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Effects of Four *Solanum melongena* L. Varieties on some Haematological Indices and Weight of Organs in Albino Rats

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Abstract: *The effects of four eggplant varieties on haematological indices and weight of organs in albino rats were evaluated. A total of 108 albino rats were randomly distributed into two major blocks of treatments (10% and 20% supplenentations), each having four sub groups with 12 rats each. The sub groups were based on the eggplant variety used in supplementation. Rats in groups A, B, C and D were fed diet supplemented S. Macrocapron (round), S. atheopicum, S. Macrocapron (oval), and S. gilo respectively. A general control group labelled 'control' was fed with commercial rat feed. Three rats from each group were sacrificed weekly and their kidney, liver and heart weighed. The haematological indices were determined using an automated haemacytometer machine. The liver, kidney and heart weight to body weight were not significantly different (p>0.05) from the control within and between treatments. The white blood cell count of rats placed on 10% eggplant supplemented diet ranged from 4.51±0.20 x10^3/µL to 5.43±0.10 x10^{3}ml/µL while rats supplemented with 20% eggplant were within 4.74±0.13 x10^3/µL and 5.56±0.10 x10^3/µL. There was a significant increase in the white blood cell count of rats placed on the eggplant supplementations except group C (S. macrocarpon (oval)).The red blood cell count was significantly lower in all the groups compared to the control except in rats placed on 10% S. Marcrocapon (round) supplemented diet. The result has shown that eggplant varieties significantly reduced RBC, increased the WBC count was increased with no significant change in PCV.*

Key Words: *Packed cell volume, red blood cell, white blood cell, Eggplant.*

I. Introduction

Haematological parameters are linked with health status and are important in the clinical evaluation of the state of health (Saliu, Elekofehinti, Komolafe and Oboh, 2012). It is known that some acute and chronic diseases adversely affect blood cells; this therefore makes the analysis of blood parameters very relevant in estimating alterations in human haematological system (Olson *et al.,* 2000). Fruit and vegetable consumption have been shown by wide epidemiological studies to reduce the risk diseases such as cancer, heart disease and stroke (Block *et al.,* 1992) among others. A diet rich in fruits and vegetables has recently been found to positively affect serum antioxidant capacity and protect against lipid peroxidation. Free radicals may cause disruption of membrane fluidity, protein denaturation, lipid peroxidation and alteration of platelet functions, which may be associated with many chronic health problems. Fruits are very important for health optimisation (Ibrahim, 2011) as such inadequate intake may increases the risk of illness and several haematological disorders from contagious diseases because of lowered defence system which in turn compromise the normal body physiology (Black, 2003). Recent research has shown that a wide range of indigenous fruit trees have the potential to provide rural households with a means to meet their nutritional and medicinal needs (Ekesa *et al.,* 2009).

Among these fruits is eggplant (*Solanum melongena* L) which is a member of the night shade family. It is believed to have originated from tropical Africa (Grubben and Denton, 2004) and belongs to the subgenous *leptostemanum melongena* (Obeng-Ofori *et al.,* 2004). This fruit is famous in india and commonly referred to as brinjal (Kantharajah and Golegaonkar, 2004). In Nigeria, the Hausa's call it Gauta/yalo; Igbo: afufa or añara, Nupe: yengi and Yoruba: igbagba (Ossamulu *et al.,* 2014). The Gilo, Kumba, Shum and Aculeatum are four cultivar groups recognized within solanum species of which the first three are most important in Africa (Horna and Gruere, 2006). *Solanum melongena* possess various nutritional and medicinal values that make them valuable addition to diets. This is basically because they have appreciable reserve of nutrients and loads of phytochemical compounds. They are rich in many mineral elements such as calcium, phosphorus, iron, sodium and potassium. Eggplants also contain phenol antioxidants (flavonoids, monophenols and polyphenols) which are partly responsible for their beneficial effects on heart disease, cancer (Vinson *et al.,* 2005; Stover *et al.,* 2007) amongst other ailments.

Solanum melongena fruit is helpful in preventing and treatment of several diseased conditions as it is effective in the reduction of blood cholesterol levels (Ossamulu *et al.,* 2014b), in regulating high blood pressure, in weight reduction and it possess anti-glaucoma effects. In traditional Chinese medicine, all parts of the plant can be used to stop intestinal bleeding. The fruit is used as an antidote in cases of mushroom poisoning. In malay medicine, the ashes are used in dry, hot poultice to treat haemorrhoids. Other medicinal applications include the use of the roots and fruits as carminative and sedatives, and to treat coelic problems (Ibiam and Nwigwe, 2013). The leaf juice is used to treat uterine complaints, and alcoholic extract of leaves as a sedative, anti-emetic and to treat tetanus after abortion (Doganlar, Frary, Daunay, Lester and Tanksley, 2002).

II. Materials and Methods

Plant Material

The different Eggplants cultivars used were obtained from a farmland in kudenda Kaduna, Nigeria. The samples were transported to the laboratory and were identified by a taxonomist in the department of Biological Science, Federal University of Technology Minna Niger State, Nigeria. The samples were dried at room temperature, pulverised and stored in containers for further use.

Experimental Animals

Young adult albino rats weighing between 110g - 130g were used for this study. The rats were obtained from a private farm (Ijeoma Rodent Farms) in Zaria, Kaduna state, Nigeria and transported to the research site (Biochemistry department, Federal University of Technology Minna Niger State, Nigeria).

Management of Experimental Animals

The animals were allowed to acclimatize for 2 weeks under standard laboratory conditions. They were maintained on standard rat feed and potable water ad libitum. They were handled in strict compliance with international guidelines as prescribed by the Canadian Council on the Care and Use of Laboratory Animals in Biomedical Research (1984).

Feed Preparation

The four eggplant samples (*S. Macrocapron* (round), *S. Atheopicum*, *S. Macrocapron* (oval), and *S. gilo*,) were separately supplemented into standard commercial feed at two different concentrations. The first had 10g of the eggplant sample(s) mixed with 90g of standard feed while the second was prepared by thoroughly mixing 20g of the eggplant sample(s) with 80g of commercial feed and made into pellets.

Experimental Design

A total of 108 adult Swiss albino rats were used for this study which lasted for 4 weeks (0ne month). They were randomly distributed into two major blocks of treatments (10% and 20% eggplant supplementation) with each having four sub groups (Groups A-D) based on the eggplant cultivar. Each sub group had a total of 12 rats. Rats in group A were fed with diet supplemented with '*S. Macrocapron* (round),' eggplant. Similarly, rats in groups B, C and D were fed with diets supplemented with *S. atheopicum, S. Macrocapron* (oval), and *S. gilo* respectively. A general control group labelled 'control' was fed with normal commercial chow. The rats were allowed food and water freely throughout the experimental period. The rats were allowed four days adaptation period with the various supplemented diets before the commencement of the analysis. During the study, the weight gain by each rat was recorded at the end of every week. Consequently, three rats from each group were fasted for about 12 hours and sacrificed under chloroform anaesthesia. Their blood samples and organs (Liver, kidney and heart) were collected for further analysis.

Blood Sample Collection

While under chloroform anaesthesia, blood was collected from each rat via heart puncture and transferred into EDTA bottle. The collected blood samples were used for determination of Packed Cell Volume (PCV), Red Blood Cell (RBC) count and white blood cell (WBC).

Determination of Red blood cell and White Blood Cell counts

The rat blood collected in an anticoagulant bottle was used in the determination of red blood cell and white blood cell counts using the haemocytometer machine (XFA 6000 Inteligent Auto Hematology Analyzer).

Determination of Packed Cell Volume (PCV)

The blood sample collected was introduced into the capillary tubes using the syringe. The tubes were then sealed by blue flames from spirit lamp. The sealed capillary tubes were then spun in microhaematocrit centrifuged for 30 minutes at 5 g. The respective PCVs were then read from Microhaematocrit reader (Zuckerman, 2007).

Body Weight Changes and Weight of some Visceral Organs

The body weights and weight of the organs were obtained using a weighing balance and mean was calculated consequently, the organs to body weight ratio was calculated.

Statistical Analysis

The results were evaluated using analysis of variance (ANOVA) and were presented as the mean value ± SEM (standard error of mean) for the control and experimental rats. Differences among the means for the groups were assessed using the Duncan's Multiple Range Test to determine which mean values were significantly different at $p<0.05$ (Sokal and Rohlf, 1969).

III. Results

The mean organ-body weight ratio at the end of the experimental period is shown in Table 1. Rats placed on diets supplemented with 10% *Solanum macrocarpon* (round) had the highest kidney organ weight ratio ($8.31\pm0.17 \times10^3$) while 10% *S. gilo* supplemented diets had the lowest value ($7.40\pm0.30 \times10^3$) although there was no significant difference ($p>0.05$) in the kidney/body weight ratio between rats in the control group and those in the experimental groups. The heart/body weight ratio ranged from $3.82\pm0.24 \times10^{-3}$ for rats fed 20% *S. aetheopicum* supplemented diets to $4.45\pm0.37 \times10^{-3}$ for rat placed on 10% *Solanum macrocarpon* (round). There was no significant difference ($p>0.05$) in the heart/body weight ratio between the control group and the experimental groups. The liver/body weight ratio was within the range of $40.04\pm2.71\times10^{-2}$ to $46.42\pm2.37\times10^{-3}$ for rats fed with 10% *S. aetheopicum* and 10% *S.gilo* supplemented diets respectively, similarly, there was no significant difference ($p>0.05$) in the liver/body weight ratio between the experimental and control groups.

The white blood cell (WBC) count of rats placed on *S. aetheopicum* supplemented diet had the highest concentration of $5.43\pm0.10 \times10^3$ml/µL for 10% formulation and $5.56\pm0.10 \times10^3$/µL for 20% formulation. The white blood cell count of rats placed on the eggplant varieties except S. Macrocapon (oval) supplemented diet were significantly ($p<0.05$) higher than those in the control ($4.75\pm0.14 \times10^3$/µL). There was no significant difference ($p<0.05$) in the white blood cell count between the rats fed with 10% and 20% *S. melongena* varieties supplemented diets (Fig 1). Rats fed with *Solanum macrocarpon* (round) supplemented diet had the highest mean red blood cell count (For both 10% and 20% supplementations). The control group had a mean red blood cell (RBC) count of $7.89\pm0.13 \times10^9$/µL. The least red blood cell count; $6.57\pm0.13 \times10^9$/µL and $6.18\pm0.13 \times10^9$/µL for 10% and 20% supplementations respectively were in obtained in the group placed on *S. marcrocarpon* (oval) supplemented diets. The red blood cell count was significantly lower in all the groups (both 10% and 20% treatments) compared to the control group (Figure 2).

Figure 3 shows the mean packed cell volume of the rats fed different eggplant supplementation. The least mean packed cell volume in 10% treatment (40.50±0.65%) was observed in rats placed on 10% *S. gilo* supplemented diets while 42.75±1.65% was least in rat fed 20% eggplant supplemented diets. Rats fed with *S. aetheopicum* supplemented diets had the highest PCV (45.00±0.87%) for 10% treatments while those fed on diets supplemented with *S. macrocarpon* (oval) had the highest PCV (46.50±1.02%) for 20% treatments. No significant difference ($p>0.05$) in the PCV level was found among the groups and between the treatments compared to the control.

Table 1: The effect of four Eggplant varieties on the weights of some organ of the experimented rats

Group	10% treatment	20% Treatment
Kidney		
Group A	8.31±0.17 [a]	7.79±0.25 [a]
Group B	7.58±0.11 [a]	7.51±0.33 [a]
Group C	7.58±0.37 [a]	7.37±0.73 [a]
Group D	7.40±0.30 [a]	7.82±0.28 [a]
Control	7.89±0.41 [a]	7.89±0.41 [a]
Heart		
Group A	4.14±0.33 [a]	4.45±0.37 [a]
Group B	3.89±0.13 [a]	3.82±0.24 [a]
Group C	3.91±0.12 [a]	3.86±0.31 [a]
Group D	4.22±0.34 [a]	3.97±0.33 [a]
Control	4.25±0.20 [a]	4.25±0.20 [a]
Liver		
Group A	42.34±2.22 [a]	44.64±3.89 [a]
Group B	40.04±2.71 [a]	41.88±3.94 [a]
Group C	45.37±2.66 [a]	42.10±1.17 [a]
Group D	46.42±2.37 [a]	45.48±2.26 [a]
Control	45.85±4.69 [a]	45.85±4.69 [a]

Values are mean±standard error of mean (SEM) of triplicate determinations. Mean ± SEM followed by different letter on a column are significantly different ($p< 0.05$).

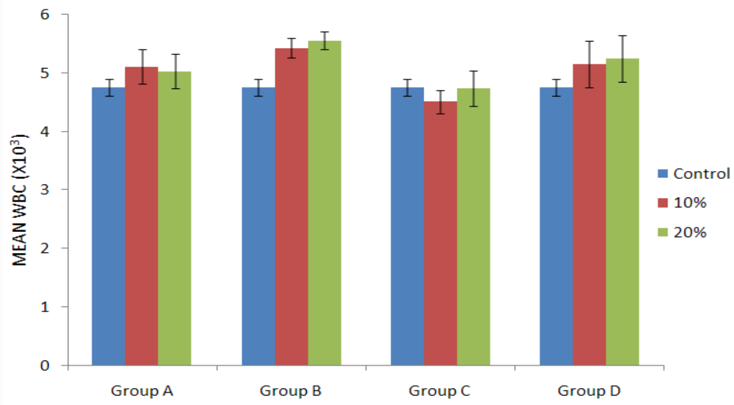

Figure 1: Mean white blood cell count (x10^3/µL) of rats fed diet supplemented with 10% and 20% of *S. melongena* varieties

Group A – Rats fed with *Solanum macrocarpon* (round) supplemented diet, **Group B** – Rats fed with *S. aetheopicum* supplemented diet**, Group C** – Rats fed with *S. macrocarpon* (oval) supplemented diet, **Group D** – Rats fed with *S. gilo* supplemented diet

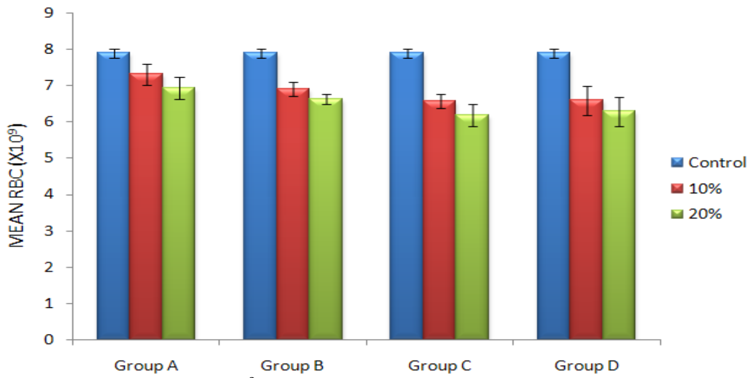

Figure 2: Mean Red blood cell count (x10^9/µL) of rats placed on diet supplemented with 10% and 20% of *S. melongena* varieties

Group A – Rats fed with *S. macrocarpon* (round) supplemented diet, **Group B** – Rats fed with *S. aetheopicum* supplemented diet**, Group C** – Rats fed with *S. macrocarpon* (oval) supplemented diet, **Group D** – Rats fed with *S. gilo* supplemented diet

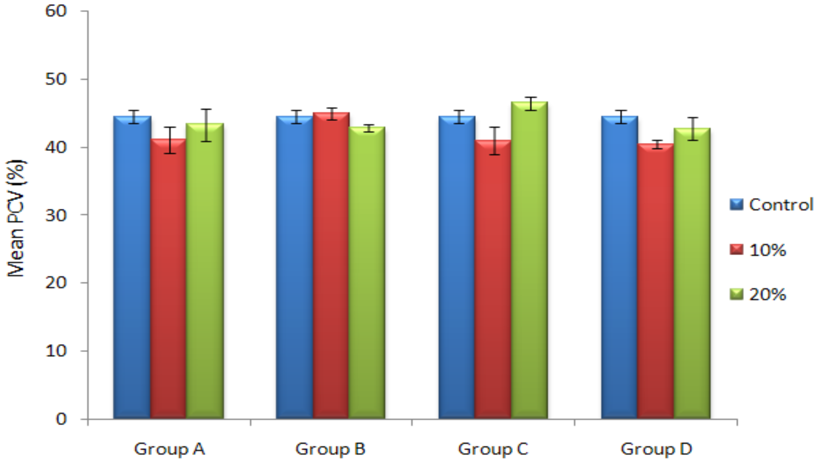

Figure 3: Mean Packed cell volume (%) of rats placed on diets supplemented with 10% and 20% of the *S. melongena* varieties

Group A – Rats fed with Solanum macrocarpon (round) supplemented diet, **Group B** – Rats fed with *S. aetheopicum* supplemented diet**, Group C** – Rats fed with *S. macrocarpon* (oval) supplemented diet, **Group D** – Rats fed with *S. gilo* supplemented diet

IV. Discussion

Organ-body weight ratio has been described by Yakubu *et al.,* 2007 as a marker of cell constriction and inflammation. The non significant ($p>0.05$) change in the liver, kidney and heart weight to body weight ratio compared to the control group shows that the various eggplant varieties had no effect on the organs. Eggplant fruits have been reported to contain high amounts of alkaloids (Ossamulu *et al.,* 2014). Although this was not in agreement with the work of Friedman *et al.,* (1995) who reported that consumption of solasodine a glycolalkaloid could induce significant liver enlargement. Many diseases can also affect the size of organs, ranging from infective conditions, inflammations to cancerous or malignant disorders (Joshi *et al.,* 2004). Previous reports on different eggplant varieties have shown that they have considerable high reserves of flavonoids and phenols which possess anti-inflammatory and anticancer properties (Gul *et al.,* 2010; Madiha *et al.,* 2011) thereby curbing any organ inflammation or enlargement.

The significant ($p<0.05$) decrease observed in red blood cell agrees with the work of Alhasssan *et al.,* (2012) who reported a significant decrease in the red blood cell count of rats administered 400mg/kgbw of *S. melongena* extract. Saponins which is an abundant bioactive compound in eggplant as previously reported in the study of Ossamulu *et al.,* (2014) may cause heamolysis of red blood cells (Kar, 2007). Eggplants have been reported to contain high amount of dietary fiber which have the ability to bind cations (López and Martos 2004) such as iron. This may interfere with iron absorption therefore debilitate its bioavailability (Reinhold *et al.,* 1981) as such causing a decrease in red blood cells.

White blood cells (leucocytes) are important component of the immune (host defence) system that are involved in protecting the body against infectious diseases caused by bacteria, fungi, viruses and invading parasites (Stock and Hoffman, 2000).The significant increase in white blood cell count as seen in this study agrees with the work of Alhassan, Mabrouk, Okpe, Salawu and Omotoso, (2012) that investigated the effects of Solanum melongena on blood system of Albino rats and reported an increase in the white blood cell count. Saba, Olayinka and Ofuegbe, (2009) and Lowenthal, Connick, McWater and York, (1994) similarly reported that eggplant may be involved in cellular immunity. Changes in white blood cell count may be due to response to various stimuli which may include variations in hormonal levels, stress, shock, infection, drug, allergic reactions and inflammations. Eggplants have been reported to contain alkaloids (Ossamulu *et al.,* 2014), phytosterol and certain pigment that have been suggested to cause occasional allergies (Patnaik, 1993). As allergic reactions ensue, white blood cells may be mobilized as a result increases their concentration.

The insignificant change ($p>0.05$) in the PCV level observed among the groups and between the treatments may indicates that the *S. melongena* varieties had no effect on the volume of total cells to plasma volume. The significant increase in white blood cell may have compensated for the significant decrease in red blood cell resulting in little or no change in packed cell volume (PCV) levels.

V. Conclusion

This study has shown that the eggplant cultivars had no effect on the kidney, liver and heart weight of the experimental rats. The eggplant varieties except *S. macrocarpon* (oval) caused a significant increase in the white blood cell count of rats placed on it. A significant decrease in red blood cell count was also observed in all the experimental groups although there was no significant change in the packed cell volume.

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