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Original Article

Acute and Chronic Toxicity of *Xylopia aethiopica* on Selected Haematological Parameters in Wistar Rats

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Abstract: Plants do not only serve as a source of food, but, also as a source of shelter, clothing and more importantly as a source of medicines for the treatment of diseases due to their therapeutic virtues. Plants like *Xylopia aethiopica* otherwise known as Negro pepper or African is used traditionally to treat several diseases and as food and spice in most African countries. It is of public interest to scientifically verify its toxicity and health benefits of this plant. The aim of this study was to investigate the effect of the administration of the leaves and fruits (with and without seeds) extracts of *X. aethiopica* on haematological parameters in Wistar Rats. The Wistar rats were administered with 125 mg/kg, 250 mg/kg, 500 mg/kg of hydro-ethanolic extracts of the leaves, fruits with seeds and fruits without seeds extracts by oral gavage for 30 days, 60 days and 90 days while the control group received feeds and water *ad libitum.* After the treatment periods, rats were sacrificed by cervical dislocation and blood collected by cardiac puncture. Full blood count was conducted using Automated Haematology analyser. Data were compared using analysis of variance (ANOVA) and a p-value of 0.05 was considered significant. The haemoglobin (Hb) level ($p = 0.46$) and packed cell volume (PCV) ($p = 0.23$) of the rats were not significantly different from controls. But, mean white blood cell count (WBC) ($p = 0.01$) and platelet count (PLT) ($p = 0.01$) were significantly increased in a dose dependent manner after three months' treatment. The mean WBC was significantly higher amongst the female rats, while mean platelet was higher amongst the male rats when compared with the controls. There was sex dependent increases in WBC and platelet counts among Wistar rats.

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INTRODUCTION

The importance of plants can never be overemphasized. Man depends on it directly or indirectly for food, shelter, clothing. Plants are also used in traditional medicine in all regions of the world to cure and/or prevent diseases (Azizi et al., 2023). A great plant amongst plants is *X. aethiopica*. It is an evergreen aromatic valuable medicinal plant found in the rain forest of tropical and subtropical Africa (Ekpiken et al., 2023). It is a West African ''pepper tree''. In English, it is called Negro pepper, kani pepper, moor pepper, Ethiopian pepper, Senegal pepper. In Arabic, it is called hab-zelim. In French, it is Noir de Guinee and Poivre de Senegal while in German, it is called mohrenpfeffer, Kannniipfeffer (Ebuete et al., 2022). The dried fruits of *Xylopia aethiopica* are used as spice, due to their strong aromatic quality, in the preparation of special local soups named "isi ewu" and "obe nta" daily in south-eastern parts of Nigeria. They are used in traditional medicine as a carminative, cough remedy, post partum tonic in alleviating after-birth wounds, and as lactation aid (Godam et al., 2021).

Xylopia consists of about 150 species which occur in tropical and subtropical Africa. *Xylopia aethiopica*, is an angiosperm belonging to the custard apple family, Annonaceae (Fetse et al., 2016; Makgobole et al., 2023). *X. aethiopica* is cultivated mainly for the fruits. They have aromatic pungent taste. The dried fruits with seeds, when crushed are used as pepper substitute (Ogbuagu et al., 2020). Ethnobotanical survey of *X. aethiopica* shows that almost every morphological part of the plant is used in traditional medicine for managing various ailments and for a wide variety of applications. They are also employed in several traditional medicine remedies in most parts of Nigeria for the treatment of stomach aches, bronchitis, biliousness, dysentery (to mention a few), and externally applied as a poultice for headache and neuralgia. In combination with leaves of *Newbouldia laevis* (Bignoniaceae), or chieftaincy leaf, or "ogilisi" in Igbo language, fruits of *X. aethiopica* is used for increasing menstrual blood flow, and is administered in combination with the root of *Blighia sapida* (Sapindaceae), or Isin in Yoruba, to terminate unwanted pregnancy and thus, it is believed to have abortifacient properties (Chinonye et al., 2022). In Southern Africa, *Xylopia aethiopica* is commonly referred to as value-added ingredient when the dried fruits are ground into powder and used in the preparation of several delicacies. Traditional herbalists also grind a mixture of seven dried fruits of *X. aethiopica with* 21 leaves of *Rouwulfia vomitaria*, and administer to induce labour and achieve delivery (Uloneme, 2021). The dried fruits are used as spices in the preparation of two special local soups such as "Obe ata" and isi-ewu in the Southern Nigeria (Godam et al., 2021).

Some studies that were done on the leaves and fruits of *X. aethiopica* include phytochemistry, serum lipid lowering effect (Ogbuagu et al., 2020), anagelsic, hypoglycaemic and immune boosting properties of xylopia aethiopica (Chinonye et al., 2022), membrane stabilization (Tijjani et al., 2022), anti-oxidant (Ndoye et al., 2024), diuretic and hypotensive (Asafo-Agyei et al., 2023), antiparasitic (Larayetan, 2021), insecticidal (Ndoye et al., 2024) and antimalarial (Larayetan, 2021). Some authors have observed that *X. aethiopica* fruits has erythropoietic properties that can be utilized to boost blood levels, and the propensity to weaken the immune system adduced to the significant decrease in the white blood cell (WBC) parameters in Wistar rats (Ogbuagu et al., 2020).
It is of public interest to scientifically verify its toxicity and health benefits of this plant. The aim of this study was to investigate the effect of the administration of the leaves and fruits (with and without seeds) extracts of *X. aethiopica* on haematological parameters in Wistar Rats.

MATERIALS AND METHODS

Ethical consideration

This research on animals was carried out in accordance with the ethical approval obtained from the Ethics Committee of the Faculty of Pharmacy, University of Benin, Benin City, Nigeria with reference number EC/FP/018/19 issued on 04 April, 2018.

Plant Material (Collection, Authentication and Processing)

The leaves and fruits of mature *X. aethiopica* were harvested during the day time from cultivated trees growing in Uhe village in Ovia North-East Local Government area of Edo state, Nigeria. They were authenticated by a plant taxonomist Professor H.O. Akinnobusun of the Plant Biology and Biotechnology Department, Faculty of Life Sciences, University of Benin, Benin City and assigned a voucher number of UBH_X 348.

Garbling was done on the harvested leaves and fruits of *X. aethiopica* so as to remove extraneous matters and adulterants. Each plant part was then packed into different sacks and transported to the laboratory. In the laboratory, they were spread out on very clean benches for two weeks at room temperature (25-27ºC) to allow for proper air drying. The leaves were further dried in a thermostatically regulated oven at 60º C for 30 min while the fruits were further dried at 60º C for 1 hr before milling with an electric miller (Kenwood, UK). The powdered samples were packed into air - tight amber coloured glass bottles and stored until required for the work.

Extraction Process

Soxhlet extraction method was used to obtain hydro-ethanol extracts of the leaves and fruits (with and without seeds) of *X. aethiopica*. A measured quantity of 2.5 kg of the powdered leaves and fruits (with and without seeds) were each extracted seperately with 7.5 L of hydro-ethanol (20% ethanol in distilled water). Each of the extract obtained was concentrated separately in vacuum using rotary evaporator and reduced to dryness in a thermostatically regulated electric oven maintained at a temperature of 20°C. They were packed separately into screw capped bottles, labelled and preserved in the refrigerator at 4°C for biological evaluations.

Experimental animals

Wistar albino rats (160–180g) of both sexes (males and females) were used for the tests. They were obtained from the animal house of College of Medicine, Ambrose Ali University, Ekpoma, Edo State, Nigeria; and kept in plastic cages. They were transferred to the animal house of the Department of Pharmacology and Toxicology, Faculty of Pharmacy, University of Benin, Benin City. The Wistar rats were kept at room temperature of 25-27ºC, served standard diet (Primier Feed Mill Ltd, Edo State) and water *ad libitum* for two (2) weeks so that they could acclimatize.

Acute toxicity test

The acute toxicity test was done using Miller and Tainter method (Singh et al., 2020). Thirty male Wistar rats and thirty female Wistar rats were used. Prior to the experiment, the animals were fasted over-night but given only water *ad libitum*. Each of the sexes was divided into five (5) groups (A - E) of 6 rats per group. Group A which served as the control received 10 mL/kg of 2% Tween-80 solution while groups B, C, D and E were served 0.5, 1.0, 2.0 and 5.0 g/Kg of the hydro-ethanol extract of the leaves and fruits (with and without seeds) in 2% Tween-80 respectively orally by oral gastric administration. Adverse side effects like weakness, aggressiveness, refusal to eat, diarrhoea, eye discharge, ear discharge, noisy breathing, morbidity and mortality due to the administration of the plant extracts to the Wistar rats were monitored first for 24 hours (immediate effects) after dosing and subsequently for two weeks (14 days), for delayed effects post drug administration.

Sub-acute toxicity test

The Sub-acute toxicity test was done in compliance with OECD (2001) guidelines. Twenty-four (24) Wistar rats each of both

Table 1A: Comparison of some haematological parameters of female Wistar rats on *X. aethiopica* leaves for three months

Parameter/ Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		LEAVES				
HCT %	1	38.46 ± 0.93 (35.89-41.03)	39.52±1.21 (36.15-42.9)	38.54±0.54 (37.04-40.04)	38.02±0.57 (36.45-39.59)	0.66
	2	39.04 ± 0.93 (36.46-41.62)	39.80±1.18 (36.51-43.09)	40.88±0.96 (38.212-43.55)	39.80±0.93 (37.21-42.40)	0.65
	3	38.66 ± 0.54 (37.15-40.17)	38.68±1.10 (35.64-41.73)	40.96±0.78 (38.81-43.12)	39.78±0.95 (37.14 - 42.42)	0.23
HGB g/dl	1	12.96 ± 0.32 (12.07 -73.85)	13.42±0.55 (11.91- 14.93)	13.18±0.12 (12.86-13.50)	12.88±0.18 (12.39-13.37)	0.67
	2	13.16 ± 0.31 (12.29-14.03)	13.76±0.39 (12.69-14.83.)	13.92±0.32 (13.03-14.81)	13.78±0.29 (12.97-14.59)	0,40
	3	13.56 ± 0.30 (12.72-14.40)	13.20±0.38 (12.13-14.27)	13.98±0.36 (12.99 - 14.97)	13.76±0.35 (12.79 - 14.73)	0.46
RBC 10^6/µl	1	6.86 ± 0.25 (6.17-7.56)	7.09±0.31 (6.23-7.96)	6.69±0.18 (6.21-7.18)	6.46±0.17 (5.99-6.92)	0.30
	2	6.96 ± 0.14 (6.57-7.36)	7.14 ± 0.23 (6.49-7.79)	7.18 ±0.19 (6.64-7.71)	7.14 ± 0.11 (6.83-7.46)	0.82
	3	7.05 ± 0.09 (6.80-7.31)	6.88±0.16 (6.43-7.34)	7.24±0.13 (6.89 - 7.59)	7.14±0.14 (6.75 - 7.54)	0.32
WBC 10^3/µl	1	11.70 ± 0.61 (10.00-13.40)	14.42±1.39 (10.57-18.27)	15.96±0.96* (13.31-18.61)	15.18±0.40* (14.08-16.28)	0.03
	2	12.80 ± 0.31 (11.95-13.65)	15.50±0.73 (13.48-17.53)	15.16±1.42 (11.22-19.10)	13.92±0.73 (11.90-15.94)	0.17
	3	13.10 ±0.14 (12.71-13.49)	15.34±0.41** (14.21-16.47)	15,22 ± 0.49* (13.85 - 16.59)	14.74±0.61 (13.03 - 16.45)	0.01

Key: - HCT = haematocrit, HGB = Haemoglobin, RBC = Red blood cell count, WBC = White blood cell count.

Table 1B: Comparison of some haematological parameters of female Wistar rats on *X. aethiopica* leaves for three months

Parameter / Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		LEAVES				
MCV µm^3	1	54.36 ± 1.03 (51.49-57.23)	54.80±0.94 (52.18-57.42)	57.72±3.19 (48.87-66.57)	57.88±2.09 (52.08-63.68)	0.49
	2	54.74 ± 0.96 (52.07-57.41)	55.64±0.29 (54.83-56.45)	56.70±0.59 (55.051-58.35)	56.16±1.90 (50.88-61.44)	0.65
	3	55.06±1.02 (52.23-57.89)	55.74±0.42 (54.57-56.91)	56.32±1.08 (53.32-59.32)	56.00±0.37 (54.97-57.03)	0.72
MCH pg	1	18.32 ± 0.39 (17.23-19.41)	18.58±0.14 (18.20-18.96)	19.86±0.60 (18.21-21.51)	19.70 ± 0.45 (18.45-20.95)	0.05
	2	18.38 ± 0.36 (17.39-19.37)	19.02±0.12 (18.68-19.36)	19.26±0.18 (18.76-19.76)	19.28±0.63 (17.52-21.04)	0.33
	3	18.46±0.23 (17.81-19.11)	18.50±0.33 (17.59-19.41)	19.12±0.14 (18.72-19.52)	19.68±0.26** (18.96-20.40)	0.00
MCHC g/dl	1	33.52 ± 0.19 (32.98-34.06)	33.62±0.26 (32.89-34.35)	34.08±0.25 (33.38-34.78)	33.54±0.29 (32.73-34.35)	0.38
	2	33.90 ± 0.11 (33.58-34.22)	34.14±0.13 (33.78-34.50)	33.94±0.14 (33.54-34.34)	34.22±0.10 (33.95-34.49)	0.23
	3	33.72 ± 0.27 (32.97-34.47)	34.36±0.16 (33.91-34.81)	34.04 ± 0.16 (33.61-34.48)	34.24±0.19 (33.72-34.76)	0.16
PLT 10^3/µl	1	539.60±58.26 (377.87-701.33)	579.20±44.07 (456.88-701.52)	620.40±36.50 (519.08-721.72)	682.60±29.14 (601.70-763.50)	0.16
	2	579.40±38.19 (473.40-685.40)	632.60±21.46 (573.03-692.17)	669.80±19.33 (616.15-723.45)	667.00±29.33 (585.58-748.42)	0.12
	3	580.00±20.35 (523.52-636.48)	633.20 ± 19.42 (579.30-687.10)	683.00 ± 18.10** (632.75-733.25)	681.40±7.06** (634.06 -728.74)	0.01

Key: - MCV = Mean Corpusular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration, PLT = Platelet count and ** = Very significant

sexes were used. They were divided into four groups (I - IV) of six (6) rats per group. Group I served as control group and was served 5 mL/Kg 2% Tween-80 solution while groups II – IV were served 125, 250 and 500 mg/Kg of the hydro-ethanol extract of the leaves and fruits (with and without seeds) of *X. aethiopica* in 2% Tween-80 respectively as a single dose daily for one month (30 days).

Sub-chronic toxicity test

For the sub-chronic toxicity test, twenty-four (24) Wistar rats each of both sexes were used. They were divided into four groups (I - IV) of six (6) rats per group. Group I served as control group and was served 5 mL/Kg 2% Tween-80 solution while groups II – IV were served 125, 250 and 500 mg/Kg of the hydro-ethanol extract of the leaves and fruits (with and without seeds) of *X. aethiopica* in 2% Tween-80 respectively as a single dose daily for two months (60 days).

Chronic toxicity test

The chronic toxicity test was done using twenty-four (24) Wistar rats each of both sexes. They were also divided into four groups (I – IV) of six rats per group. Group I was the control group and was served 5 mL/Kg 2% Tween-80 solution while groups II – IV were served 125, 250 and 500 mg/Kg of the hydro-ethanol extract of the leaves and fruits (with and without seeds) of *X. aethiopica* in 2% Tween-80 respectively as a single dose daily for three months (90 days).

At the end of each of the study period above, the rats were anaesthesized in a chloroform saturated chamber and dissected. Blood samples were collected from each of the animal via carotid cannulation. The samples so collected were put in EDTA containers for the analysis of haematological parameters.

Haematological Analysis

The blood samples collected in EDTA containers were used for the determination of some haematological parameters using an automated haematology autoanalyzer – SYSMEX KX- 21N (Sysmex Corporation, Kobe, Japan)**.**

Principle of Assay

The principle of assay is based on the aspiration of a specific volume of blood diluted in a specified ratio and fed into a transducer which has a minute hole called aperture. On both sides of the aperture are electrodes in between which direct current flows. Blood cells suspended in the diluted sample pass through the aperture, causing direct current resistance to change between the electrodes and the red cell size detected as electric pulses. The blood cell count is then calculated by counting the pulses and a histogram of blood cell sizes is plotted by determining the pulse sizes.

Statistical analysis

Graph pad Instat version version 2.0.5 software (UK) was used. The values were expressed as Mean ± Standard Error of Mean (SEM). Statistical analysis of variance was done by ANOVA (one- way Analysis of Variance). The level of significance between the various groups was considered at $p< 0.05$.

RESULTS

Haematological parameters of Wistar rats on hydro-ethanol extracts of the leaves, fruits (with seeds and without seeds) X. aethiopica for one, two and three months. Tables 1-6 represents the results of the haematological parameters of female and male Wistar rats that received the hydro-ethanol extracts of the leaves and fruits (with and without seeds) for one, two and three months.

The haematological parameters of female Wistar rats on *X. aethiopica* leaves for one, two and three months (Tables 1A and 1B), indicate no significant changes in the measured parameters except for total WBC and platelet count which were significantly increased when compared with the controls. The

Table 2A: Comparison of the haematological parameters of male Wistar rats on *X. aethiopica* leaves for three months

Parameter/ Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		LEAVES				
HCT %	1	40.02±1.04 (37.13-42.91)	40.78±1.38 (36.95-44.61)	39.66±2.36 (33.12-46.20)	42.560.68 (40.67-44.45)	0.54
	2	40.06±0.89 (37.59-42.53)	41.10 ±2.17 (35.09-47.11)	43.58±1.74 (38.75-48.41)	40.58±0.61 (38.88-42.28)	0.38
	3	40.50±0.68 (38.60-42.40)	41.74±1.85 (36.59-46.89)	43.86 ± 1.44 (39.87-47.85)	41.06±0.62 (39.34-42.78)	0.29
HGB g/dl	1	14.34 ± 0.26 (13.62-15.05)	14.26±0.38 (13.21-15.31)	13.58±0.89 (11.10-16.06)	14.38±0.28 (13.60-15.16)	0.67
	2	14.76±0.25 (14.07-15.45)	14.62±0.36 (15.61-15.63)	15.08±0.47 (13.77-16.30)	14.28±0.81 (12.03-16.53)	0.75
	3	14.68 ± 0.14 (14.30-15.06)	14.72 ± 0.32 (13.82-15.61)	15.32±0.39 (14.24-16.40)	14.26±0.42 (13.10-15.42)	0.21
RBC 10^6/µl	1	7.48±0.37 (6.45-8.5)	7.17±0.33 (6.26-8.07)	7.55±0.17 (7.09-8.01)	8.10±0.11 (7.78-8.42)	0.14
	2	7.71 ± 0.38 (6.67-8.76)	8.51±0.67 (6.67-10.36)	9.32±0.54 (7.81-10.83)	8.61±0.18 (8.11-9.10)	0.17
	3	8.51 ± 0.30 (7.67-9.36)	8.68±0.52 (7.24-10.12)	9.89±0.45 (8.66-11.13)	9.05±0.21 (8.47-9.64)	0.10
WBC 10^3/µl	1	14.26 ± 0.95 (1161-16.91)	14.04±0.67 (12.19-15.89)	16.98±2.33 (10.52-23.44)	17.54±1.07 (14.55-20.52)	0.22
	2	16.14 ± 0.54 (14.65-17.63)	18.78 ± 1.78 (13.87-23.70)	20.56±1.43 (16.59-24.53)	17.08±0.91 (14.55 -19.61)	0.10
	3	16.96 ± 0.63 (15.21-18.71)	19.06 ± 1.53 (14.83-23.29)	21.48±1.53 (17.25-25.71)	18.64±1.33 (14.96-22.33)	0.15

HCT = haematocrit, HGB = Haemoglobin, RBC = Red blood cell count, WBC = White blood cell count

Table 2B: Comparison of the haematological parameters of male Wistar rats on *X. aethiopica* leaves for three months

Parameter / Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		LEAVES				
MCV µm^3	1	52.86±1.20 (49.53-56.19)	55.10±0.92 (52.55-57.65)	56.34±1.30 (52.74-59.94)	52.66±0.84 (50.34-54.98)	0.08
	2	50.28±0.93 (47.69-52.87)	49.94±2.05 (44.25-55.63)	48.98±0.94 (46.38-51.58)	46.74±0.60 (45.08-48.40)	0.23
	3	50.48±0.80 (48.27-52.69)	49.10±1.24 (45.65-52.55)	49.58 ± 1.01 (46.78-52.38)	49.32±0.72 (47.32-51.32)	0.76
MCH pg	1	18.3±0.27 (17.59-19.09)	18.82±0.39 (17.74-19.90)	19.58±0.47 (18.29-20.87)	17.88±0.27 (17.13-18.63)	0.02
	2	18.36±0.58 (16.75-19.97)	17.68±1.69 (12.99-22.37)	16.36±1.00 (13.58-19.15)	14.72±0.16 (14.28-15.16)	0.10
	3	17.90±0.62 (16.19-19.61)	17.92±0.93 (15.35-20.49)	17.70 ± 1.35 (13.94-21.46)	15.84 ± 0.40 (14.73-16.95)	0.32
MCHC g/dl	1	35.74±0.97 (33.06-38.42)	35.60±0.91 (33.08-38.12)	34.80±1.10 (31.74-37.88)	33.9±0.23 (33.27-34.53)	0.44
	2	35.20±0.96 (32.53-37.87)	35.12±1.97 (29.65-40.59)	34.18±1.49 (30.05-38.32)	31.46±0.31 (30.61-32.31)	0.20
	3	36.02±1.10 (32.96-39.09)	35.50±1.48 (31.40-39.60)	35.28±1.92 (29.94-40.62)	32.46±0.72 (30.45-34.47)	0.30
PLT 10^3/µl	1	520.00±39.54 (410.23-629.77)	567.40±36.09 (467.23-667.57)	527.00±27.07 (451.85-602.15)	548.40±44.30 (425.43-671.37)	0.80
	2	521.00±31.16 (434.91-607.81)	516.40±33.13 (424.43-608.37)	539.40±49.81 (401.13-677.67)	558.20±45.20 (432.73-683.67)	0.88
	3	527.80±45.96 (400.23-655.37)	518.00±18.19 (467.51-568.49)	585.20±45.38 (459.23-711.17)	563.00±61.29 (392.85-733.15)	0.71

MCV = Mean Corpusular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration and PLT = Platelet count.

total WBC was significantly increased after rats have been treated for one month with 250 mg/Kg and 500 mg/Kg of extract and for three months with 125 mg/Kg and 250 mg/Kg of extract. The increase in platelets was after treatment for three months with 250mg/ml and 500 mg/ml of the extract.

Tables 2A and 2B represents the haematological parameters of male Wistar rats that were on *X. aethiopica* leaves for one, two and three months. There was no significant change observed in the measured haematological parameters when compared with controls.

Effect of *X. aethiopica* fruits without seeds extract haematological parameters

Tables 3A and 3B are tables showing the comparison of some of the haematological parameters of female Wistar rats on *X. aethiopica* fruits without seeds for one, two and three months. There were no significant changes in the mean values of the parameters when compared with the mean values of the controls except in the total WBC which was significantly higher after one month on 500 mg/Kg and three months on 250 mg/mL and 500 mg/mL extracts than controls.

Tables 4A and 4B represent the haematological parameters of male Wistar rats on fruits without seeds for one, two and three months. There were no observable significant changes in their mean values except in that of MCHC after three months on months on 125, 250 and 500 mg/Kg and also after three months on 250 and 500 mg/Kg concentrations of extract.

Effect of *X. aethiopica* fruits with seeds extract on haematological parameters

Tables 5A and 5B shows the effect of hydro-ethanol extract of the fruits with seeds of *X. aethiopica* on the haematological parameters of female Wistar rats after one, two and three-months oral administration. There was a significant increase in the mean values of total WBC only after one month on 500 mg/Kg when compared to the mean values of the control. However, there were no significant changes in the other parameters considered at all the concentrations used.

Tables 6A and 6B show the effect of the hydro-ethanol extract of the fruits with seeds of *X. aethiopica* on the haematological parameters of male Wistar rats after one, two and three-months administration. However, there were no significant changes in the mean values of each of the parameters considered when compared to their corresponding mean values.

Table 3A: Comparison of some haematological parameters of female Wistar rats on *X. aethiopica* fruits without seeds for three months.

Parameter / Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		FRUITS WITHOUT SEEDS				
HCT %	1	38.50 ± 1.58 (34.11-42.89)	38.92 ± 1.28 (35.37-42.47)	40.80 ± 1.19 (37.49-44.11)	41.48 ± 1.24 (38.04-44.92)	0.35
	2	38.72 ± 1.08 (35.72-41.72)	40.14 ± 0.57 (38.56-41.72)	39.98 ± 1.10 (36.92-43.04)	40.90 ± 1.88 (35.68-46.12)	0.67
	3	39.84 ± 0.98 (37.11-42.57)	39.98 ± 0.43 (38.79-41.17)	40.62 ± 0.73 (38.60-42.64)	41.02 ± 1.50 (36.86-45.18)	0.82
HGB g/dl	1	13.52 ± 0.72 (11.51-15.53)	13.28 ± 0.53 (11.81-14.75)	13.56 ± 0.75 (11.48-15.64)	14.30 ± 0.53 (12.84-15.76)	0.71
	2	13.40 ± 0.40 (12.29-14.51)	13.72 ± 0.56 (12.18-15.26)	14.24 ± 0.36 (13.25-15.24)	14.52 ± 0.42 (13.35-15.69)	0.31
	3	13.24 ± 0.51 (11.81-14.67)	13.80 ± 0.57 (12.21-15.39)	14.30 ± 0.42 (13.14-15.46)	14.12 ± 0.40 (13.01-15.23)	0.45
RBC 10^6/µl	1	7.02 ± 0.30 (6.20-7.84)	7.09 ± 0.21 (6.51-7.67)	7.10 ± 0.48 (5.76-8.43)	7.59 ± 0.30 (6.77-8.42)	0.61
	2	6.93 ± 0.25 (6.25-7.62)	7.21 ± 0.22 (6.59-7.83)	7.14 ± 0.50 (5.74-8.54)	7.87 ± 0.30 (7.04-8.71)	0.27
	3	6.97 ± 0.20 (6.42-7.52)	7.33 ± 0.14 (6.95-7.72)	7.64 ± 0.27 (6.89-8.39)	7.74±0.34 (6.79-8.68)	0.17
WBC 10^3/µl	1	10.40 ± 1.15 (7.21-13.94)	11.36 ± 0.52 (0.92-12.80)	13.38 ± 1.44 (9.39-17.37)	16.16 ± 2.07* (10.41-21.91)	0.05
	2	10.64 ± 0.87 (8.23-13.06)	11.98 ± 1.44 (7.97-15.99)	15.98 ± 1.71 (11.25-20.71)	16.14±2.67 (8.74-23.54)	0.10
	3	11.30 ± 0.73 (9.26-13.34)	15.06 ± 0.74 (13.00-17.12)	17.62 ± 1.32** (13.95-21.29)	18.48 ± 1.91** (13.18-23.78)	0.01

Key:- HCT = haematocrit, HGB = Haemoglobin, RBC = Red blood cell count, WBC = White blood cell count , * = Significant and ** = Very significant.

Table 3B: Comparison of some haematological parameters of female Wistar rats on *X. aethiopica* fruits without seeds for three months

Parameter/ Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		FRUITS WITHOUT SEEDS				
MCH Pg	1	19.30 ± 0.29 (18.49-20.11)	19.24 ± 0.27 (18.49-19.99)	19.60 ± 0.42 (18.43-20.77)	19.70 ± 0.25 (19.00-20.40)	0.68
	2	18.30 ± 0.26 (17.59-19.01)	18.34 ± 0.23 (17.70-18.98)	18.20 ± 0.35 (17.22-19.18)	18.36 ± 0.25 (17.66-19.06)	0.98
MCHC g/dl	1	35.14 ± 0.47 (33.84-36.44)	35.22 ± 0.28 (34.44-36.00)	35.20 ± 0.31 (34.34-36.06)	35.24 ± 0.26 (34.51-35.97)	1.00
	2	34.76 ± 0.16 (34.32-35.20)	34.56 ± 0.29 (33.76-35.36)	34.92 ± 0.47 (33.63-36.21)	35.08 ± 0.43 (33.90-36.26)	0.76
	3	34.74 ± 0.18 (34.25-35.23)	34.96 ± 0.17 (34.49-35.43)	34.8 ± 0.27 (34.04-35.56)	34.98 ± 0.21 (34.40-35.57)	0.82
PLT 10^3/µl	1	599.20 ± 61.41 (428.73-769.67)	600.00 ± 48.24 (466.10-733.90)	639.60 ± 49.46 (502.31-776.89)	657.20 ± 46.08 (529.29-785.11)	0.81
	2	504.80 ± 12.34 (470.54-539.06)	532.20 ± 30.71 (446.94-617.46)	563.60 ± 43.34 (443.30-683.90)	575.40 ± 36.18 (474.95-675.85)	0.44
	3	509.00 ± 8.74 (484.74-533.26)	537.40 ± 20.58 (480.28-594.52)	556.60 ± 28.75 (476.79-636.41)	563.80 ± 24.99 (494.40-633.20)	0.33

Key:- MCV = Mean Corpusular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration and PLT = Platelet count.

Table 4A: Comparison of some haematological parameters of male Wistar rats on *X. aethiopica* fruits without seeds for three months

Parameter/ Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		FRUITS WITHOUT SEEDS				
HCT %	1	39.64 ± 0.23 (39.00-40.28)	40.46±0.48 (39.14-41.78)	40.54±1.42 (36.61-44.47)	40.78±0.87 (38.38-43.19)	0.81
	2	39.78±0.17 (39.32-40.24)	40.08±1.05 (37.18-42.99)	40.50±1.64 (35.96-45.04)	41.80±1.25 (38.34-45.26)	0.63
	3	39.72±0.39 (38.63-40.81)	40.18±0.29 (39.39-40.97)	40.96±0.55 (39.43-42.49)	41.22±0.58 (39.62-42.83)	0.13
HGB g/dl	1	12.86 ± 0.16 (12.43-13.30)	13.58±0.28 (12.81-14.35)	13.76±0.52 (12.31-15.21)	13.92±0.49 (12.56-15.28)	0.27
	2	13.66 ± 0.13 (13.29-14.03)	13.94±0.12 (13.65-14.28)	13.98±0.12 (13.61-14.28)	14.02±0.11 (13.71-14.33)	0.19
	3	13.86±0.10 (13.59-14.13)	14.04±0.07 (13.85-14.23)	14.08±0.04 (13.98-14.18)	14.12±0.09 (13.88-14.36)	0.12
RBC 10^6/µl	1	7.35 ± 0.28 (6.56-8.13)	8.07±0.39 (7.00-9.14)	8.22±0.47 (6.92-9.52)	8.29±0.30 (7.45-9.13)	0.28
	2	7.25±0.28 (6.46-8.04)	7.75±0.32 (6.85-8.64)	8.06±0.40 (6.95-9.17)	8.12±0.25 (7.42-8.82)	0.24
	3	7.37±0.27 (0.61-8.14)	7.79±0.25 (7.10-8.49)	7.87±0.39 (6.78-8.97)	8.21±0.22 (7.60-8.81)	0.28
WBC 10^3/µl	1	15.60± 1.38 (1178-19.42)	16.94±1.69 (12.24-21.64)	16.66±1.45 (12.65-20.68)	16.84±1.88 (11.63-22.05)	0.93
	2	17.02±1.12 (13.90-20.14)	18.60±1.24 (15.17-22.03)	17.56±0.90 (15.06-20.06)	17.60±1.10 (14.54-20.66)	0.78
	3	17.10±1.11 (14.02-20.18)	18.62±0.97 (15.92-21.32)	18.00±0.80 (15.79-20.21)	18.02±1.10 (14.97-21.07)	0.76

Key:- HCT = haematocrit, HGB = Haemoglobin, RBC = Red blood cell count and WBC = White blood cell count

Table 4B: Comparison of some haematological parameters of male Wistar rats on *X. aethiopica* fruits without seeds for three months

Parameter/ Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		FRUITS WITHOUT SEEDS				
MCV µm^3	1	48.22 ± 0.72 (46.23-50.21)	48.62±0.91 (46.08-51.16)	48.92±1.41 (45.01-52.84)	48.96 ± 0.90 (46.47-51.45)	0.95
	2	49.82±0.32 (48.93-50.71)	50.44±1.29 (46.86-54.02)	50.74±1.38 (46.90-54.58)	50.94±1.60 (46.90-55.38)	0.93
	3	50.02±0.32 (49.12-50.92)	50.32 ± 0.40 (49.20-51.44)	50.62±0.82 (48.33-52.91)	50.40±0.61 (48.72-52.08)	0.90
MCH Pg	1	16.90±0.79 (14.71-19.09)	17.20±1.10 (14,15-20.25)	17.40±1.23 (13.98-20.82)	17.44±1.38 (13.62-21.26)	0.99
	2	20.24±0.50 (18.86-21.62)	20.32 ± 0.60 (18.66-21.98)	21.00±0.55 (19.47-22.53)	21.84±0.76 (19.72-23.96)	0.26
	3	19.92±0.56 (18.37-21.47)	20.56±0.70 (18.61-22.51)	20.94±0.54 (19.45-22.43)	21.86±0.70 (19.91-23.81)	0.22
MCHC g/dl	1	31.20 ± 0.30 (30.37-32.03)	32.60±0.74 (30.55-34.65)	32.88±0.57 (31.31-34.45)	32.90±0.29 (32.11-33.70)	0.09
	2	39.08±0.60 (37.42-40.74)	39.64±0.39 (38.56-40.72)	39.66±0.53 (38.18-41.14)	40.02±0.69 (38.10-41.94)	0.70
	3	39.28±0.35 (38.32-40.24)	40.36±0.30 (39.52-41.20)	40.46±0.44 (39.25-41.67)	40.56±0.29* (39.74-41.38)	0.07
PLT 10^3/µl	1	353.20±20.38 (296.63-409.77)	382.00±37.94 (276.69-487.31)	407.00±29.17 (326.02-487.98)	388.20±41.08 (274.16-502.24)	0.72
	2	400.60±8.02 (378.33-422.87)	531.80±39.44* (422.31-641.29)	534.00±36.38* (433.02-634.98)	551.40±25.99** (479.26-623.54)	0.01
	3	421.80 ± 17.78 (372.44-471.16)	537.60 ± 45.13(412.32-662.88)	567.00 ± 35.66* (468.02-665.98)	581.40 ± 33.21* (489.22-673.58)	0.02

Key:- MCV = Mean Corpusular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration, PLT = Platelet count, * = Significant and ** = Very significant

Table 5A: Comparison of some haematological parameters of female Wistar rats on *X. aethiopica* fruits with seeds for three months

Parameter/ Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		FRUITS WITH SEEDS				
HCT %	1	37.02±1.08 (34.03-40.00)	37.82±1.04 (34.94-40.70)	37.90±1.46 (33.85-1.95)	37.92±1.42 (33.98- 41.86)	0.95
	2	37.00 ± 0.63 (35.26-38.75)	38.72 ± 0.29 (37.92-9.52)	38.74±1.14 (35.59-1.89)	38.56±1.62 (34.06-43.06)	0.60
	3	37.34 ± 0.68 (35.46-39.22)	38.84 ± 0.43 (37.65-40.03)	38.80 ± 0.52 (37.37-0.23)	38.94 ± 0.99 (36.20-38.40)	0.33
HGB g/dl	1	12.84 ± 0.57 (11.25-14.43)	13.62±0.26 (12.91-14.33)	14.18±0.61 (12.48-15.88)	14.26±0.35 (13.29-15.23)	0.17
	2	12.56 ± 0.11 (12.25-12.87)	12.96±0.22 (12.35-13.57)	13.32±0.66 (11.48-15.16)	13.60±0.64 (11.83-15.37)	0.46
	3	13.60 ± 0.16 (13.16-14.04)	13.86 ± 0.11 (13.55-4.17)	14.02 ± 0.24 (13.37-14.67)	14.16 ± 0.14 (13.756-14.56)	0.15
RBC 10^6/µl	1	7.38 ± 0.60 (5.71-9.05)	7.74±0.72 (5.74-9.75)	7.78±0.69 (5.88-9.69)	7.80±0.68 (5.91-9.68)	0.97
	2	5.46 ± 0.12 (5.12-5.81)	5.74±0.16 (5.30-6.18)	5.8±0.23 (5.24-6.53)	5.90±0.32 (5.01-6.79)	0.49
	3	5.76 ± 0.16 (5.32-6.19)	6.09 ± 0.09 (5.85-6.33)	6.18 ± 0.15 (5.76-6.60)	6.39 ± 0.31 (5.54-7.25)	0.17
WBC 10^3/µl	1	8.46 ± 1.09 (5.44-11.48)	10.16±0.54 (8.66-11.66)	10.98±0.42 (9.81-12.15)	13.58±0.62** (11.86-15.30)	0.01
	2	4.28 ± 0.36 (3.27-5.29)	5.24±0.43 (4.05-6.43)	5.42±0.55 (3.88-6.96)	5.80±0.43 (4.61-6.99)	0.14
	3	4.68 ± 0.25 (3.98-5.38)	5.56±0.26 (4.84-6.28)	5.84 ± 0.51 (4.44-7.24)	6.02 ± 0.33* (5.09-6.95)	0.07

Key:- HCT = haematocrit, HGB = Haemoglobin, RBC = Red blood cell count, WBC = White blood cell count , * = Significant and ** = Very significant.

Table 5B: Comparison of some haematological parameters of female Wistar rats on *X. aethiopica* fruits with seeds for three months

Parameter/ Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		FRUITS WITH SEEDS				
MCV µm^3	1	45.60 ± 0.66 (43.78-47.42)	46.00±1.99 (40.46-51.55)	48.22±2.89 (40.21-56.24)	49.04±3.6 2 (38.98-59.10)	0.73
	2	65.32±0.80 (63.10-67.55)	68.10 ± 2.64 (60.77-75.43)	64.90 ± 1.12 (61.79-68.01)	67.84 ± 1.42 (63.90-71.78)	0.41
	3	66.02 ± 0.67 (64.15-67.89)	67.00 ± 1.40 (63.11-70.89)	66.76 ± 1.50 (62.61-70.91)	68.16 ± 0.89 (65.69-70.63)	0.64
MCH Pg	1	16.78 ± 0.61 (15.10-18.46)	17.04±1.04 (14.16-19.92)	18.20±1.79 (13.24-23.16)	18.14±1.64 (13.60-22.68)	0.83
	2	22.24 ± 0.20 (21.67-22.81)	22.90±0.64 (21.12-24.68)	22.54±0.28 (21.78-23.30)	23.22±0.16 (22.79-23.65)	0.30
	3	22.36 ± 0.33 (21.45-23.27)	22.94 ± 0.22 (22.32-23.56)	23.02 ± 0.27 (22.26-23.78)	23.12 ±0.31 (22.26-23.98)	0.27
MCHC g/dl	1	36.14± 0.37 (35.11-37.17)	36.30±0.26 (35.59-37.00)	37.94±1.47 33.87-42.01)	38.12±1.25 (34.60-41.60)	0.37
	2	34.00 ± 0.22 (33.38-34.62)	34.22±0.67 (32.36-36.08)	34.84±0.65 (33.02-36.66)	34.52±0.66 (32.70-36.34)	0.76
	3	33.86 ± 0.14 (33.46-34.26)	34.12 ± 0.28 (33.35-34.89)	34.58 ± 0.46 (33.32-35.84)	34.76 ± 0.24 (34.08-35.44)	0.18
PLT 10^3/µl	1	453.80±26.42 (380.45-527.15)	462.20±25.36 (391.78-532.61)	502.00±23.48 (436.81-567.19)	547.00±55.43 (393.12-700.88)	0.26
	2	222.00 ± 21.66 (161.88-282.12)	231.40±30.04 (148.02-314.78)	244.80±16.54 (198.90-290.70)	243.60±25.33 (173.28-313.92)	0.89
	3	251.60 ± 14.50 (211.36-291.84)	284.60 ± 13.68 (246.63-322.57)	294.20 ± 18.69 (242.32-346.08)	290.60 ± 16.77 (244.05-337.15)	0.26

Key:- MCV = Mean Corpusular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration and PLT = Platelet count

DISCUSION

Previous studies on the effect of on *X. aethiopica* were centred on the use of whole fruits and for short period of time in Wistar rats. Also most of the studies did not take into consideration sex variation when evaluating the effect of *X. aethiopica* in Wistar rats (Kadiri et al., 2015; Onyebuagu et al., 2014; Oso et al., 2019). The present study evaluated the effects of hydro-ethanolic extracts of leave, fruits without seeds and fruits with seeds in males and female Wistar rats for one, two and three months at different concentrations. The administration of ethanolic extract of leave, fruits without seed and fruits with seed resulted in increased mean levels of total WBC and platelets among female Wistar rats but not in male Wistar rats in a dose dependent manner. *X. aethiopica* is not toxic in any way to Wistar rats at the dose and duration of treatment. There were no significant changes in the mean values of the other measured haematological parameters. The results are partially at variance with previous report (Assih et al., 2022). The authors reported insignificant increase in all haematological parameters except platelet that increase with concentration of leave extract.

The observed results of insignificant increase the haematological parameters among male Wistar rats on *X. aethiopica* fruits without seeds and a significant increase in total WBC and platelets among female Wistar rats aligned with previous report (Nwafor et al., 2009). The authors reported a significant increase in total WBC and platelet count. However, the results are not consistent with the findings of Oso *et al*., (2019) who observed a significant decrease in platelet count following administration of *X. aethiopica* fruits without seeds (pods) to rats (Oso et al., 2019).

The observed increase in total WBC levels among female Wistar rats on *X. aethiopica* fruits with seeds is partly in agreement with previous findings (Onyebuagu et al., 2014), but not consistent in several other ways. The authors reported that the administration of *X. aethiopica* in Wistar rats caused increase in Hb concentration and RBC among Wistar rats that received the 2.5% w/w, since changes in Hb concentration will also affect the total RBC. They suggested a possible induction of erythropoietin by *X. aethiopica*. This suggestion was hinged on a previous study which reported a high iron content that make

up of 53.8% of the phyto-mineral composition of the *X.aethiopica* fruits (Evuen et al., 2022). The differences may be due to the environmental changes in the location where *X. aethiopica* is cultivated. The phytochemical constituents of plants varies not only due to varieties or species but due to external variables including environmental conditions, agricultural practices, and post-harvest handling. It is important to note that the phytochemical composition of a given plant can change based on the geographic region as a result of the differences in type of soil, levels of precipitation, light intensity, humidity (Pereira et al., 2024). The report of insignificant changes in red cell indices is also not consistent with previous study (Nwafor et al., 2009; Onyebuagu et al., 2014). The authors reported significant increases in the RBC indices such as Hb, PCV, MCV, MCH and MCHC.

It is important to state that the significant increases observed in the total WBC and platelet count were transient and did not have any compensatory effect on the WBC differentials that is, it did not cause any increase in the neutrophils nor the lymphocytes. Therefore, the increases might be likely due to stress on the rats because of the environment (being caged for many days), or from daily oral administration of the extract or the effect of the extracts administered. It is known that administration of drugs or new substances into a life animal may cause sudden increase in total WBC and platelet count (Shugaba et al., 2012).

CONCLUSION

The administration of hydro-ethanolic extracts of *X. aethiopica* to Wistar rats caused a significant increase observed in the total WBC and platelet count even though transient but not in the male Wistar rats. Acute or chronic administration of *X.aethiopica* may not have adverse effects.

Table 6A: Comparison of some haematological parameters of male Wister rats on *X. aethiopica* fruits with seeds for three months

Parameter / Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		FRUITS WITH SEEDS				
HCT %	1	36.82 ± 0.98 (34.11-39.53)	37.02 ± 1.10 (33.98-40.07)	37.58 ± 0.83 (35.28-39.88)	37.92 ± 1.37 (34.12-41.72)	0.88
	2	36.82 ± 0.98 (34.11-39.53)	37.70 ± 0.85 (35.33-40.07)	38.22 ± 1.41 (34.31-42.13)	38.30 ± 1.09 (35.27-41.33)	0.77
	3	36.98 ± 0.66 (35.16-38.80)	38.40 ± 0.64 (36.62-40.18)	38.72 ± 0.76 (36.61-40.83)	38.78 ± 0.51 (37.37-40.19)	0.21
HGB g/dl	1	14. 88 ± 0.46 (13.59-16.17)	14.96 ± 0.57 (13.37-16.55)	15.28 ± 0.52 (13.85-16.71)	15.46 ± 0.50 (14.07-16.85)	0.84
	2	14.88 ± 0.46 (13.59-16.17)	15.04 ± 0.47 (13.7316.35)	15.24 ± 0.69 (13.32-17.16)	15.30 ± 0.44 (14.08-16.52)	0.94
	3	14.94 ± 0.22 (14.33-15.55)	15.72 ± 0.30 (14.89-16.55)	15.64 ± 0.38 (14.58-16.70)	15.88 ± 0.29 (15.06-16.70)	0.18
RBC 10^6/µl	1	6.63 ± 0.44 (5.41-7.85)	6.75 ± 0.24 (6.09-7.41)	6.87 ± 0.20 (6.33-7.42)	7.05 ± 0.19 (6.53-7.57)	0.76
	2	6.57 ± 0.33 (55.66-7.48)	6.97 ± 0.18 (6.46-7.48)	7.11 ± 0.17 (6.64-7.58)	7.16 ± 0.11 (6.87-7.46)	0.23
	3	17.70 ± 1.04 (14.81-20.59)	17.96 ± 1.20 (14.63-21.29)	17.90 ± 1.15 (14.71-21.09)	18.30 ± 1.08 (15.29-21.31)	0.98
WBC 10^3/µl	1	17.10 ± 1.98 (11.60-22.60)	17.52 ± 1.87 (12.33-22.71)	17.66 ± 2.20 (11.56-23.76)	18.48 ± 1.35 (14.73-22.24)	0.96
	2	17.92 ± 1.19 (14.63-21.21)	18. 18 ± 1.46 (14.13-22.22)	18.78 ± 1.70 (14.07-23.49)	18.56 ± 1.82 (13.50-23.62)	0.98
	3	17.70 ± 1.04 (14.81-20.59)	17.96 ± 1.20 (14.63-21.29)	17.90 ± 1.15 (14.71-21.09)	18.30 ± 1.08 (15.29-21.31)	0.98

Key:- HCT = haematocrit, HGB = Haemoglobin, RBC = Red blood cell count and WBC = White blood cell count.

Table 6B: Comparison of some haematological parameters of male Wistar rats on *X. aethiopica* fruits with seeds for three months

Parameter/ Units	Duration in months	Treatment Doses				P value
		Control (A)	125mg/Kg (B)	250mg/Kg (C)	500mg/Kg (D)	
		FRUITS WITH SEEDS				
MCV µm^3	1	52.96±1.09 (49.95-55.97)	53.66±1.56 (49.34-57.98)	52.98±0.90 (50.47-55.49)	53.32\±0.96 (50.64-56.00)	0.97
	2	52.32 ± 0.44 (51.11-53.53)	53.82±0.88 (51.37-56.27)	53.94±0.44 (52.71-55.17)	54.54±0.92 (51.99-57.03)	0.19
	3	52.26 ± 0.51 (50.85-53.67)	53.54±0.66 (51.71-55.37)	53.74±0.84 (51.40-56.08)	54.14±0.76 (52.04-56.24)	0.30
MCH Pg	1	21.20 ± 0.86 (18.81-23.59)	21.32±0.82 (19.05-23.59)	21.38±0.40 (20.27-22.50)	21.46±0.39 (20.38-22.54)	0.99
	2	21.02 ± 0.48 (19.68-22.36)	21.80±0.23 (21.17-22.43)	21.22±0.44 (19.99-22.45)	21.78±0.45 (20.53-23.03)	0.46
	3	21.88 ± 0.47 (20.57-23.19)	22.10±0.46 (20.84-23.36)	22.22±0.72 (20.21-24.23)	22.26±0.49 (20.89-23.63)	0.96
MCHC g/dl	1	40.08±0.67 (38.22-41.94)	40.10±0.27 (39.35-40.85)	40.22±0.21 (39.64-40.80)	40.16±0.15 (39.73-40.59)	0.99
	2	40.02 ± 0.27 (39.27-40.77)	40.40±0.16 (39.96-40.84)	40.10±0.55 (38.57-41.63)	40.46±0.42 (39.30-41.62)	0.80
	3	40.24 ± 0.40 (39.12-41.36)	40.38±0.31 (39.52-41.24)	40.40±0.12 (40.06-40.74)	40.54±0.25 (39.83-41.25)	0.91
PLT 10^3/µl	1	536.40 ± 43.99 (414.30-658.50)	552.80±34.81 (456.16-649.44)	628.40±53.45 (480.03-776.77)	591.60±14.42 (551.56-631.64)	0.38
	2	511.80 ± 32.46 (421.70-601.90)	543.80±42.62 (425.47-662.13)	547.20±28.71 (467.51-626.89)	606.40±33.18 (514.29-698.51)	0.31
	3	535.20 ± 17.97 (485.32-585.08)	569.60±20.59 (512.45-626.75)	576.60±25.61 (505.50-647.70)	618.20±15.00˚(576.56-659.84)	0.07

Key:- MCV = Mean Corpusular Volume, MCH = Mean Corpuscular Haemoglobin, MCHC = Mean Corpuscular Haemoglobin Concentration and PLT = Platelet count

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All data generated during this study are included in this published article.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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