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Effect of *Dacryodes edulis* stem bark and seed on haematological parameters of wistar rats

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Abstract
This study was designed to assess the effect of *Dacryodes edulis* stem bark and seed on haematological parameters of Wistar rats. The stem bark and seeds of *D. edulis* were locally sourced from the same tree *D. edulis* in Ologbo area, Edo State, Nigeria. Acute toxicity was determined using Lorke's method. In the main study, 80 Wistar rats were divided into 16 groups of 5 rats each. Group 1 served as control. Groups 2, 3 and 4 were administered 500, 1000 and 2000 mg/kg body weight of aqueous extract of *D. edulis* stem bark respectively while groups 5, 6 and 7 were administered 500, 1000 and 2000 mg/kg bw of methanol extract of *D. edulis* stem bark respectively. Animals in Group 8 served as control for the seed extracts treatment. Groups 9, 10, 11 and 12 were administered 250, 500, 1000 and 2000 mg/kg body weight of aqueous extract of *D. edulis* seed respectively while groups 13, 14, 15 and 16 were administered 250, 500, 1000 and 2000 mg/kg bw of methanol extract of *D. edulis* seed respectively via oral route for 28 days. At the end of the 28 day, animals were sacrificed and blood was collected via cardiac puncture. The acute toxicity study of *D. edulis* showed that the LD_{50} of the extracts used is greater than 5000 mg/kg as no mortality was recorded at this dose except for a decline in the normal activity of the animals administered 5000 mg/kg dose. Administration of 1000 mg/kg and below of aqueous and methanol extracts of *D. edulis* stem bark and seed was observed to have no significant effect on the parameters determined when compared with those in the control animals. However, administration of 2000 mg/kg of aqueous and methanol extracts of *D. edulis* stem bark and seed significantly ($p<0.05$) reduced haematological parameters when respectively compared with those in the control animals. The results of this study showed that extracts of *D. edulis* stem bark and seed at high dose possess hemolytic activities and could lead to the destruction of the immune system.

Keywords: anaemia, *Dacryodes edulis* stem bark and seed, hemolysis, reduced immunity

Introduction
Haematology refers to the study of the number and morphology of the cellular elements of blood particularly; the red blood cells (erythrocytes), white blood cells (leucocytes) and the platelets (thrombocytes) in addition to the use of these results in the diagnosis and monitoring of diseases [1]. Haematological studies are of ecological and physiological interest in helping to understand the relationship of blood characteristics to the environment [2]. Erythrocytes have three main functions; to distribute oxygen to the periphery from the lungs through the pulmonary capillaries, remove carbon dioxide from the tissues back to the lungs through the systemic capillaries and to ensure that the acidic and basic values of the body are normal [3]. In order for the metabolic needs of tissues to be met, the appropriate amount of nutrients and oxygen must be available and supplied to the tissues [4].White blood cells are the cells of the immune system [5]. Platelets are a component of blood whose main function is to stop bleeding by clumping and clogging blood vessel injuries [6]. Hematological complications consist mainly of abnormalities in the function, morphology and metabolism of erythrocytes, leukocytes and platelets [7].

Dacryodes edulis is African pear that belongs to the family of Burseracaea. The leaves shades and are dioecious plant species found in the humid tropical zone of non-flooded forest [8]. The fruit tree is grown in Africa countries. The plant is known in English as "Bush butter tree" and "Native pear". Numerous species of *Dacryodes*have been use in traditional medicine. Diverse parts of *D. edulis* have antibiotic, immunostimulating, anti-inflammatory, antioxidant, hypoglycemic and hypolipidemic potentials [9-11]. An array of chemical constitutes have been isolated from the plant such as terpenes, flavonoids, tannins, alkaloids and saponins. The stem exudates contain tannin, saponin and alkaloids with implications in the treatment of variety of skin disease and inflammation [12]. A pervious finding by Chimaobi *et al.*, [13] showed that, *D. edulis* leaves have a high capacity to scavenge free radicals (DPPH, superoxide, and hydroxyl) as well as high reducing power as depicted by the ferric and molybdate. The capacity was linked to the presence of flavonoids and phenolic content which denotes electron or proton to oxidants/ radicals and neutralized them.

Materials and methods
1. Collections and identification of plant materials
The stem bark and seeds of *D. edulis* were locally sourced from the same tree *D. edulis* in Ologbo area, Edo State, Nigeria. They were chopped in pieces, air dried and ground to fine powder using milling machine. Aqueous and methanol extracts were made by soaking 500 g of the plant powder in 4 litres of distilled water and 4 litres of methanol for 48 and 72 hours respectively with regular stirring, followed by sieving through a cheese cloth and concentration using a freeze drier.

2. Acute toxicity study
Lorke [16] method was applied in this study. It is usually done in two phases. In phase I a total of 18 rats were divided into 6 groups

of 3 rats each. Animals in groups A, B and C were administered 10, 100 and 1000 mg/kg aqueous extract of *D. edulis* stem bark, while those in groups D, E and F were administered 10, 100 and 1000 mg/kg methanol extract of *D. edulis* stem bark via oral. Animals were monitored regularly for clinical signs as well as mortality. At the end of day 14th, recovery and survival of acute intoxication was observed and experiment was terminated. In phase II experiment, 18 rats were also divided into 6 groups of 3 rats each. Animals in groups A, B and C were administered 1600, 2900 and 5000 mg/kg aqueous extract of *D. edulis* stem bark, while those in groups D, E and F were administered 1600, 2900 and 5000 mg/kg methanol extract of *D. edulis* stem bark via oral route. Animals were monitored regularly for clinical signs as well as mortality. At the end of day 14th, recovery and survival of acute intoxication was observed and experiment was terminated. Similarly, phase I and II experiment was also conducted using aqueous and methanol extracts of *D. edulis* seed.

3. Experimental design and animals treatment

This study was based on the "limited study" described in OECD guidelines [16] which encourages the use of few numbers of animals by limiting the use of experimental groups. Eighty (80) adult male Wistar rats with body weight between 145 and 170 g were used for the experiment. They were acclimatized for seven (7) days during which they were fed *ad libitum* with standard feed and drinking water and were housed in clean cages placed in well-ventilated housing conditions (under humid tropical conditions) throughout the experiment. All the animals received humane care according to the criteria outlined in the 'Guide for the Care and Use of Laboratory Animals' prepared by the National Academy of Science and published by the National Institute of Health [17]. They were divided into 16 groups of 5 rats each. Group 1 served as control in which rats were given only feed and water. Groups 2, 3 and 4 were administered 500, 1000 and 2000 mg/kg body weight of aqueous extract of *D. edulis* stem bark respectively while groups 5, 6 and 7 were administered 500, 1000 and 2000 mg/kg bw of methanol extract of *D. edulis* stem bark respectively. Animals in Group 8 served as control for the seed treatment. Groups 9, 10, 11 and 12 were administered 250, 500, 1000 and 2000 mg/kg body weight of aqueous extract of *D. edulis* seed respectively while groups 13, 14, 15 and 16 were administered 250, 500, 1000 and 2000 mg/kg bw of methanol extract of *D. edulis* seed respectively via oral route for 28 days.At the end of the 28 day, animals were sacrificed and blood was collected via cardiac puncture.

4. Determination of haematological parameters

The red blood cells (RBC) and white blood cells (WBC) counts were determined by the improved Neubauer haemocytometer method. The haemoglobin (Hb) concentration was determined according to Jain [18], using the cyano methaemoglobin method. The packed cell volume (PCV) was determined by the micro haematocrit method according to Dacie and Lewis [19]. Schilling method of differential lecukocyte count was used to determine the distribution of the various white blood cells [20]. Mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) were computed according to Jain [18].

5. Statistical analysis

Results are expressed as mean ± standard error of the mean (SEM). The levels of homogeneity among the groups were assessed using One-way Analysis of Variance (ANOVA) followed by Dunca Pos Hoc test. All analyses were done using SPSS Software Version 16.0 and P values < 0.05 were considered statistically significant.

Results and discussion

1. Results

1.1 Acute toxicity of *D. edulis* extracts

The result of the acute toxicity of *Dacryodes edulis* in this study showed that the LD_{50} of its aqueous extract of stem bark (AQSB), methanolic extract of stem bark (MTSB), aqueous extract of seed (AQSD) and methanolic extract of seed (MTSD) is greater than 5000 mg/kg as no mortality was recorded at this dose except for a decline in the normal activity of the animals administered 5000 mg/kg dose as presented in tables 1 and 2.

1.2 Effect of extracts of *D. edulis* stem bark on haematological parameters of rats after 28 days of treatment

The results of the effect of extracts of *D. edulis* stem bark on haematological parameters of rats after 28 days of treatment are presented in tables 3 and 4. Administration of 500 and 1000 mg/kg of aqueous and methanol extracts of *D. edulis* stem bark was observed to have no significant effect on the haematological parameters of animals when compared with those in the control group. However, administration of 2000 mg/kg of aqueous and methanol extracts of *D. edulis* stem bark significantly ($p<0.05$) decreased the RBC, HCT, HGB, MCV, MCH, WBC, platelet, granulocyte, lymphocyte and monocyte counts when compared with those animals in the control group.

1.3 Effect of extracts of *D. edulis* seed on haematological parameters of rats after 28 days of treatment

The results of the effect of extracts of *D. edulis* seed on haematological parameters of rats after 28 days of treatment are presented in tables 5 and 6. Administration of 250, 500 and 1000 mg/kg of aqueous and methanol extracts of *D. edulis* seed was observed to have no significant effect on the haematological parameters of animals when compared with those in the control group. However, administration of 2000 mg/kg of aqueous and methanol extracts of *D. edulis* seed significantly ($p<0.05$) decreased the RBC, HCT, HGB, MCV, MCH, WBC, platelet, granulocyte, lymphocyte and monocyte counts when compared with those animals in the control group.

Table 1: Acute toxicity of extracts of *d. edulis* stem bark

Study phase/ (animal)	Dosage of extract (mg/kg) b.w	No of rats per group	No. of death recorded	% mortality
Phase one				
A	10 mg/kg AQSB	3	0	0
B	100 mg/kg AQSB	3	0	0
C	1000 mg/kg AQSB	3	0	0

D	10 mg/kg mtsb	3	0	0
E	100 mg/kg MTSB	3	0	0
F	1000 mg/kg MTSB	3	0	0
Phase two				
A	1600 mg/kg AQSB	3	0	0
B	2000 mg/kg AQSB	3	0	0
C	5000 mg/kg aqsb	3	0	0
D	1600 mg/kg MTSB	3	0	0
E	2000 mg/kg MTSB	3	0	0
F	5000 mg/kg MTSB	3	0	0

Legend: AQSB = Aqueous extract of *D. edulis* stem bark, MTSB = Methanol extract of *D. edulis* stem bark.

Table 2: Acute Toxicity of Extracts of *D. edulis* Seed

Study phase/ (animal)	Dosage of extract (mg/kg) b.w	No of rats per group	No. of death recorded	% Mortality
Phase one				
A	10 mg/kg AQSD	3	0	0
B	100 mg/kg AQSD	3	0	0
C	1000 mg/kg AQSD	3	0	0
D	10 mg/kg MTSD	3	0	0
E	100 mg/kg MTSD	3	0	0
F	1000 mg/kg MTSD	3	0	0
Phase two				
A	1600 mg/kg AQSD	3	0	0
B	2000 mg/kg AQSD	3	0	0
C	5000 mg/kg AQSD	3	0	0
D	1600 mg/kg MTSD	3	0	0
E	2000 mg/kg MTSD	3	0	0
F	5000 mg/kg MTSD	3	0	0

Legend: AQSD = Aqueous extract of *D. edulis* Seed, MTSD = Methanol extract of *D. edulis* Seed

Table 3: Effect of extracts of *D. edulis* stem bark on red blood cell parameters of rats after 28 days of treatment

Treatment groups	RBC ($X10^{12}$/L)	Hb (g/DL)	HCT (%)	MCV (FL)	MCH (PG)
Control	6.65 ± 0.13^{b}	16.75 ± 0.21^{b}	36.58 ± 0.34^{b}	57.12 ± 0.43^{b}	20.43 ± 0.75^{b}
AQSB 500 mg/kg	6.80 ± 0.18^{b}	16.47 ± 0.17^{b}	36.38 ± 0.31^{b}	54.07 ± 0.45^{b}	22.21 ± 0.5^{b}
AQSB 1000 mg/kg	6.40 ± 0.32^{b}	16.47 ± 0.33^{b}	36.95 ± 0.13^{b}	55.14 ± 0.21^{b}	24.06 ± 0.66^{b}
AQSB 2000 mg/kg	2.27 ± 0.11^{a}	8.40 ± 0.26^{a}	15.53 ± 0.26^{a}	32.13 ± 0.23^{a}	10.86 ± 0.54^{a}
MTSB 500 mg/kg	6.87 ± 0.098^{b}	16.58 ± 0.26^{b}	36.48 ± 0.25^{b}	54.75 ± 0.30^{b}	21.56 ± 0.43^{b}
MTSB 1000 mg/kg	6.41 ± 0.36^{b}	16.57 ± 0.25^{b}	36.48 ± 0.27^{b}	56.97 ± 0.34^{b}	22.13 ± 0.55^{b}
MTSB 2000 mg/kg	3.01 ± 0.20^{a}	8.98 ± 0.25^{a}	14.79 ± 0.23^{a}	31.13 ± 0.12^{a}	9.22 ± 0.7^{a}

Results are presented as mean ± SEM with n = 5. Values with different superscripts along the same column are significantly different at $p<0.05$.
Legend: AQSB = Aqueous extract of *D. edulis* stembark, MTSB = Methanol extract of *D. edulis* stembark, RBC = Red Blood Cell, Hb = Hemoglobin, HCT = Haematocrit, MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Hemoglobin

Table 4: Effect of extracts of *d. edulis* stembark on white blood cell parameters of rats after 28 days of treatment

Treatment groups	WBC($X10^{9}$/L)	PLT($X10^{9}$/L)	LYM (%)	MON (%)	GRA (%)
Control	8.35 ± 0.18^{b}	382.75 ± 0.23^{b}	26.73 ± 0.23^{b}	8.98 ± 0.26^{b}	57.85 ± 0.38^{b}
AQSB 500 mg/kg	8.70 ± 0.69^{b}	382.85 ± 0.10^{b}	26.32 ± 0.24^{b}	8.71 ± 0.48^{b}	56.60 ± 0.76^{b}
AQSB 1000 mg/kg	8.25 ± 0.16^{b}	382.19 ± 0.029^{b}	26.99 ± 0.14^{b}	8.95 ± 0.27^{b}	54.62 ± 2.80^{b}
AQSB 2000 mg/kg	3.08 ± 0.22^{a}	208.77 ± 0.16^{a}	12.36 ± 0.25^{a}	2.67 ± 0.35^{a}	32.97 ± 3.74^{a}
MTSB 500 mg/kg	8.20 ± 0.18^{b}	383.02 ± 0.13^{b}	26.50 ± 0.43^{b}	8.58 ± 0.54^{b}	56.89 ± 2.86^{b}
MTSB 1000 mg/kg	8.15 ± 0.27^{b}	382.66 ± 0.25^{b}	26.27 ± 0.39^{b}	8.91 ± 0.54^{b}	54.94 ± 3.37^{b}
MTSB 2000 mg/kg	3.10 ± 0.52^{a}	205.06 ± 0.67^{a}	13.71 ± 0.39^{a}	2.85 ± 0.29^{a}	33.41 ± 3.40^{a}

Results are presented as mean ± SEM with n = 5. Values with different superscripts along the same column are significantly different at $p<0.05$.
Legend: AQSB = Aqueous extract of *D. edulis* stembark, MTSB = Methanol extract of *D. edulis* stembark, WBC = White Blood Cell Count, PLT = Platelet Count, LYM = Lymphocyte Count, MON = Monocyte Count, GRA = Granulocyte Count

Table 5: Effect of extracts of *D. edulis* seed on red blood cell parameters of rats after 28 days of treatment

Treatment groups	RBC ($X10^{12}$/L)	Hb(g/dL)	HCT (%)	MCV (FL)	MCH (pg)
Control	5.49±0.92^{b}	15.93±1.0^{b}	34.8±2.46^{b}	55.08±0.46^{b}	26.43±0.60^{b}
AQSD 250 mg/kg	5.94±0.72^{b}	15.39±3.32^{b}	35.52±1.76^{b}	56.12±0.71^{b}	25.14±0.53^{b}
AQSD 500 mg/kg	5.52±0.82^{b}	15.68±2.31^{b}	37.12±1.56^{b}	57.45±0.66^{b}	27.65±0.64^{b}
AQSD 1000 mg/kg	5.45±0.83^{b}	15.81±1.66^{b}	33.97±2.20^{b}	55.23±0.83^{b}	27.72±0.84^{b}
AQSD 2000 mg/kg	2.47±0.89^{a}	7.90±1.28^{a}	18.93±1.86^{a}	32.84±0.76^{a}	12.27±0.88^{a}
MTSD 250 mg/kg	5.86±0.76^{b}	15.53±1.79^{b}	32.62±1.54^{b}	56.13±0.55^{b}	25.17±0.81^{b}
MTSD 500 mg/kg	5.56±0.66^{b}	15.99±1.49^{b}	34.22±1.63^{b}	55.65±0.72^{b}	26.32±0.36^{b}
MTSD 1000 mg/kg	5.56±0.59^{b}	15.99±2.30^{b}	33.90±1.32^{b}	57.35±0.83^{b}	24.15±0.70^{b}
MTSD 2000 mg/kg	2.55±1.43^{a}	8.22±1.74^{a}	19.24±2.76^{a}	33.21±0.76^{a}	11.11±0.77^{a}

Results are presented as mean ± SEM with n = 5. Values with different superscripts along the same column are significantly different at $p<0.05$.
Legend: AQSD = Aqueous extract of *D. edulis* Seed, MTSD = Methanol extract of *D. edulis* Seed, RBC = Red Blood Cell, Hb = Hemoglobin, HCT = Haematocrit, MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Hemoglobin

Table 6: Effect of extracts of *D. edulis* seed on white blood cell parameters of rats after 28 days of treatment

Treatment Groups	WBC ($X10^{9}$/L)	PLT ($X10^{9}$/L)	LYM (%)	MON (%)	GRA (%)
Control	9.51±0.64^{b}	365.02±6.60^{b}	30.57±1.75^{b}	8.73±1.93^{b}	60.96±6.61^{b}
AQSD 250 mg/kg	9.30±0.91^{b}	367.67±9.79^{b}	33.77±4.29^{b}	8.93±1.48^{b}	59.99±7.32^{b}
AQSD 500 mg/kg	9.00±0.91^{b}	361.67±7.89^{b}	30.37±2.89^{b}	8.73±1.37^{b}	61.99±7.32^{b}
AQSD 1000 mg/kg	8.23±1.48^{b}	365.98±8.45^{b}	33.04±4.82^{b}	9.04±1.76^{bc}	60.30±5.23^{b}
AQSD 2000 mg/kg	3.13±1.52^{a}	111.35±6.97^{a}	11.22±0.60^{a}	4.39±0.65^{a}	35.42±4.54^{a}
MTSD 250 mg/kg	9.64±1.44^{b}	369.24±5.45^{b}	32.07±1.75^{b}	8.89±2.17^{b}	58.56±6.34^{b}
MTSD 500 mg/kg	9.63±1.54^{b}	365.14±7.35^{b}	31.05±1.65^{b}	9.09±2.07^{b}	60.46±5.36^{b}
MTSD 1000 mg/kg	9.31±1.45^{b}	364.97±8.94^{b}	35.32±3.26^{b}	8.96±1.94^{b}	62.57±3.93^{b}
MTSD 2000 mg/kg	3.98±1.46^{a}	115.81±5.85^{a}	13.87±1.76^{a}	4.36±0.51^{a}	36.55±4.60^{a}

Results are presented as mean ± SEM with n = 5. Values with different superscripts along the same column are significantly different at $p<0.05$.
Legend: AQSD = Aqueous extract of *D. edulis* Seed, MTSD = Methanol extract of *D. edulis* Seed, WBC = White Blood Cell Count, PLT = Platelet Count, LYM = Lymphocyte Count, MON = Monocyte Count, GRA = Granulocyte Count

Discussion

Anaemia increases in prevalence and severity as renal function decreases, it becomes much more common at reduced glomerular filtration rate [21]. Depending on the severity, some of the symptoms of anaemia may include: pale skin, fatigue, weakness, loss of appetite, low haematocrit and hemoglobin in a RBC etc. Factors likely to contribute to anaemia in chronic kidney diseases include blood loss, shortened red cell life span, vitamin deficiencies, the "uremic milieu," erythropoietin (EPO) deficiency, iron deficiency and inflammation [22, 23]. However, the typical "anaemia of chronic renal insufficiency" is a result of a decreased production of red blood cells by the bone marrow. This defect in red blood cell production is largely explained by the inability of the failing kidneys to secrete hormone erythropoietin. This hormone is a necessary stimulus for normal bone marrow to produce red blood cells.Experimental evidences have revealed that exposure to certain plants, drugs, and compounds significantly change haematological parameters. The haematopoietic system is very sensitive to chemicals and foreign compounds at increased doses. Thus, it is an essential index of toxicity with high analytical potential for human toxicity [24].

Lethal dose (LD_{50}) is a quantitative index of acute toxicity, which is usually determined in the preliminary step of evaluating the safety/toxicity of drugs, compounds, and medicinal plants [24]. It provides information on the nature of toxicity and the basis for the classification and dosage design of a substance or drug [25]. The acute toxicity of *Dacryodes edulis* in this study showed that the LD_{50} of its aqueous extract of stem bark (AQSB), methanolic extract of stem bark (MTSB), aqueous extract of seed (AQSD) and methanolic extract of seed (MTSD) is greater than 5000 mg/kg as no mortality was recorded at this dose except for a decline in the normal activity of the animals administered 5000 mg/kg dose (Tables 1 and 2). This might implies that the plant extract is relatively safe and harmless. This is consistent with the study of Ononamadu *et al*., [26] who reported that the LD_{50} of methanolic extract of *D. edulis* leaves is greater than 5000 mg/kg. Yelwa *et al*., [27] has also reported that the LD_{50} of methanolic extract of *D. edulis* leaves is greater than 4000 mg/kg. According to Kennedy *et al.* [28], any substance with LD_{50} greater than 5000 mg/kg by the oral route is regarded as safe and practically harmless. The administered graded doses of the aqueous and methanolic extracts of *D. edulis* did not result in lethality over the 24-hour period. No death and latent toxicity was observed in the animals after keeping them for extra 14 days. Hence, the acute toxicological results showed that the plant is relatively safe.

In this study, no significant difference was observed when the blood levels of erythrocyte parameters (haematocrit (HCT), haemoglobin (Hb), red blood cell (RBC), Mean Corpuscular Volume (MCV) and Mean Corpuscular Heamoglobin (MCH)) of animals treated with 500 and 1000 mg/kg of both aqueous and methanol extracts of *D. edulis* stem bark when compared with those in the control animals as presented in table 3. However, there was a significant ($p<0.05$) decrease in the blood levels of erythrocyte parameters of animals treated with 2000 mg/kg of both aqueous and methanol extracts of *D. edulis* stem bark when compared with those in the control animals. Aqueous and methanol extracts of *D. edulis* seed was observed to have similar effect with it stem bark extracts (Table 5). This might be an indication that there may be decreased production of red blood cells therefore, suggesting the toxic nature of the plant extracts to red blood cells at this dose [29].The decrease in the blood levels of erythrocyte parameters observed in this study might be

suggestive that *D. edulis* stem bark and seed have possible potentials to inhibit erythropoietin release from the kidneys [30], which is the humoral regulator of RBC production and also affect the oxygen-carrying capacity of the blood and the amount of oxygen delivered to the tissues since red blood cells and haemoglobin (Hb) are very important in transferring respiratory gases [31,32]. This results collaborates the toxic effect of *D. edulis* seed [14] and stem bark [37] on the kidney at a dose of 2000 mg/kg. It is therefore possible that consumption of *D. edulis* stem bark and seed at higher dose by humans may lead to anaemia especially in menstruating and pregnant women. It has also been reported that values of RBC and associated parameters lower than normal ranges are indicative of anemic conditions while higher values are suggestive of polycythemia [33], thus, the 28-day treatment with *D. edulis* stem bark and seed extracts at higher dose of 2000 mg/kg may have the potential to induce anemia. The non-significant difference observed in the haematological parameters of animals treated with 250, 500 and 1000 mg/kg of stem bark and seed extracts of *D. edulis* is consistent with the findings of Ononamadu *et al*. [26] who reported a non-significant difference in heamatological indices of animals administered up to 600 mg/kg body weight of *D. edulis* leaves.

The results of this study also revealed no significant difference in the white blood cell parameters (WBC, monocyte, lymphocyte and granulocyte counts) and platelet count of animals treated with 500 and 1000 mg/kg of both aqueous and methanol extracts of *D. edulis* stem bark when compared with those in the control animals as presented in table 4. However, there was a significant ($p<0.05$) decrease in the blood levels of erythrocyte parameters of animals treated with 2000 mg/kg of both aqueous and methanol extracts of *D. edulis* stem bark when compared with those in the control animals. Aqueous and methanol extracts of *D. edulis* seed was observed to have similar effect with it stem bark extracts (Table 6). White blood cells, monocyte, lymphocyte, granulocyte and platelet counts are used to provide useful information for diagnosis in routine clinical evaluation of the state of health of a patient. Changes in the haematological system have a higher predicative value for human toxicity [34].

The significant decrease observed in the leucocytes (WBC) and thrombocytes (platelet) counts of animals treated with 2000 mg/kg body weight of extracts of *D. edulis* stem bark and seed probably indicates that the body's ability to attack and destroy invading bacteria, viruses and other injurious agents (Phagocytosis) was compromised by the extracts, thus destroying the immune system [35]. This is consistent with the reports of Akunne and Orhue [14] and Akunne *et al*. [37], who observed that *D. edulis* seed and stem bark administered at higher dose, 2000 mg/kg induced oxidative stress in the liver, kidney and heart of treated animals.The result of this study might also be an indication that stem bark and seed extracts of *D. edulis* has inhibited the actions of platelet activating factor (PAF) and thus the blood clotting potentials. It could also be suggestive that it has the potential to inhibit thrombopoietin production [36].

Conclusion

The significant decrease observed in the red blood cell parameters of animals treated with 2000 mg/kg of both aqueous and methanolic extracts of *D. edulis* stem bark and seed might be suggestive that the extracts at this dose possess hemolytic activities. Furthermore, the significant decrease observed in the white blood cell parameters of animals treated with 2000 mg/kg of both aqueous and methanolic extracts of *D. edulis* stem bark and seed might be an indication that the extracts at this dose could lead to the destruction of the immune system.

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