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Research Article

HEMATOLOGICAL PROPERTIES OF *IRVINGIA GABONENSIS* IN MALE ADULT RATS

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ABSTRACT
Irvingia gabonensis has medicinal properties and lowers blood sugar levels often associated with diabetes mellitus when incorporated in the diet. The present study examined hematologic potentials of *I. gabonensis* Baill. exLanen. (Irvingiaceae) stem bark extract in cadmium-induced male rats. Twenty male rats (100-190 g) were divided into four groups of five rats each group. Group A were control rats, group B received cadmium only, group C received cadmium and 200 mg/kg dosage of extract and group D received cadmium and 400 mg/kg dosage of extract.Increasing doses (200 and 400 mg/kg body weight) of *I. gabonensis* ethanol stem bark extract were administered by oral gavage to the other two treatment group C and D.The animals were sacrificed using diethyl ether, and their blood sample collected into ethylenediaminetetra acid (EDTA) bottles, for assessing hemoglobin (Hb), red blood cell (RBC), packed cell volume (PCV), white blood cell (WBC) count and WBC differentials, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). The results shows reduction ($p > 0.05$) in the hemoglobin level (11.1 ± 0.05 g/dl)and WBC count (1.2 ± 0.01) (X 10^3 mm^3) of cadmium untreated group and reversing all abnormalities in the hematological parameters determined when comparing with the extract treated groups, most especially at 400 mg/kg (16.2 ± 0.37 g/dl) and (4.36 ± 0.12) (X 10^3 mm^3). In conclusion, *I. gabonensis* has a protective effect on blood profile against the cadmium toxicity.
Keywords: Hematology, stem bark, cadmium

INTRODUCTION

Irvingia gabonensis Baill. exLanen. (Irvingiaceae) is a commercial and indigenous fruit tree of West and Central Africa and identified as the most important tree for domestication[1,2]. The plant occurs freely in many parts of Africa, is extensively used tropical African tree, identified as a high priority species and a Non Timber Forest Product. Erythrocytes (red blood cells) are a nucleate packed with the oxygen carrying protein-hemoglobin. Human erythrocytes survive in the circulation for about 120 days, worn out erythrocytes are removed from the circulation by macrophages of the spleen and bone marrow. This signal for removal of defective complex oligosaccharides attached to integral membrane protein of the plasmalemma[3]. Cadmium (Cd) is a toxic metal that is present throughout the environment and in humans and animals piles upmainly in liver and kidneys[4]. It is a proved toxic and carcinogenic heavy metal pollutant. It is in various chemical forms in the metallurgical and other industrial produce pigments, batteries and reagents[5]. Environmental exposure to Cd can occur through the diet and drinking water or by Cd fume inhalation[6]. Because of the widespread use of *Irvingia gabonensis*, it is necessary to study its effect on blood, the tissue that transports substances in the body[3]. To further carry out scientific scrutiny on this plant, this study examined the hematological responses of the stem bark extract of *I. gabonensis* in rats since blood are associated with the development of several diseases.

MATERIALS AND METHODS

Plant Material

Fresh stem bark of *Irvingia gabonensis* collected on the 16th January, 2014 from a local garden at Ekiti State, Nigeria. The plant was identified and authenticated by Mr. Omotayo in the Department of Plant Science, Ekiti State University, Ado-Ekiti, Nigeria. A voucher specimen number was deposited at the herbarium of the Department of Plant Science, Ekiti State University, Ado-Ekiti, Nigeria with a voucher no U.H.A.E. 60.

Preparations of *Irvingia gabonensis* stem bark extract

Fresh stem bark of *Irvingia gabonensis* was cut into smaller pieces and air-dried at room temperature. The air-dried stem bark (500 g) was milled into fine powder using a commercial blender. The powdered stem bark extracted with (1 L) of 70 % ethanol for 12 h by maceration following traditional method. The ethanolic extracts were concentrated to dryness under reduced pressure at 50 ± 1°C in a rotator evaporator. The resulting crude dark-brown powdered residual extract gave a percentage yield of 5.01 %.

Animals

A total number of 20 in bred albino male rats weighing between 100-190 g used in this study. The animals bought from the animal house of the Department of Chemical Sciences, Afe Babalola University, Ado-Ekiti, Nigeria. The animals divided into cages and allowed to acclimatize for 7 days in a well aired room at a room temperature of 20 ± 2°C under natural lighting condition. The animals allowed free access to standard rat chow (Top feeds Ltd., Ado-Ekiti, Nigeria) and distilled water *ad libitum*. The ethical committee of the Afe Babalola University approved this study. All animals in this study follow the international, national and institutional guidelines for Care and Use of Laboratory Animals as published by the[7].

Induction of Experimental Animal

Cadmium induced in groups B, C and D. Briefly, cadmium dissolved in distilled water and after that managed by intravenous injection (through tail vein) at a dose of 200 mg/kg body weight.

Experimental Design

Twenty rats with fifteen cadmium-induced rats and five normal rats, divided into four groups with five rats each.

Group A: Control rats
Group B: Cadmium rats
Group C: Cadmium rats 200 mg/kg body weight of *Irvingia gabonensis* stem bark extract
Group D: Cadmium rats 400 mg/kg body weight of *Irvingia gabonensis* stem bark extract

Blood sample collection
Whole blood was collected by cardiac puncture from each experimental rat into a tube containing Ethylenediaminetetra acid (EDTA) and centrifuged for 15 minutes at 3000 rpm.

Hematological parameters determination
The parameters such as packed cell volume (PCV), hemoglobin (Hb), white blood cell (WBC), red blood cell (RBC), neutrophil, lymphocytes, eosinophils, monocytes, mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular volume (MCV) analyzed using an automated analyzer (Sysmex K-2 IN, Japan).

Statistical analysis
All the data analyzed by statically using Student's t-test and one-way ANOVA. Values of $p < 0.05$ are significant.

RESULT
Table 1 shows significant decrease in hemoglobin (Hb), packed cell volume (PCV), mean corpuscular hemoglobin concentration (MCHC), mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), red blood cell (RBC) in cadmium-induced untreated group when compared to the control, 200 and 400 mg/kg treated groups.

Table 1: Effects of *Irvingia gabonensis* stem extract on hematological parameters in Cadmium-induced toxicity rats

Groups	Hb (g/dl)	PCV (%)	MCHC (X 10^2 g/l)	MCH (pg)	MCV (fl)	RBC (X 10^{12}/L)
Control	15.6 ± 0.68^a	37.8 ± 1.07^a	3.12 ± 0.05^a	29.60 ± 0.68^b	78.60 ± 2.16^{ab}	5.34 ± 0.24^b
Cadmium untreated	11.1 ± 0.05^b	30.23 ± 0.40^c	1.21 ± 0.02^c	20.14 ± 0.23^c	48.45 ± 0.02^c	2.50 ± 0.02^c
200mg/kg treated	14.60 ± 0.51^a	32.6 ± 1.12^a	3.32 ± 0.29^a	28.00 ± 0.44^a	80.00 ± 0.71^b	4.16 ± 0.05^a
400mg/kg treated	16.2 ± 0.37^a	33.20 ± 0.37^a	3.18 ± 0.03^b	30.20 ± 0.37^b	75.40 ± 0.51^a	5.28 ± 0.10^b

g/dl = gram per deciliter, MCH = mean corpuscular hemoglobin, pg = Picogram, MCV = mean corpuscular volume, fm =femtoliter
Values are expressed as mean of five replicates ± SEM. Values with different superscripts along the row are significantly different ($p < 0.05$)

Table 2 also shows significant decrease in the of the white blood cells and the differential count (WBC), neutrophils (N), lymphocyte (L) and monocytes (M) in cadmium-induced untreated group when compared to the control 200 and 400 mg/kg treated groups.

Table 2: Effects of *Irvingia gabonensis* stem extract on White blood cell indices in Cadmium-induced toxicity rats

Groups	WBC (X $10^3 mm^2$)	Neu (%)	Lym (%)	Eos (%)	Mon (%)
Control	4.16 ± 0.12^b	49.40 ± 0.75^a	41.80 ± 0.80^b	2.80 ± 0.37^a	6.00 ± 0.63^a
Cadmium untreated	1.2 ± 0.01^c	31.02 ± 0.03^c	32.10 ± 0.01^c	0.2 ± 0.31^b	3.2 ± 0.31^b
200mg/kg treated	3.90 ± 0.25^b	45.80 ± 1.91^a	45.20 ± 2.15^b	2.4 ± 0.51^a	6.6 ± 0.68^a
400mg/kg treated	4.36 ± 0.12^a	47.00 ± 0.71^a	45.80 ± 1.11^a	2.0 ± 0.32^a	5.6 ± 0.81^a

WBC = white blood cells, Neu = neutrophils, Lym = lymphocytes, Eos = eosinophils, Mon = monocytes
Values are expressed as mean of five replicates ± SEM. Values with different superscripts along the row are significantly different ($p < 0.05$)

DISCUSSION
The present decade has witnessed a great and intense resurgence in the interest and use of medicinal plant and medicinal plant products, especially in Africa and North America. The useful effects of these plant materials attributed to the combinations of secondary metabolites present in the plant[8]. The healing powers of herbs recognized the botanical medicine has one of the oldest practiced professions by humanity[9]. Apart from the lack of information about the adverse or toxicity of this plant extract and despite its widespread use in folk medicinal or traditional practice, there is lack of information underlying its biochemical mechanism responsible for some of the observable and reported properties of this plant. The results of the present study suggest that *Irvingia gabonensis* stem bark extract caused a significant decrease in hemoglobin level of the rats. However, hematological parameters provide information about the status of bone marrow[10]. Further, the present study shows that hematological parameters in cadmium control (untreated group) showed abnormalities. This might be because of excess glucose with the hemoglobin results in glycosylated hemoglobin with decrease in red blood cell (RBC). This suggests an imbalance between its synthesis and destruction and packed cell volume (PCV) are affected by cadmium-induced toxicity, a sign of anemia[11,12]. Lowered RBC count, decreased MCH and MCV are other hematological changes found in the group where administrated cadmium[11,13]. Anemia is an important expression of cadmium toxicity. Cd induced toxicity credited to damage in the synthesis of erythropoietin, a hormone whose role is to promote formation of the red blood cells[14]. Friberg[15] had noted that anemia in humans is because of environmental exposure to Cd. The liver, spleen and bone marrow are the major hematopoietic organs which serve as targets of Cd exposure[16]. The present study has, however explained that Cd induced toxicity ameliorated following managing stem bark extract of *Irvingia gabonensis*. In addition, decrease in the MCV, MCHC and MCH individual red blood cells while decrease in WBC and its indices (lymphocytes, neutrophil, monocytes) in cadmium untreated group might suggest decrease in immune in fighting foreign substances. Excellent performance of the ethanolic extract (especially at 400 mg/kg) in reversing all this irregularities in the hematological parameters may be due ascribes to the presence of iron in the plant extract as reported by[17], an essential part of many enzymes in cells and parts of heme group in hemoglobin. Most iron in the body stored within the red blood cells where iron is critical for hemoglobin synthesis[10]. The presence of other antioxidant vitamins (vitamin B, and C) and mineral (Zn, Ca, Fe, K, P, Cu, etc.),

total flavonoids and total phenol[17] might be responsible in improving the immune being weak because of the generation of reactive oxygen species because of cadmium-induction and shows the ethanolic extract may not have negative effect on the bone marrow and hemoglobin metabolism.

CONCLUSION

Exposures to Cd have proved change in the hematological profile of male rats. This accounts for the toxicity of this Cadmium to hematopoietic tissues. The stem barks extract of *Irvingia gabonensis* which have antioxidant properties reversed the changes in hematological parameters and thus ameliorate the toxic effects of cadmium. In conclusion, the results of this study suggest that treatment of rat with *Irvingia gabonensis* stem bark extract had a marked protective effect against cadmium toxicity.

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