^0 C) for a period of two weeks and blended using an electric blender into coarse powder. The powdered *R. heudelotii* seed (1000g) was extracted with 95% ethanol in the ratio of 1:9 ground powder to ethanol via maceration for 72h and thereafter filtered and concentrated at 50^0C using a rotary evaporator[10] to obtain the ethanol extract yield and kept in the refrigerator at temperature of at 4 degrees Celsius for a period of 48hours prior to use.

Experimental animals

Twenty-four (100–150g) Wistar rats were obtained from the animal breeding center of the University of Cross River State, Nigeria and housed in standard cages under ideal conditions of 12/12 hours dark/light cycle, 65% humidity, and 25^0C in the animal house of Department of Biochemistry. Animals were given daily diet and water *ad libitum*. All animals were also

be treated following the National Institutes of Health (NIH) guidelines for the usage and care of laboratory animals.[11]

Collection of blood samples for analyses

At the end of the twenty-eight (28) days experimental period, the rats were anaesthetized using ketamine. Blood samples were collected into sterile, plain bottles and centrifuged for 10 min at 3000rpm to obtain serum and used for biochemical assays, while blood samples for hematological analyses were collected into ethylene-diamine tetra acetic acid (EDTA, pH 7.4) treated sample bottles. Kidney and liver were harvested and their respective weights estimated for every rat sacrificed. Standard procedures were used to evaluate alkaline phosphatase (ALP), Aspartate aminotransferase (AST), Total protein concentration and Alanine aminotransferase (ALT).

Table 1: Animal groupings and treatment schedule (experimental design).

Groups	No of Animals	Feed Formulation
1	6	rat pellets only + 63ml of water
2	6	125g of rat pellet + 7ml of garlic oil + 63ml of water
3	6	125g of rat pellet + 7ml of garlic oil + 7ml of extract + 63ml of water
4	6	125g of rat pellet + 7ml of extract + 63ml of water

Fig 1 table of group, treatment and administration.

Biochemical analysis: Biochemical assays were carried out using serum and the following parameters were estimated: hepatic enzymatic activities (ALT, AST, ALP), protein level (TP, ALB, Globulin), lipid profile (TC, TG, HDL-C, LDL, VLDL), antioxidant level (GPX, GSH, SOD, MDA), glucose level.

Haematological Indices: The following haematological parameters were estimated, RBC, HGB, HCT, MCH, RBDW.

SERUM ENZYMES

Serum Alanine Aminotransferase (ALT): The ALT concentration in the sample was estimated by ***Randox kit method*** according to Ekam.[12] The principle behind this method is the formation of pyruvate and glutamate by the transfer of an amino group from L-alanine to α-ketoglutarate.

Serum Aspartate Aminotransferase (AST): AST activity in serum was estimated by Randox kit method[13] which is a measurement of catalytic enzyme concentration.

Serum Alkaline Phosphatase (ALP): The ALP activity in serum was estimated by kit method of[14] ***based*** on the measurement of the rate of hydrolysis of phosphate esters.

SERUM PROTEINS

Protein estimation: Total protein was estimated based on the interaction of cupric ions, in an alkaline medium with protein peptide bonds to form a coloured complex.

Albumin estimation: Serum albumin content was determined using Bromocresol Green Method. The measurement of serum albumin is based on its quantitative binding and reaction with the indicator 3,3,5,5-tetra-abromocresol sulpho-bephithalein (bromocresol green BCG).

Globulin estimation: Serum globulin content was determined by subtracting albumin from total protein content. For the routine chemistry profile, globulins will be calculated as follows.

Total Protein – Albumin = Globulin

SERUM LIPID PROFILE: The serum lipid indices namely, TC, TG and HDL-c were estimated using Randox analytical kits, according to the manufacturer's protocol.

The LD-c and VLDL-c was determined by calculation using the Friedewald Formula (FF) equation.[15]

SERUM ANTIOXIDANT: Markers namely SOD was estimated using fluorescent cellular antioxidant assay kits determined following previously described method.[16]

GLUCOSE LEVEL: Serum glucose concentration determination was carried out by Glucose oxidase (GOD) and Peroxidase (POD) Method.[17]

HAEMATOLOGICAL INDICES

The RBC count was estimated using the method of Dacie & Lewi,[15] which involved a 1:200 dilution of blood with Haymen's fluid and then counting in a special counting chamber under the microscope.

Hemoglobin (HB) concentration was determined using sahlis method**.**[15]

The packed cell volume (PCV) was determined by the method of Dacie & Lewis, 1991.

White blood cell (WBC) count was estimated from heparinized blood by the method.[15]

RESULTS

Serum enzymatic activities: Analyzed data showed that rats in group D (rats administered with rat chow + *Ricinodemdrom hendeloti* seed extract) exhibited a higher ($P < 0.05$) activity of alanine aminotransferase (ALT) compared to the other groups. However, with respect to aspartate aminotransferase (AST), no significant activity was observed among the groups. Activities of alkaline phosphatase (ALP) in group B were considerably the highest (Figure 1).

Serum proteins: Overall analysis showed no significant differences ($P > 0.05$) in the concentrations of serum total protein, albumin and globulin among the groups i.e. A, B, C and D (Figure 2).

Lipid profile: The concentration (mg/dl) of total cholesterol in group B (rats administered with rat chow + 7ml of garlic oil) was significantly higher relative to the other groups. Similarly, the low-density lipoprotein cholesterol and high-density lipoprotein cholesterol (mg/dl) in groups B and C (rats administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract) were higher ($P < 0.05$) than those of groups A and D (i.e. rats fed with rat chow only; and rat chow + 7ml of the extract respectively). However, no marked difference was observed between the groups in terms of their triacylglycerol and very low-density lipoprotein cholesterol concentrations as depicted in Figures 3a and 3b respectively. Furthermore, the phospholipids content (mg/100ml) in group D was found to be significantly decreased among the groups (Figure 3c).

Fig. 1 Hepatic enzymatic activities (U/L): alanine aminotransferase (ALT), aspartate aminotransferase (AST) and alkaline phosphatase (ALP). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract b. = $P < 0.05$ vs group B, d = $P < 0.05$ vs group D. n = 6.

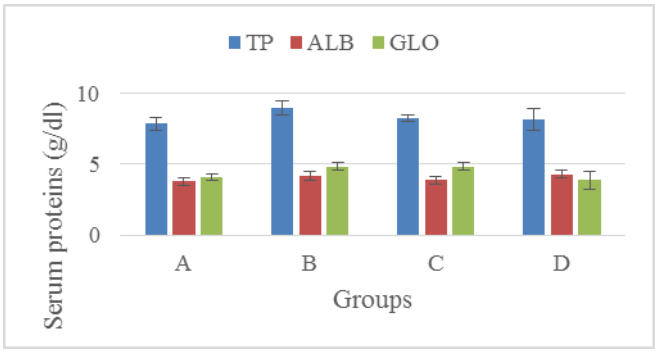

Fig. 2: Serum proteins (g/dl). Total protein (TP), albumin (ALB) and globulin (GLO). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. No significant difference among the groups (P > 0.05), n = 6.

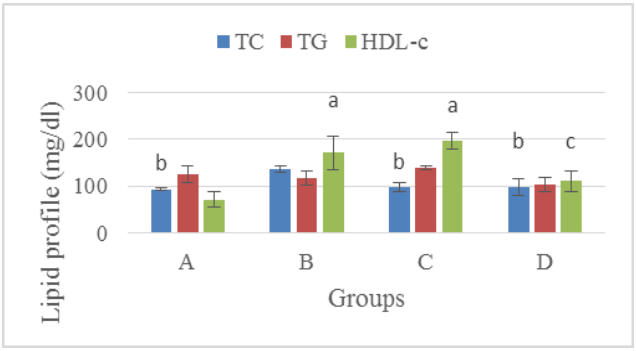

Fig. 3a Lipid profile (mg/dl). Total cholesterol (TC), triacylglycerol (TG) and high-density lipoprotein cholesterol (HDL-c). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. a = $P < 0.05$ vs group A, b = $P < 0.05$ vs group B, c = $P < 0.05$ vs group C. n = 6.

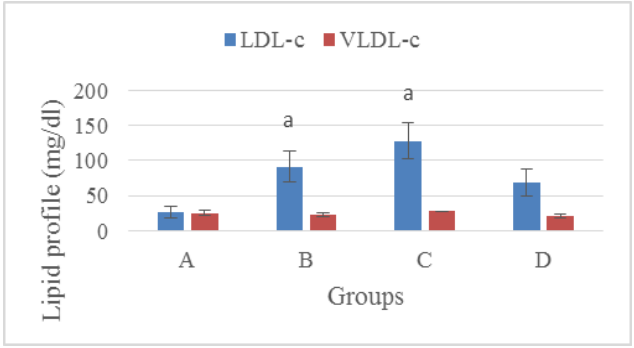

Fig. 3b: **Lipid profile (mg/dl)**. Low density lipoprotein cholesterol (LDL-c) and very low-density lipoprotein cholesterol (VLDL-c). Groups A: administered with rat chow only, B:

administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. a = $P < 0.05$ vs group A, n = 6.

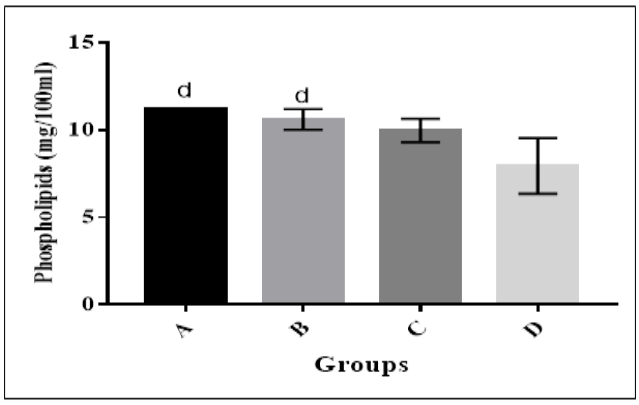

Fig. 3c: **Phospholipids (mg/100ml)**. Low density lipoprotein cholesterol (LDL-c) and very low-density lipoprotein cholesterol (VLDL-c). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. d = $P < 0.05$ vs group D, n = 6.

Serum antioxidants

Comparatively, the activities of glutathione peroxidase (GPx) enzyme among the groups did not differ significantly (Figure 4a). On the contrary, the level of reduced form of glutathione (GSH) in group A (which were fed with rat chow only) increased quite significantly relative to the other groups. The highest activity of superoxide dismutase (SOD) was clearly evident in group C (fed with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract) than any other group (Figure 4b). A scenario of no significant difference among the groups was observed in the case of malondialdehyde (MDA) concentration (Figure 4c).

Serum glucose

Although there was no significant difference among the groups with regards to their serum glucose concentration, group C (administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract) showed the least ($P > 0.05$) concentration of serum glucose (Figure 5).

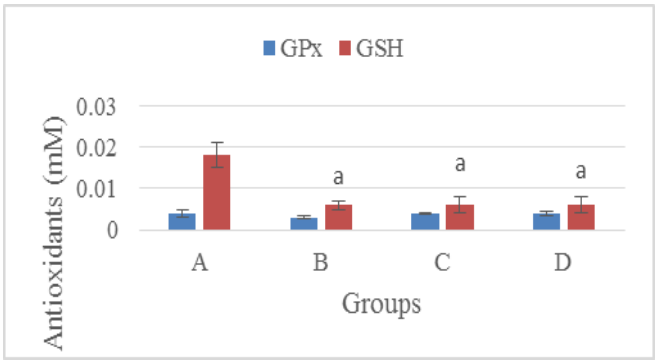

Fig. 4a: **Antioxidants (mM)**. Glutathione peroxidase (GPx) and reduced form of glutathione (GSH). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. a = $P < 0.05$ vs group A, n = 6.

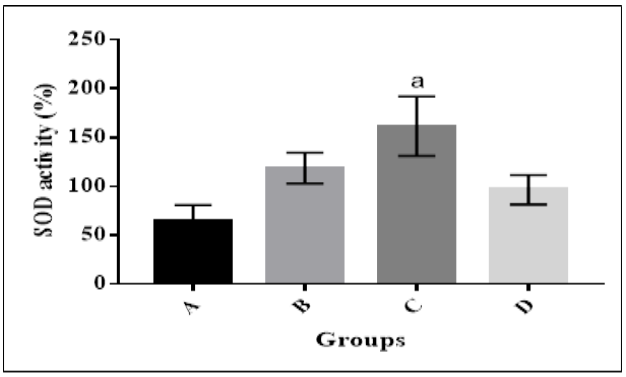

Fig. 4b: **Superoxide dismutase (SOD) concentration (%)**. Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. a = $P < 0.05$ vs group A, n = 6.

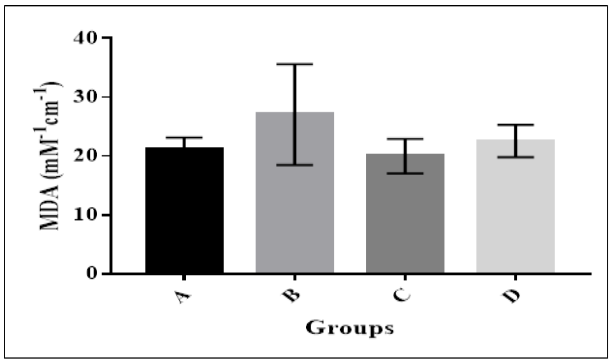

Fig. 4c: **Malondialdehyde (MDA) concentration ($mM^{-1}cm^{-1}$)**. Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered

with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. No significant difference among the groups. n = 6.

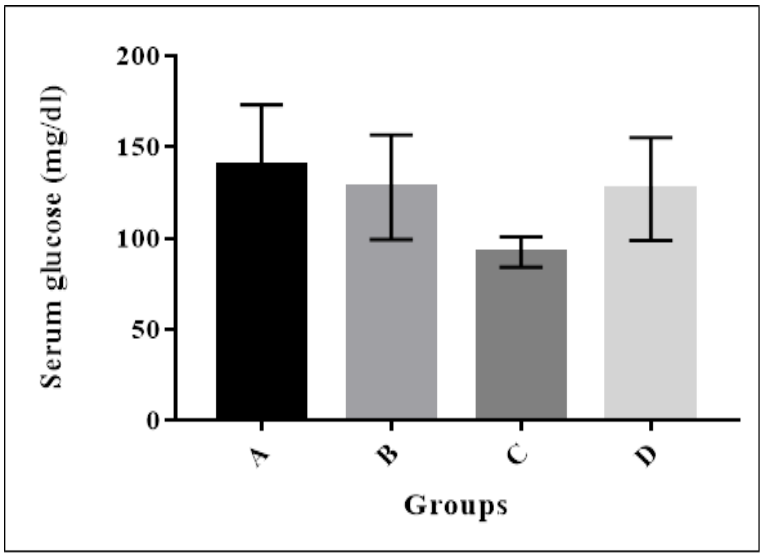

Fig. 5: **Serum glucose concentration (mg/dl)**. Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. No significant difference among the groups. n = 6.

Haematological indices

I. Data obtained revealed that the red blood cell (RBC) count (10^6/uL) of the various test and control groups were not significantly different from one another. However, it is However, in comparison amongst groups, groups C and D showed the highest and least RBC counts respectively at non-significant levels had the highest and least RBC count ($P > 0.05$). The same trend was observed in the case of haemoglobin (HGB) level (g/dl) and haematocrit (HCT%) as shown in Figure 6a.

II Figure 6b indicates that in terms of mean corpuscular volume (MCV, fL), mean corpuscular haemoglobin concentration (MCHC, g/dl) and red blood cell distribution width – standard deviation (RDW-SD, fL); no significant difference was observed between the control and experimental groups i.e. Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract ($P > 0.05$).

III The mean corpuscular haemoglobin (MCH, pg); red blood cell distribution width – coefficient of variation (RDW – CV, %) and the granulocytes (GRA, %) of the groups did not significantly differ from one another (Figure 6c). Furthermore, the platelet distribution width (PDW, fL) of group C (i.e. rats administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract) was generally the highest ($P < 0.05$) among the groups. In contrast, however, the platelet (PLT, 10^3/uL) count of rats in group C was generally the lowest albeit statistically insignificant ($P < 0.05$) among the groups (Figure 6d).

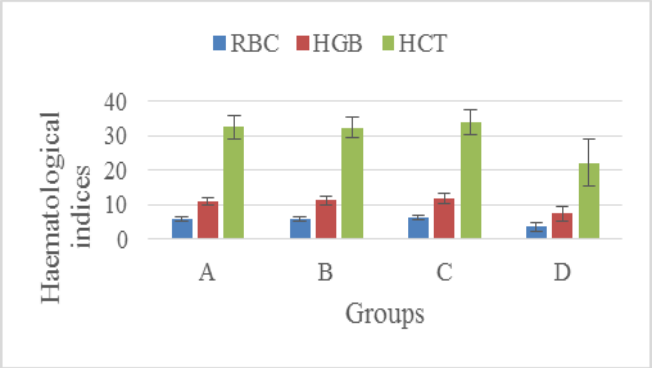

Fig. 6a: **Haematological indices**. Red blood cell (RBC, 10^6/uL), haemoglobin (HGB, g/dl) and haematocrit (HCT, %) Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. No significant difference among the groups. n = 6.

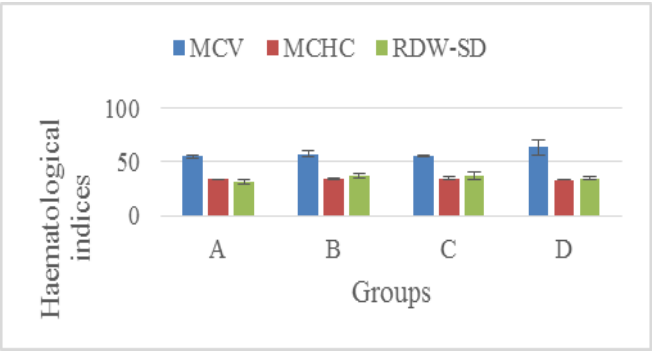

Fig. 6b: **Haematological indices**. Mean corpuscular volume (MCV, fL), mean corpuscular haemoglobin concentration (MCHC, g/dl) and red blood cell distribution width – standard deviation (RDW-SD, fL). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. No significant difference among the groups. n = 6.

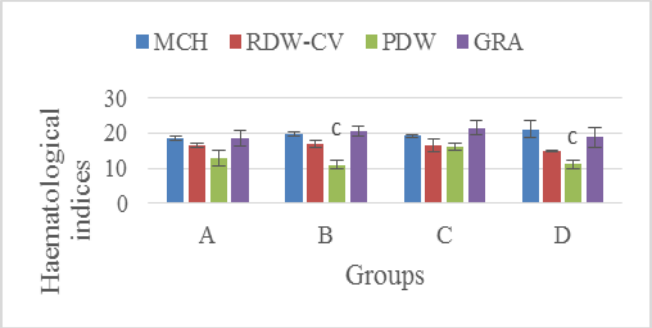

Fig. 6c: **Haematological indices**. Mean corpuscular haemoglobin (MCH, pg); red blood cell distribution width – coefficient of variation (RDW – CV, %) and the granulocytes (GRA, %). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. No significant difference among the groups. n = 6.

Moreover, the overall Data revealed that the white blood cell (WBC, 10^3/uL) and lymphocyte (LYM, 10^3/uL) counts of rats in group D (i.e. rats fed with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract) increased considerably ($P < 0.05$) than in the control and other test groups. The mean platelet volume (MPV) data did not follow the pattern for rats administered with chow + 7ml of garlic oil in comparison to the rest of the groups as depicted in Figure 6e. In addition, the levels of monocytes (MON, %) and procalcitonin (PCT, %) of both the control and experimental rats were more or less within a close range ($P > 0.05$) as shown in Figure 6f.

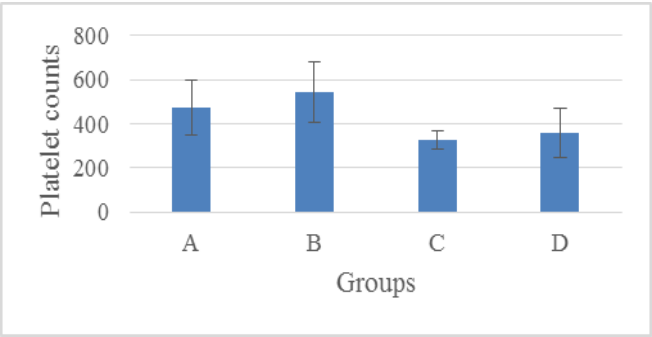

Fig. 6d: Haematological indices. Platelet (PLT) count (10^3/uL). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. No significant difference among the groups. n = 6.

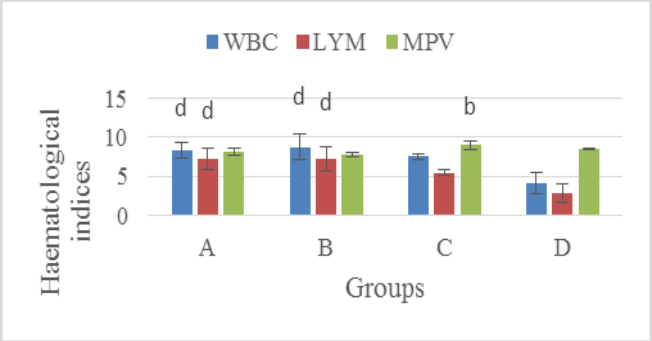

Fig. 6e: Haematological indices. White blood cell count (WBC, 10^3/uL); lymphocytes (LYM, 10^3/uL) and mean platelet volume (MPV, fL). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. b = P < 0.05 vs group B; d = P < 0.05 vs group D. n = 6.

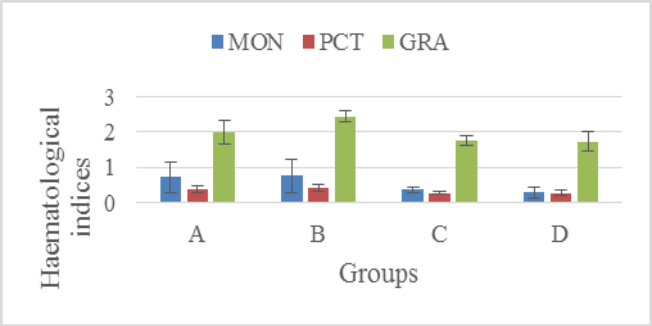

Fig. 6f: Haematological indices. Monocytes (MON, %); procalcitonin (PCT, %) and granulocytes (GRA 10^3/uL). Groups A: administered with rat chow only, B: administered with rat chow + 7ml of garlic oil; C: administered with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendeloti* seed extract; D: administered with rat chow + 7ml of *Ricinodemdrom hendeloti* seed extract. No significant difference among the groups. n = 6.

DISCUSSION

This study investigated nutrient profile and dietary supplementation of *Ricinodendron heudelotii* seed on some biochemical indices in Wistar rats. The hepatic function test result as revealed in this study showed variations in the concentrations of the hepatic function biomarkers: serum ALT, AST and ALP levels. Administration with *R. hendeloti* seed extract elevated the ALT serum level. Elevation of serum enzyme is an indication of possible damage to the liver. The rise in the enzymes' activities depicts liver injury due to increased membrane permeability and porous cell membrane, resulting to leakage of the intracellular

enzymes into the circulating blood. These enzymes leak into the blood depending on the extent of tissue damages and this is in line with previous reports.[18] However, the reversal of increased serum level of ALT as observed when the plant was combined with garlic oil and the decreasing ALP maybe due to the prevention of leakage of intracellular enzymes by its protective effects due to presence of antioxidants cum phytochemicals activity. This finding is in agreement with the commonly accepted view that serum levels of transaminases return to normal with healing of hepatic parenchyma and the regeneration of hepatocytes.[19] Based on the results obtained, it can be inferred that the seed extract of *Ricinodendron heudelotii* has some protective effect on the liver as seen by the reduction in the level of the hepatic enzymes, which also supports that the plant may have some protective effect on the liver evident by reduction in serum liver enzymes. More so, the plant *R. heudelotii* seed extract contains tannins, saponins, flavonoids, alkaloids, terpenoids, steroids, and quinine. Flavonoids and tannins have been shown to have antioxidative activity and hepatoprotective and free radical scavenging capacity.[20]

Most striking and interesting from the present study is the fact that despite these disparities in effect when combined the extract complimented the garlic oil to exert an overall hepatoprotective effect. Results from this study showed no significant difference ($P>0.05$) in the concentrations of serum total protein, albumin and globulin among the experimental groups, thus strongly indicating that the seed extract of *Ricinodendron heudelotii* may have hepatoprotective activities, which may be mediated by antioxidant activity in rats in vivo, therefore confirming earlier studies by Stefania.[21]

Dyslipidemia is characterized by hypertriglyceridemia, increased plasma total (TC) cholesterol, very low-density lipoprotein cholesterol (VLDL-c) and low-density lipoproteins cholesterol (LDL-c) and decrease in high-density lipoproteins cholesterol (HDL-c).[22,23] This usually is a consequence of increase in fat synthesis and mobilization by the lipids contained in the seeds of many medicinal plants. In the present study, there was observed dyslipidemia in group B and C as compared to the normal control. This is similar to earlier work of Enyievi[15] on other plants. There was, however, a decrease in the group treated with *Ricinodendron heudelotii*. This may represent a balance of factors that affect LDL-c production and catabolism.[24] Considering that *R. heudelotii* seed extract could not reversed the elevated TC, LDL-c and VLDL-c levels, the extract might not be appropriate for modulation of the induced hyperlipidemia (lipid metabolizing disorders) and thus, continuous

consumption may progressively lead to cardiovascular disease and even stroke. It is therefore recommended that the plant should not be administered alone in this regard, rather a combine therapy as in the case in this study is suggestive. The observed null effect of the extract that depressed HDL-c as well as the significantly decreased phospholipids content in *R. heudelotii* treatment group as compared to other experimental groups warrants further study.

Comparatively, findings from this study are indicative that the activities of glutathione peroxidase (GPx) enzyme among the groups did not differ significantly. On the contrary, the level of reduced form of glutathione (GSH) in group A (which were fed with rat chow only) increased quite significantly relative to the other groups. The highest activity of superoxide dismutase (SOD) was clearly evident in group C (fed with rat chow + 7ml of garlic oil + 7ml of *Ricinodemdrom hendelotii* seed extract) than any other group. There was no significant difference among the groups was observed in the case of malondialdehyde (MDA) concentration.

Superoxide dismutase and GPx are 2 important enzymes of the antioxidant defense system, which participates in regulating lipid peroxidation. A decrease in the activities or expression of these enzymes may predispose tissues to free radical damage. Dietary lipid composition influences the level of this enzymes.[25] Results from this study shows that rats in the combines therapy groups (i.e Group C) have the most important activity of SOD. On the other hand, glutathione peroxidase is very important in the elimination of hydrogen peroxide in cells. The reduced glutathione concentration was observed to have same trend as that of GPx in the treatment group as compared with the control. A study[26] reported that Glutathione is capable of preventing damage to important cellular components caused by reactive oxygen species such as free radicals, peroxides, lipid peroxides, and heavy metals.

In this study, the combine treatment group and that of the extract only shows a decrease in serum glucose. Although, this decrease was not statistically significant, however, the effectiveness of the extract to reduce the blood glucose level of the experimental animals could be attributed to the extracts ability to stimulate the pancreatic beta cells to release insulin due to the presence of the phytochemical constituent of the seed.[27] This mechanism corresponds to the function of the oral hypoglycemic agents such as metformin, sulphonylureas, hence suggesting the potency of *Ricinodendron heudelotii* as a therapy for hyperglycemia.

Hematological parameters are useful markers used to ascertain the adverse effect of plant extracts or even drugs on blood constituents.[28] In this study, red blood cell (RBC) count (10^6/uL) of the various test and control groups were not statistically significantly different from one another. However, The extracts of *R. heudolotii* reflected a surprising trend. Following the administration in the combines therapy group, there was a slight increase in HCT as compared to the control group, and this is in consonance with the assumption that hematocrit measure the amount of red blood cell count, thus translating to the fact that the plant may be effective in cushioning the effect occasion by anaemia. However, the administration of the extract led to a significant decrease in WBC values as compared to that of the controls. This may be due to complex chemical reactions which may lead to lymphopenia. In this study, we observed mild changes within normal ranges for all doses of the experimental groups. The results showed no deleterious effects on blood cell counts and hemoglobin concentration, thereby suggesting that the extract had no toxic effect on the blood. These findings were consistent with those reported by other studies, indicating the lack of significant consequences by the various plant extracts on the hematological parameters.[29,30,31]

CONCLUSION

This work investigated nutrient profile and dietary supplementation of *R. heudelotii* seed on some biochemical indices in Wistar rats. Based on the results, we can conclude that the activities of the extract which was capable of reversing some parameters relative to hepatic function as well as some stabilizing activity, evident in the seed of *R. heudelotii* has some hepatoprotective effect and also exhibit antioxidative activities. Considering that *R. heudelotii* seed extract could not reversed the elevated TC, LDL-c and VLDL-c levels, the extract might not be appropriate for modulation of the induced hyperlipidemia (lipid metabolizing disorders) and thus, continuous consumption may progressively lead to cardiovascular disease and even stroke. Though the decrease in blood serum glucose was insignificant, the effectiveness of the extract to reduce the blood glucose level of the experimental animals suggest the potency of *R. heudelotii* as a therapy for hyperglycemia. This study also conclude that the extract possesses anti anaemic activities and also concluded that the *R. heudelotii* had no deleterious toxic effect on the blood. The study also concluded that in some instance, a combine's therapy of R. heudelotii is suggestive.

Significance Statement

This study validated the ethnopharmacological use of *R. heudelotii* seed extract as dietary supplent. It provides a basis for elucidating the active principles responsible for some biochemical parameters.

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