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Investigation of the Biochemical Effect of Aqueous Extract of *Dialium guineense* Stem Bark on Haematological Parameters in Rats

Abu OD[1]*, Awhin EP[2], Ohikhuare F[3] and Osamudiamen EE[4]

[1]*Department of Biochemistry, Faculty of Life Sciences, University of Benin, Nigeria*

[2]*Department of Medical Biochemistry, Faculty of Basic Medical Sciences, Delta State University, Nigeria*

[3]*Department of Chemistry and Biochemistry, College of Letters and Science, University of Wisconsin, USA*

[4]*Department of Biological Sciences, College of Science, Engineering and Technology, Minnesota State University, USA*

***Corresponding author:** Abu OD, Department of Biochemistry, Faculty of Life Sciences, University of Benin, Benin City, Nigeria

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ABSTRACT

Dialium guineense is a medicinal plant used in folklore medicine for the treatment of different diseases. The present study investigated the biochemical effect of aqueous extract of *Dialium guineense* (AEDG) stem bark on haematological parameters in rats. Ten adult male Wistar rats weighing 150 to 180 g (mean weight = 165 ± 15 g) were randomly assigned to two groups of five rats each: control and observation groups. The observation group rats received 1000 mg/kg body weight, bwt, AEDG stem bark, orally for twenty-eight days. Haematological indices of rat blood were analysed using haematological Swelab autocounter 920E+ (UK) system. The results showed that there were no significant differences in the concentrations of hematological parameters ($p > 0.05$), except that the levels of white blood cells were significantly elevated at weeks 1 and 3, and granulocytes at week 1 only ($p < 0.05$). These results indicate that aqueous extract of *D. guineense* stem bark is not toxic to rats blood. It contains compound(s) that can activate the immune system of rats.

Keywords: Blood Tissue; *Dialium Guineense;* Haematotoxicity; Haematopoietic System; Occupational Safety

Introduction

In recent years, haematotoxicity has become a major consideration in the assessment of adverse effects caused by pharmaceuticals and occupational/environmental chemical exposures [1]. The blood accounts for 7 % of the body weight of a typical adult human. Functions of the blood include oxygen delivery to tissues, maintenance of vascular integrity, and immunity. The haematopoietic tissue is specifically sensitive to drugs used for the treatment of cancer, infections, and immune-mediated disorders [2]. The tissue is also susceptible to secondary effects of substances that hinder nutrients availability (for example, iron); the clearance of toxicants; or the synthesis of growth factors [for example, erythropoietin and granulocyte colony-stimulating factor (G-CSF)]. It is almost possible to predict the consequences of direct or indirect damage to blood cells and their precursors [3,4]. They include hypoxia, hemorrhage, and infection [5]. These effects may be subclinical or acute [6]. As sources of therapeutically active compounds medicinal plants have gained wide acceptability, globally [7].

The isolation and characterization of pharmacologically important compounds from natural sources is the present focus of most researches in Ethnomedicine [8-10]. *Dialium guineense* is a medicinal plant used locally to treat diverse kinds of diseases [11,12]. A substantial tropical fruit tree of the family Leguminosae, it bears tiny, frequently grape-sized edible fruits that are coated in brown, inedible

shells. At the southernmost border of the Sahel in Africa, it grows in thick woods. The Central African Republic, Sudan, and West Africa are the original home of this plant. In Nigeria, it is referred to by a variety of names, including "Icheku (Igbo), Awin (Yoruba), Tsamiyarkurm (Hausa), and Amughen (Edo) [12]. According to reports, the plant's extracts are rich in phytochemicals [13-31]. As yet not much is known about the responses of the blood to extracts of the plant. The aim of this study was to investigate the biochemical effect of AEDG stem bark on haematological parameters in rats.

Materials and Methods

Chemicals

The chemicals and reagents used in this study were of analytical grade and they were products of Sigma-Aldrich Ltd. (USA).

Collection of Plant Material

The stem barks of *D. guineense* were collected from Auchi, Edo State, Nigeria and authenticated at the herbarium of the University of Benin, Nigeria, domiciled in the Department of Plant Biology and Biotechnology (No. UBHD330).

Plant Extract Preparation

The plant stem bark was washed and shade-dried at room temperature for 30 days and thereafter pulverized. Approximately 500 g of the ground plant material was soaked in distilled water (5 L) with intermittent stirring for 72 h. The resultant extract was filtered with a muslin cloth and freeze dried via lyophilization [32-35].

Experimental Rats

Male Wistar albino rats were bought from the Department of Anatomy, University of Benin, Nigeria. The rats were housed in metal cages under standard laboratory conditions (25 oC, 60 ± 5 % humidity and 12-h light/12-h dark cycle). They were acclimatized for fourteen days before commencement of the study, and had free access to feed and water.

Experimental Design

Ten adult male Wistar rats weighing 150 to 180 g (mean weight = 165 ± 15 g) were randomly assigned to two groups of five rats each: control and observation groups. The observation group rats received 1000 mg/kg bwt, AEDG stem bark orally for twenty-eight days.

Haematological Analysis

Haematological parameters of rat blood were analysed using haematological Swelab autocounter 920E+ (UK) system.

Statistical Analysis

Data are presented as mean ± standard error of mean (SEM, n = 5). Statistical analysis was performed using SPSS version 20. Mean differences among the groups were compared using Duncan multiple range test. Statistical significance was assumed at $p < 0.05$.

Results

Effect of Aqueous Stem Bark Extract of *D. guineense* on Rat Weight

As shown in Figure 1, percentage increases in body weight of rats treated with aqueous extract of *D. guineense* stem bark increased significantly and time-dependently ($p < 0.05$).

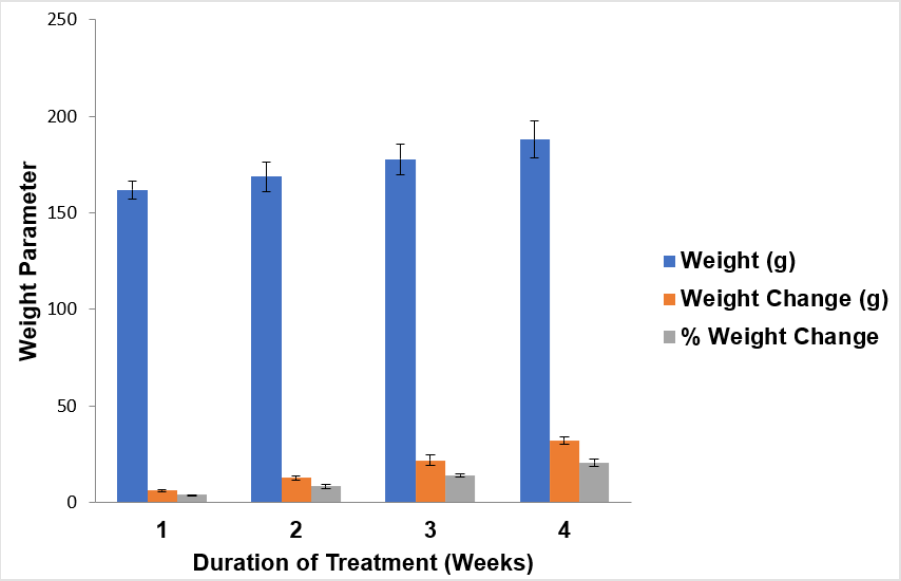

Figure 1: Body Weight of Rat.

Biochemical Effect of Aqueous Stem Bark Extract of *D. guineense* on Hematological Parameters in Normal Rats

There were no significant differences in the concentrations of hematological parameters ($p > 0.05$), except that the levels of white blood cells were significantly elevated at weeks 1 and 3, and granulocytes at week 1 only ($p < 0.05$; Figures 2-6).

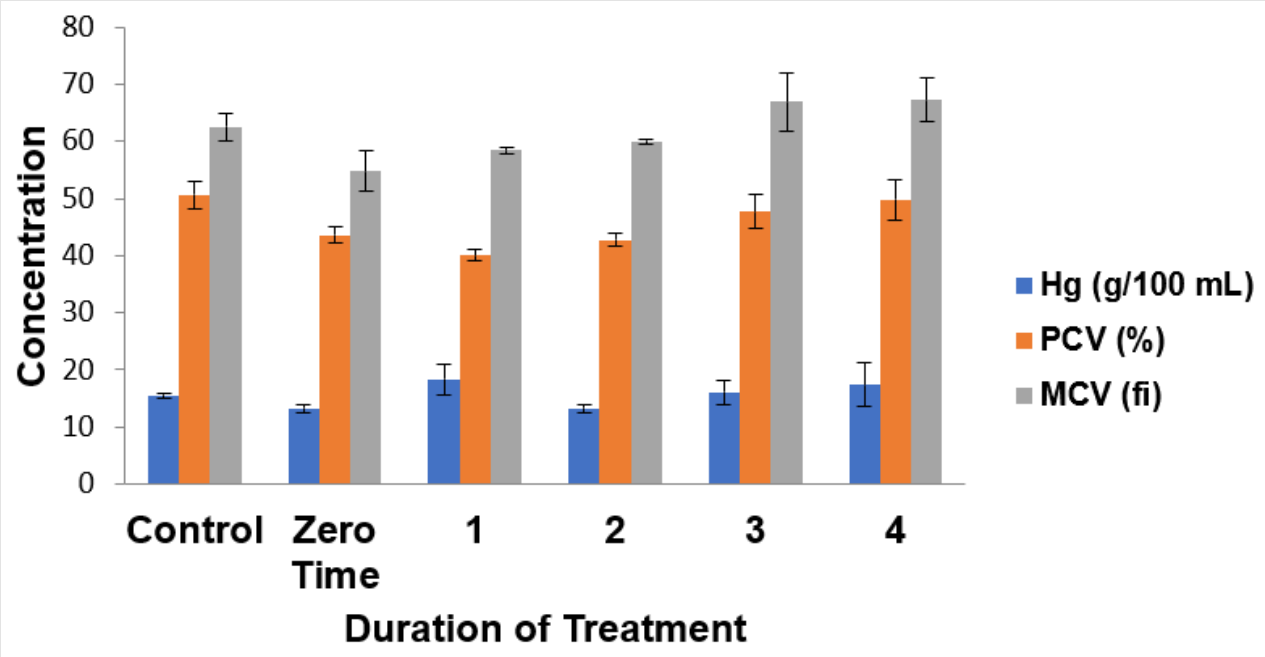

Figure 2: Concentrations of Haemoglobin, Packed Cell Volume and Mean Corpuscular Volume.

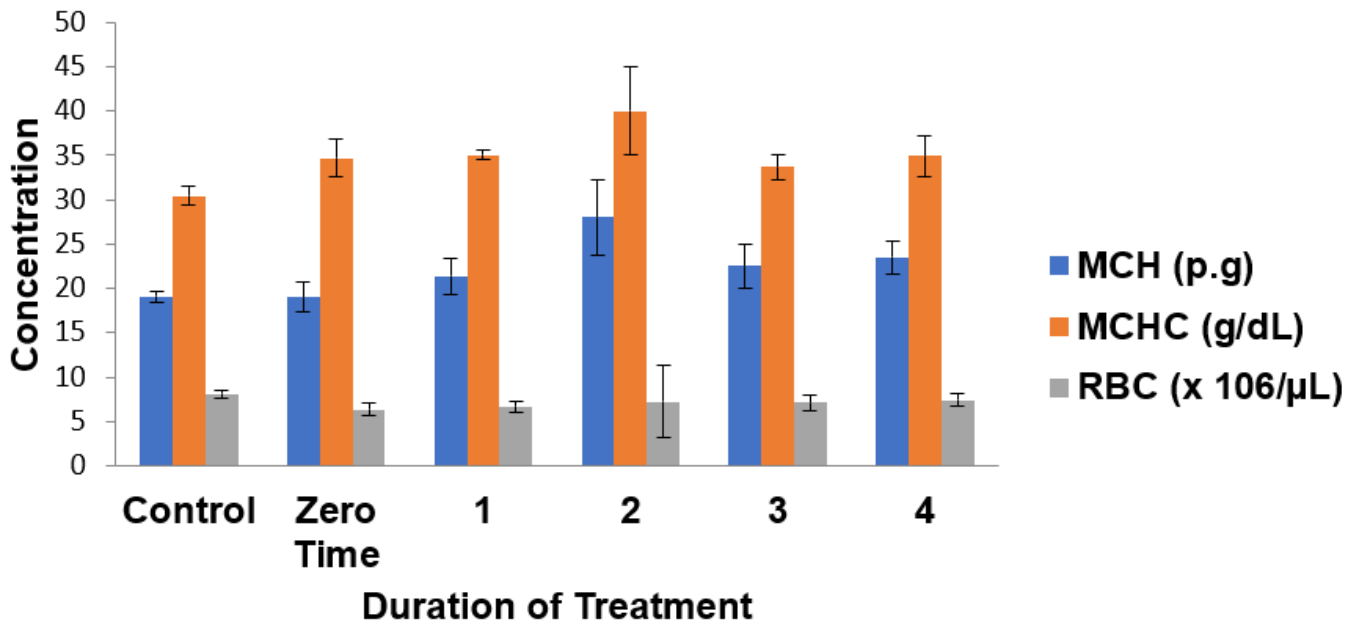

Figure 3: Concentrations of Mean Corpuscular Haemoglobin, Mean Corpuscular Haemoglobin Concentration and Red Blood Cells.

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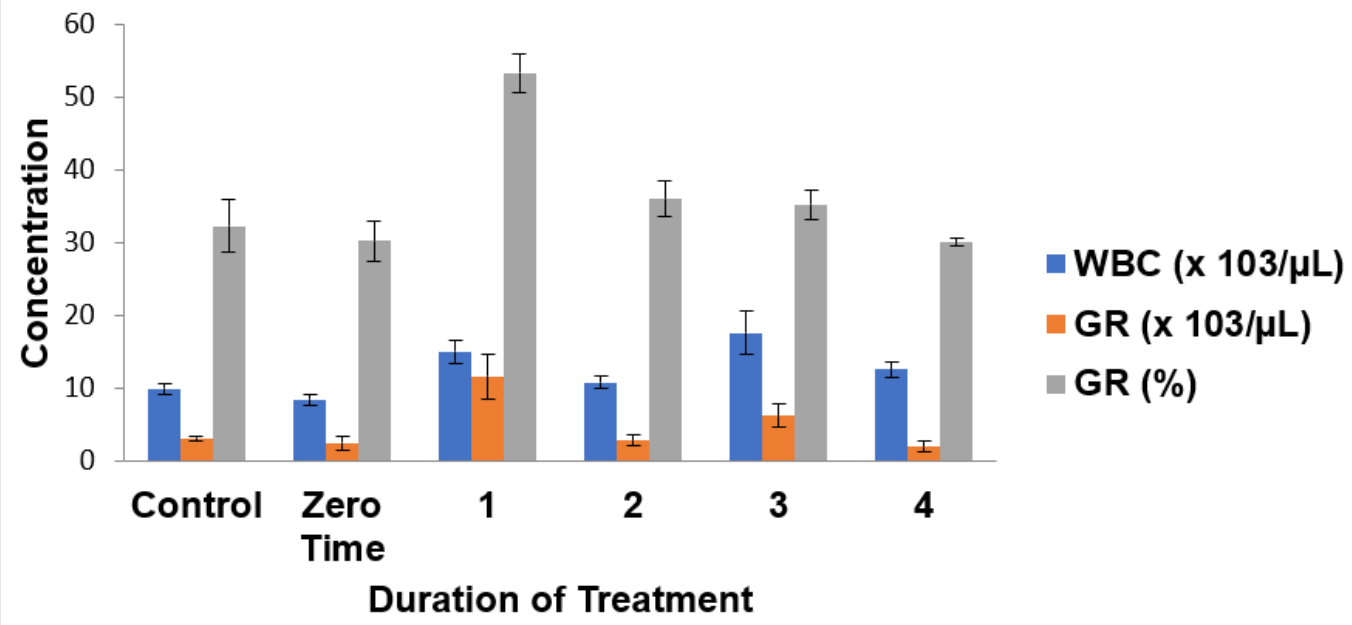

Figure 4: White Blood Cells and Granulocytes Concentrations.

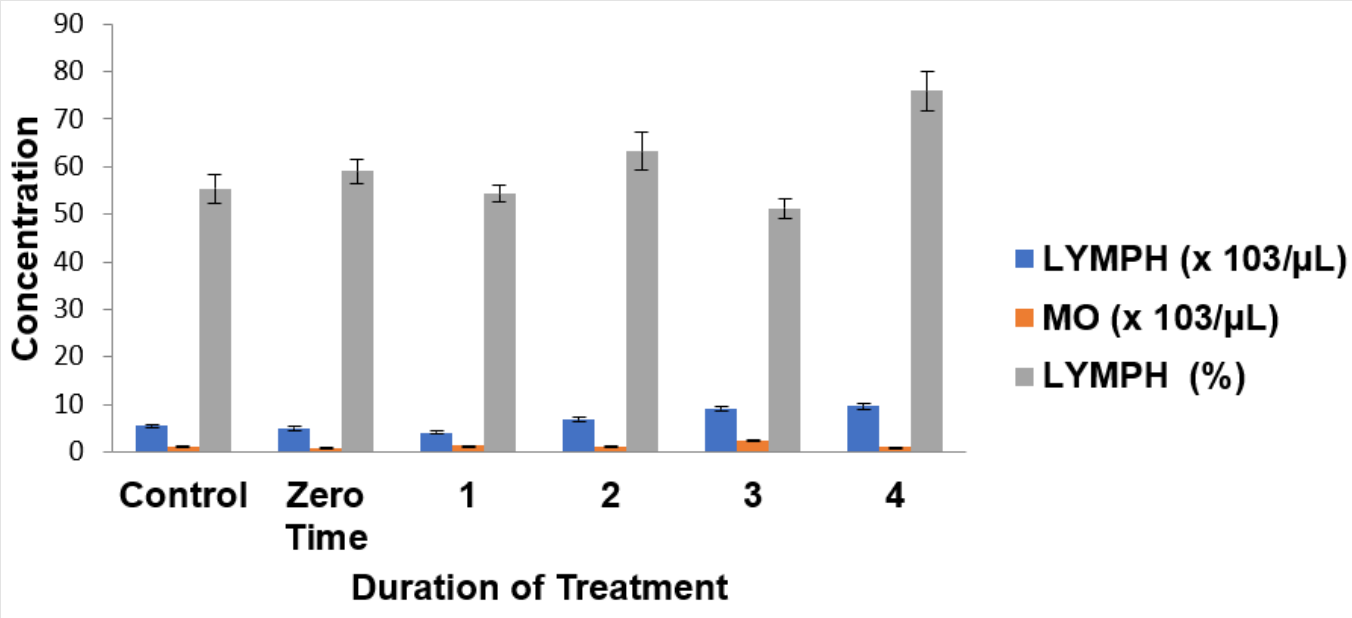

Figure 5: Concentrations of Lymphocytes and Monocytes.

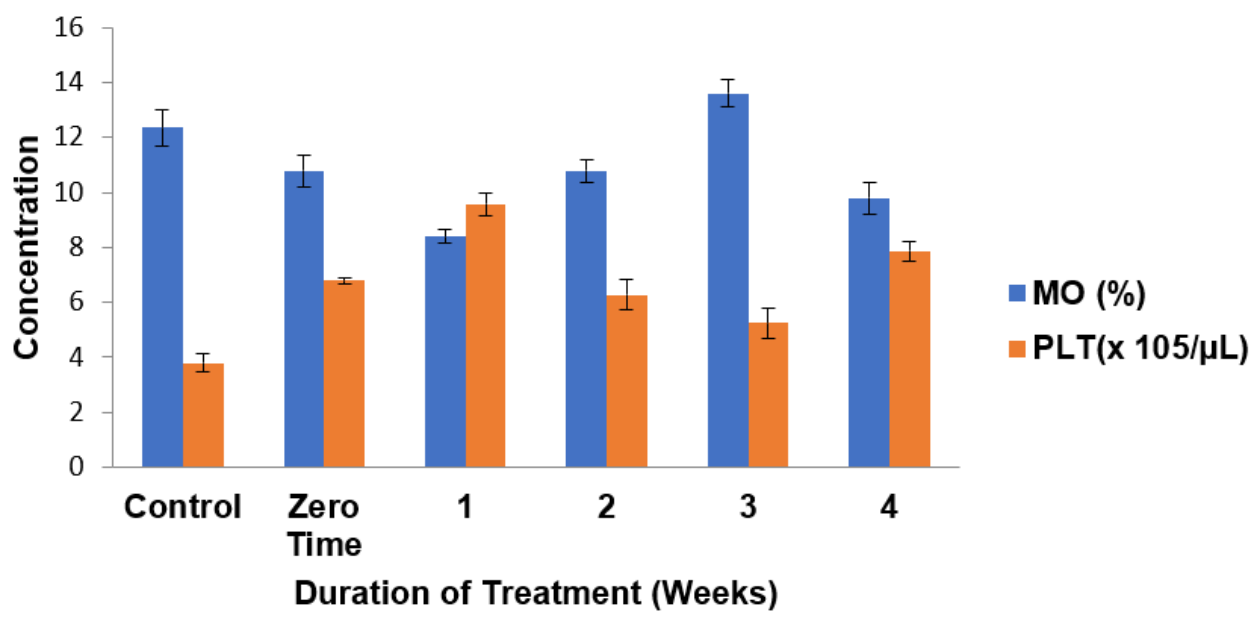

Figure 6: Percentage Monocytes and Concentration of Platelets.

Discussion

In preclinical and clinical safety assessments, blood and haematopoietic tissue are given careful attention besides liver and kidney. This is so because of the high mitotic rate of haematopoietic tissue, the direct contact blood cells have with substances administered systemically, and the severity of haematotoxicity [1]. In normal individuals, red cells, platelets and neutrophils are synthesized at a very high rate (1 – 3 million/s). Like other rapidly dividing tissues (intestine and gonads), bone marrow is highly sensitive to the toxic effect of drugs and other agents. It is also a key target for molecules engineered to stimulate the synthesis of blood cells or prevent myelotoxicity [5]. Bone marrow impairment or direct damage to blood cells which causes cytopenia or dysfunction can be life-threatening. The obvious sequelae include anoxia (due to anaemia), infection and sepsis following leukopenia, and haemorrhage. These alterations which may be dramatic or subtle present with a number of secondary/compensatory changes in haematopoietic or extra-medullary tissues. As a serious adverse effect of drug therapy, primary iatrogenic (drug-induced) blood dyscrasias is difficult to assess and its pathogenesis is not well known [3,4]. Haematological parameters such as haematocrit, haemoglobin, erythrocytes and white blood cells are used to evaluate toxicity. They are employed in environmental/occupational monitoring.

The normal ranges of these parameters are altered by exposure to certain toxic substances. Studies have shown that alterations in haematological parameters by medicinal compounds could either be beneficial or deleterious [36]. This study investigated the biochemical effect of AEDG stem bark on haematological parameters in rats. The results showed that there were no significant differences in the concentrations of haematological parameters, except that the levels of white blood cells were significantly elevated at weeks 1 and 3, and granulocytes at week 1 only, an indication that the medicinal plant extract may contain principle(s) that can activate the immune system. Previous studies reported the relative safety of extracts of *D. guineense* stem bark [37-50]. Extracts of *D. guineense* stem bark have been reported to possess different pharmacological and biological activities [51- 71].

Conclusion

The results obtained in this study indicate that aqueous extract of *D. guineense* stem bark is not toxic to rats blood. It contains compound(s) that can activate the immune system of rats.

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