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Determination of Impact of Acute and Chronic Administration of Aqueous Root Extract of *E. Tremula* (*Burburwa*) on some Haematological parameters in Wistar Albino Rats

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Abstract

Eragrostis tremula (Burburwa) is an herbal plant native to tropical Africa, India and Myanmar. It is found in sandy soils and abandoned cultivations. It is used locally for sweeping, used as fodder for cattle and extensively being used in traditional medicine practice without assessing its safety. This study investigated the impact on blood cells (WBCs) on chronic/acute use of aqueous root extract of *Eragrostis tremula* among males/females wistar rats. The preliminary phytochemical screening revealed the presence of alkaloids, carbohydrate, phenols, saponins, tannins, anthraquinones, cardiac glycosides, flavonoids and diterpene. Lorke's method was used for oral acute toxicity study (LD50 determination). A total of 20 wistar rats were used, divided into four groups of five rats each. Group I was control and administered with distilled water, Group II, Group III and Group IV were respectively administered with 200 mg, 400 mg and 800 mg of the extract per kilogram body weight, for 21 days. The result of acute oral toxicity study was estimated to be greater than 5000 mg/kg. Total and differential (neutrophil, lymphocyte, and mixed cells) leukocyte counts were analysed. *Eragrostis tremula* aqueous root extract significantly ($p<0.05$) decreased lymphocyte and total leukocyte counts, but no significant changes ($p>0.05$) were observed in neutrophil and mixed cells count when the treated groups were compared with the control group. In conclusion, the findings of the present study have shown that, aqueous root extract of *Eragrostis tremula* has impact on lymphocyte and total leukocyte count in the wistar rats which is dependent on dose of the extract. The extract at high doses increases the lymphocyte and total leukocyte counts of the treated groups.

Keywords: Total leukocyte count; Aqueous Root Extract; *Eragrostis Tremula*; wistar rats.

Introduction

Blood is a fluid connective tissue that transports oxygen and nutrients to body cells and removes carbon dioxide and other waste products of metabolism away from the cells (Cheeke, and Shull, 1999). It is a composed of formed elements (erythrocytes, leucocytes, thrombocytes) and fluid plasma and it accounts for 7% of human body weight (Austin and Perkins, 2006). Checking the effect of substances on haematological parameters can be used as a way of evaluating the extent of untoward consequences of foreign substances including plant extracts on the blood composition of animals (Ashafa *et al*., 2009).

White blood cells (WBCs), also called leukocytes or leucocytes. They are the main cells of the immune system that provide innate and specific adaptive immunity. All white blood cells are produced and derived from multipotent cells in the bone marrow known as haematopoietic stem cells. Leukocytes are found throughout the body, including the blood and lymphatic system, they are involved in protecting the body against both infectious disease and foreign invaders (Maton *et al.,* 1997). White blood cells (leukocytes) are an important part of the body's defence against infectious

organism, tumors as well as other foreign substances. To defend the body adequately, a sufficient number of white cells must receive a message that an infectious organism or foreign substances has invaded the body, get to where they are needed, and then kill and digest the harmful organism or substance. White cells are further divided into five different classes which include; basophils, neutrophils, eosinophils, lymphocytes and monocytes (Chesbrough, 2009). Neutrophils defend against bacterial or fungal infection, eosinophils defend against parasitic infections and in response to allergies (Saladin, 2012). Like eosinophils, basophils play a role in both parasitic infections and allergies (Voehringer, 2009). Basophils excrete two chemicals that aid in the body's defenses and contain histamine and heparin (Saladin, 2012). Lymphocyte defend against viral infection, lysis of virally infected cells, tumour cells and allografts (Berrington *et al.,* 2005). Monocyte defend against bacterial infection, killing infected host cells via antibody-dependent cell mediated cytotoxicity.

Herbal medicine is used by about 60% of the world population both in the developing and in the developed countries where modern medicines are predominantly used (Ogbonnia *et al.,* 2008; Rickert *et al.,* 1999). Certain medicinal plants and herbs are believed to enhance health and improve resistance against infection through conditioning the body tissues and re-establishing body equilibrium (Sumit *et al*., 2014).

Eragrostis tremula (Burburwa) is native to tropical Africa, India and Myanmar. It is found in sandy soils and abandoned cultivations. It belongs to the family Poaceae. It is used as fodder for cattle (Skerman, 1990). And eaten in times of food scarcity (Ambasta, 2016). The plant (*E. tremula*) is harvested for wild animal, for local use for sweeping, building of thatch mud, and food for source of energy (Bergamin *et al.,*2010). The genus Eragrostis contains about 350 species which are important medicinal plants widely distributed in tropical, subtropical and warm temperate regions (Peterson and Vega, 2007). Plant extracts play a significant role in the prevention and curing infections by modulating the immune system, as a result, their application and use has increased dramatically (Bashir *et al.,* 2015). Herbal medicines act on the immune system by either suppressing or stimulating innate or adaptive immune cells/molecules (Radokovic *et al.,* 2015). Immune regulation is important in maintaining normal protection, and the search for herbal immunomodulatory compounds to treat various infections by enhancing the body's natural resistance is of growing interest (Rahman *et al.,* 2013). Many medicinal plants are known to have immunomodulatory properties and maintain organic resistance against infection by re-establishing the body's immune system such as *Dendropanaxmorbifera* found to increase the number and proliferation of T- and B-lymphocytes (Chukwujekwu *et al.,* 2006). *Pomegranate peel* extract inhibits neutrophil myeloperoxidase (MPO) activity and attenuates lipopolysaccharide-induced lung inflammation in mice (Bhattacharya *et al.,* 2003).

The ethanol extract of *E. tremula* possesses memory enhancing properties which can be utilized in the management of amnesia and cognitive deficit (Nazifi *et al.,* 2019). Some of the species have been used in ethnomedicine against various disease conditions including learning and memory related problems (Soladoye *et al.,* 2010; Odugbemi, 2008). Isoorientin, isovitexin, and caffeic acid remote from *Eragrostis japonica* were reported to possess neuroprotective activities (Na *et al.,* 2018). *Eragrostis ferruginea* was also reported to possess important compounds with neuroprotective activities against amyloid beta peptide (Na *et al.,* 2010).

Plant extracts play a significant role in the prevention and curing infections by modulating the immune system, as a result, their application and use has increased dramatically (Bashir *et al.,* 2015). Herbal medicines act on the immune system by either suppressing or stimulating innate or adaptive immune cells/molecules (Radokovic *et al.,* 2015). Immune regulation is important in maintaining normal protection, and the search for herbal immunomodulatory compounds to treat various infections by enhancing the body's natural resistance is of growing interest (Rahman *et al.,* 2013).

Blood is a tissue that carries this root extracts and other substances to various places in the body for their desired effect. Based on our knowledge, no report has been made on the impact of this root extract on the immune cells. This research therefore, aimed at determining the phytochemical constituents, acute toxicity and the impact of acute and chronic administration of aqueous root extract of *E. tremula* (*burburwa*) on blood cells particularly the leukocyte counts in wistar albino rats.

Materials and Methods

Experimental Animals/ Animal Care

Apparently healthy wistar rats, weighing between 90 g-159 g of either gender (female 10; male 10) were purchased from animal house in the Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University Sokoto (UDUS). The animals were house in the animal house of the Faculty of Pharmaceutical Sciences, UDUS, Nigeria. They were maintained in clean metabolic cages and placed in an air-conditioned room with good ventilation, photo periods of 12-hours light and 12-hours darkness. The rats were maintained on rat pellet feeds of standard animal feed (Top feed Nigerian limited), which was obtained from the animal house of the Faculty of Pharmaceutical Sciences, UDUS, Sokoto and supplied with clean drinking water ad libitum.

Ethical approval for the use of animals was obtained from Usmanu Danfodiyo University Research and Ethics Committee. And animal ethics approval number was generated. Experimental guidelines were followed as stipulated by Organization for Economic Co-operation and Development (OECD) guidelines (OECD, 2001). The guidelines of National Institute of Health (NIH) for the care of laboratory animals were properly adhered to. Varying concentrations of the root extract were prepared on daily basis by mixing with distilled water and administered to the rats per kg of the body weight. The stock root extract was kept refrigerated at 4°C until required for use (Ahmad *et al.,* 2013).

Plant Collection and Identifications

The whole plants of *Eragrostis tremula (Burburwa)* were obtained from Gandi Town, Sokoto state. The plants roots were identified and authenticated at the Herbarium unit of the Department of Pharmacognosy and Echnomedicine, Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University, Sokoto (UDUS). The Herbarium voucher number, PCG/UDUS/POAC/0007 wasgenerated and deposited in the Herbarium.

Plants Preparation and Extraction

The plants roots were aseptically cut off, washed and air dried under shade, it was grinded into powder form. The powder samples were sieved and kept for further processing. Plant extraction was performed at the Pharmacognosy and Ethnopharmacy laboratory of the Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University Sokoto, Nigeria. The grinded roots powder (600 grams) was extracted with distilled water (4.5 litres) by cold maceration with occasional shaking for 24 hours. The resulting root extract was filtered using Whatman number 1 filter paper and the filtrate was concentrated to dryness in an oven at 50°C to obtain a dried root extract. The dried root extract was stored refrigerated at 4°C at the animal house until required for use (Ahmad *et al.,* 2013).

Preliminary Phytochemical Screening

Preliminary phytochemical screening of aqueous root extract of *Eragrostis tremula* was carried out using standard procedures described by Evans (2009). The extract was screened for the presence or absence of Phyto-constituents such as alkaloids, carbohydrate, phenols, saponins, proteins and amino acids, tannins, anthraquinones, cardiac glycosides, triterpenoids, flavonoids, diterpenes.

Experimental Design

Acute Toxicity Study (Determination of LD50); Limit Test

Lorke's Method (Lorke, 1983). Acute oral toxicity study, limit test, was performed in two phases, phase I and phase II in accordance with Lorke's method.

Phase I of Acute Toxicity Study

Nine Wistar rats were divided into three groups; group I, II and III respectively, of three rats each. Single dose of 10 mg, 100 mg and 1000 mg of the

extract was respectively administered to the animals in group I, II and III per kg of body weight by intragastric gavage using oral cannula. Observations for the signs of toxicity were made and recorded within the first four hours and subsequently for 24 hours after administration of the extract. The rats were closely monitored for behavioral changes and mortality for up to 14 days (Enegide *et al*., 2013).

Phase II of Acute Toxicity Study

Three rats were divided into three groups; group I, II and III respectively, of one rat each. Single dose of 1600 mg, 2900 mg and 5000 mg of extract was respectively administered to the group I, II and III rats per kg of body weight by intragastric gavage using oral cannula. Observations for the signs of toxicity were made and recorded within the first four hours and subsequently for 24 hours after administration of the extract. The rats were closely monitored for behavioral changes and mortality for up to 14 days (Enegide *et al*., 2013).

Grouping and Treatment

This study is experimental analytical study involving Wistar rat, and was conducted in Sokoto, in the animal house of the Faculty of Pharmaceutical Sciences, Usmanu Danfodiyo University Sokoto. Twenty (20) experimental Wistar rats were randomly divided in to four groups of five rats each (n = 5). Group I (normal control group), Group II, III and IV (treatment groups). The weights of each Wistar rats were measured on day 1, 7, 14, and 21. Group I received distilled water 10 ml/kg body weight and Group II, III and IV were orally administered with varying doses of the extract. Single doses of 200 mg, 400 mg and 800 mg of the extract were administered orally to the group II, III and IV respectively, daily for 21 days. All the rats were made to have free access to food and water throughout the study period.

Blood Sample Collection

The animals were anaesthesized in a covered transparent plastic container containing cotton wool soak with 10 ml chloroform. Three milliliters (3 ml) blood samples were collected from the animals through cardiac puncture using 5 ml syringes, and the blood samples from each animal was emptied partly into an EDTA anticoagulated container. The blood collected was gently inverted 5-6 times to mix the blood and the anticoagulant in order to prevent clotting. The rats were later sacrificed through lumbar dislocation. The collected samples were analyzed immediately in the Haematology Department of Specialist Hospital, Sokoto.

Sample Analysis

The total and differential WBC counts were estimated using an automated Coulter Counter System (Sysmex KX-21N) with standard calibration, according to the manufacturer's instructions for analysis of human blood using standard protocols (Jain, 1986).

Statistical Analysis

The results obtained were entered into SPSS version 23 for analysis. Continuous variables were expressed as mean and standard deviation (SD). Analyses of variance (ANOVA) were performed to explore differences on variables across the groups. Bonferroni test was used as post hoc test to compare some groups. The p value ≤ 0.05 was used to determine the level of statistical significance.

Results

The results obtained in the current study were presented in tables and figure.

Preliminary Phytochemical Screening

The root extract was screened for the presence Alkaloids, Carbohydrate, Phenols, Saponins, Proteins & Amino Acids, Tannins, Anthraquinones, Cardiac Glycosides, Triterpenoids, Flavonoids, Diterpenes. The result of the screening reveals the presence of Alkaloids, Carbohydrate, Phenols, Saponins, Tannins, Anthraquinones, Cardiac Glycosides, Flavonoids and Diterpenes; whereas Proteins & Amino Acids, and Triterpenoids, were found to be absent in the extract as depicted in the table 1 below.

Table 1: Preliminary Phytochemical Screening of *Eragrostis Tremula.*

Phytochemicals	Test	Result
Alkaloids	Meyer's	+
	Wagner's	+
	Dragendroff's	+
Carbohydrate	Molisch's	+
	Felling's	+
Phenols	Ferric chloride	+
Saponins	Fronthin's	+
Proteins & Amino Acids	Xanthoproteic	–
Tannins	Ferric chloride	+
	Lead sub-Acetate	+
Anthraquinones	Bontrager's	–
Cardiac Glycosides	Keller-Killani's	+
Triterpenoids	Salkowski's	+
	Liberman Burchard	+
Diterpenes	Copper acetate	+

Key: –: Absent; +: Present

Acute Oral Toxicity (Median Lethal Dose, LD50)

Phase I of Acute Oral Toxicity Study

Table 2 depicts the result of phase I of median lethal dose determination of aqueous root extract of *Eragrostis tremula* after a single oral dose administration of 10 mg/kg, 100 mg/kg and 1000 mg/kg for group I, group II and group III respectively. No death or any sign of toxicity were observed in all the three groups after 24 hours and up to end of the study.

Table 2: **Result of Phase I of Acute Oral Toxicity Study (Median Lethal Dose, LD50 Determination).**

Groups	N	Dose	Mortality
Group I	3	10 mg/kg	0
Group II	3	100 mg/kg	0
Group III	3	1000 mg/kg	0

Key: N: Number of rats

Phase II of Acute Oral Toxicity Study

The result of phase II of acute oral toxicity study (median lethal dose determination) of the aqueous root extract of *Eragrostis tremula* after a single oral dose administration of 1600 mg/kg, 2900 mg/kg and 5000 mg/kg for group I, group II and group III respectively are depicted in the table 3. No mortality was documented in all the groups after 24 hours as shown in the table 3. below.

Table 3: **Result of Phase II of Acute Oral Toxicity Study (Median Lethal Dose, LD50 Determination)**

Groups	N	Dose	Mortality
GroupI	1	1600 mg/kg	0
GroupII	1	2900 mg/kg	0
GroupIII	1	5000 mg/kg	0
Key: N: Number of rats			

Total and Differential Leukocyte Count

The result of the impact of aqueous root extract of *Eragrostis tremula* on total and Differential leukocytes countin wistar rats was depicted in table 4, table 5and figure 1.

Table 4: Impact of Aqueous Root Extract of *E. Tremula* on Total and Differential Leukocyte Count in Wistar Rats.

Groups N= 20	Treatment	Dose (kg/bwt)	Mean±SD ($\times 10^9$ cells/ L)			
			TLC	NEU	LMP	MXD
I	Distilled water	10 ml	9.50±1.12	0.92±0.26	7.76±0.95	0.82±0.58
II	*E. tremula*	200 mg	3.72±0.89	0.560±0.24	2.84±0.62	0.32±0.19
III	*E. tremula*	400 mg	6.88±0.66	0.90±0.38	5.42±0.87	0.56±0.42
IV	*E. tremula*	800 mg	6.62±0.95	1.060±0.69	5.10±1.55	0.46±0.23
F			33.043	1.189	18.260	1.460
p-value			<0.0001	0.345	<0.0001	0.263

Key: TLC: Total leukocyte count. NEU: Neutrophil; LYM: Lymphocyte; MXD: Mixed cells (monocytes, eosinophils and basophils); N: Number of rats.
Values are expressed as Mean±SD (standard deviation); p-value ≤ 0.05 is statistically significance.

Table 5: Group Comparison of the Impact of Aqueous Root Extract of *E. Tremula* on Total and Differential Leukocyte Count in Wistar Rats. Post-hoc Test (Bonferroni)

Comparison	95% Confidence Interval (p- value)			
	TLC	NEU	LYM	MXD
I vs II	<0.0001	1.000	<0.0001	0.360
I vs III	0.002	1.000	0.017	1.000
I vs IV	0.001	1.000	0.006	0.986
II vs III	<0.0001	1.000	0.008	1.000
II vs IV	0.001	0.529	0.022	1.000
III vs IV	1.000	1.000	1.000	1.000

Key: TLC: Total leukocyte count; NEU: Neutrophil; LYM: Lymphocyte; MXD: Mixed cells (monocytes, eosinophils and basophils); p-value ≤ 0.05 is statistically significance.

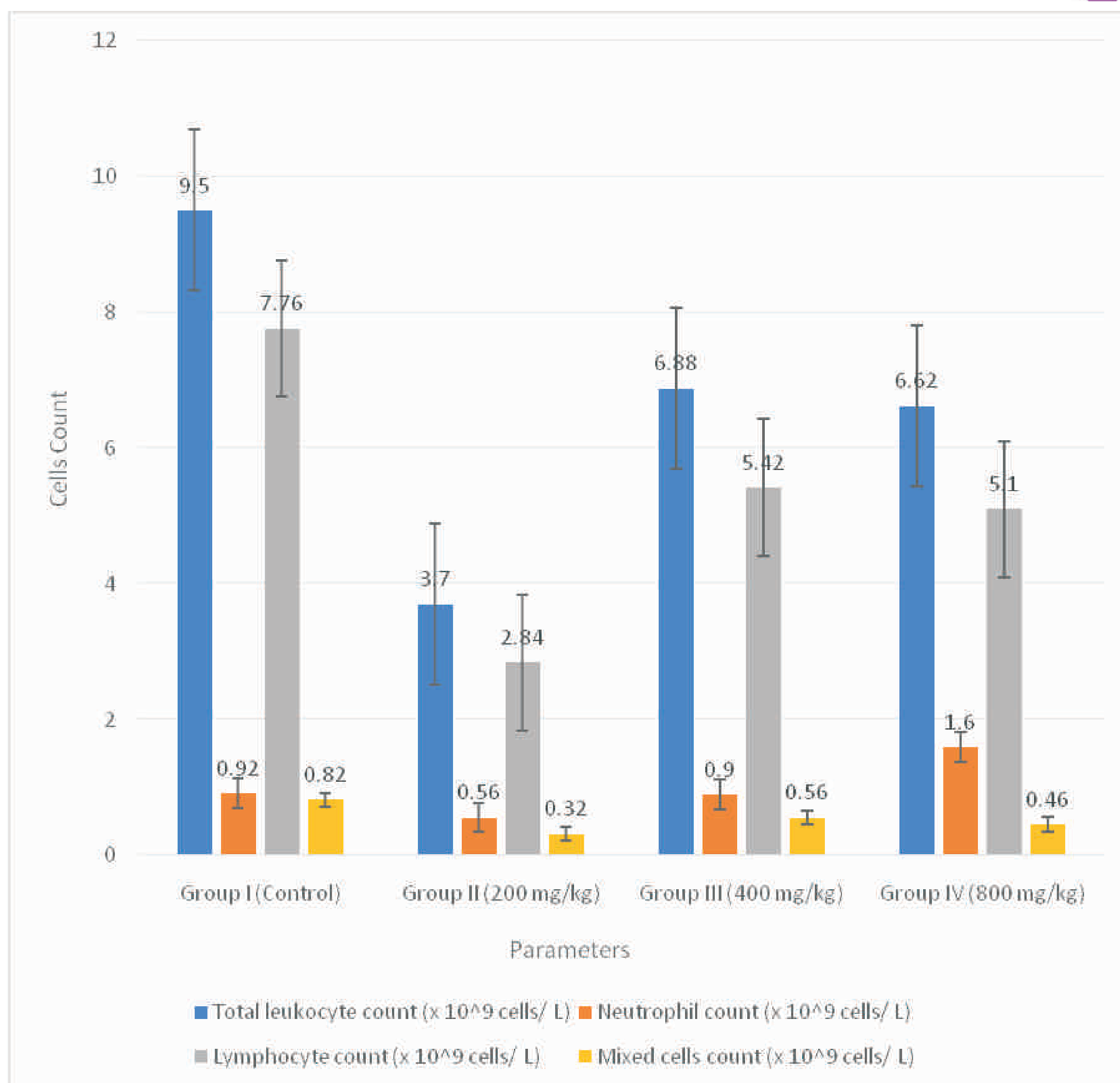

Figure 1: **Result of the impact of Aqueous Root Extract of *E. Tremula* on Total and Differential (Neutrophil, Lymphocyte and Mixed Cells) Leukocyte Count of Wistar Rats. Values are expressed as Mean±SD (standard deviation).**

Discussion

The preliminary phytochemical screening carried out in this research revealed the presence of alkaloids, carbohydrate, phenols, saponins, tannins, anthraquinones, cardiac glycosides, flavonoids and diterpenes (table 1). This is partially consistent with the finding carried out in Zaria, by Nazifi *et al*. (2019), who reports the presence of alkaloids, cardiac glycosides, flavonoids, tannins, saponins, steroids and triterpenes in hydroalcoholic extract of *E. tremula. Our finding is at variance with a previous report (*Nazifi *et al*., 2019) which indicated the presence of triterpenoids. However, the plant genotype, environmental conditions and plant maturity stage have a great influence over the phytochemical profile (Duelund and Mouritsen, 2017). External factors such as temperature, amount of sunlight, soil fertility and water availability can be responsible for variation in phytochemical composition of a plant (Gonzalez-Zamora *et al*., 2015). These phytochemicals compounds have previously been reported as principal components of

resveratrol derivatives in various extracts of medicinal herbs (*Cai et al., 2004*). The differences between the current study and that conducted by Nazifi *et al*. (2019) could be attributed to conditions such as temperature, soil fertility, weather, and sun light. In the future, the speciation of *E. tremula* from the two places is required to know why the differences.

Acute toxicity is the ability of a substance to cause adverse effect within 24 hours of exposure (Senin, 2006). In the current study, quanta dose was used, in which rats were observed for mortality. In both the phase I and phase II of acute oral toxicity study; no mortality was documented (table 2 and table 3). Our finding is in agreement with the finding carried out in Zaria by Nazifi *et al*. (2019) which reported the absence of mortality in hydroalcoholic extract of *E. tremula in mice.* Absence of mortality in the animal loaded with 5000 mg/kg body weight (highest does) is an indication that the median acute lethal does (Ld50) of the aqueous root extract of *E. tremula* is greater than 5000 mg/kg body weight. According to the recommendation of Globally Harmonized System of Classification and Labelling of Chemicals (2003), a chemical is not classified as toxic if its Ld50 is greater than5000 mg/kg (Erhirhie *et al*., 2018).

In the current work, total and differential leukocyte counts (TLC) of wistar rat groups treated with varying doses of the aqueous root extract of *E. tremula* was compared with that of the control group and within the groups. There was a statistically significant decrease ($p<0.05$) in total leukocyte count of rat groups treated with 200 mg, 400 mg, and 800 mg of the extract per kg of body weight when compared with that of control group rats (table 4 and figure 2). The total leukocyte count of group I (control) is higher than that of group II (200 mg/kg), group III (400 mg/kg) and group IV (800 mg/kg). However, within the groups there was a significance increase ($p<0.05$) in total leukocyte count of group II (200 mg/kg) when compared with that of group III (400 mg/kg) and group IV (800 mg/kg) (table 5 and figure 1). This suggests that the extract has potential impact on leucocyte count at higher concentration within the groups in the wistar rat, there is dose dependant. The significant decrease in total leukocyte count relative to the control group at lower dose may be associated to impact of the extract at lower dose. The decreased WBCs in the treated groups might indicate depressed immune-response. The reduction in the total white blood cell count could also be due to reduced production of white blood cells, re-distribution of white blood cells from peripheral blood into the tissues or rapid destruction of white blood cells (Guyton & Hall 1996). This was however increased as more of the extract was consumed within the groups. The significant increase in WBCs might indicate activation of the immune system, a normal cell-mediated immune response (El-Demerdash, 2004).

We observed a statistically significant decrease ($p<0.05$) in lymphocyte count of rat groups treated with 200 mg, 400 mg, and 800mg of the extract per kg of body weight when compared with that of control group rats (table 4 and figure 1). The lymphocyte count of group I (control) is higher than that of group II (200 mg/kg), group III (400 mg/kg) and group IV (800 mg/kg). However, within the groups there was a significant increase ($p<0.05$) of lymphocyte count of group II (200 mg/kg) when compared with that of group III (400 mg/kg) and group IV (800 mg/kg) (table 5 and figure1). This suggests that the extract has a potential dose dependent variation impact on lymphocyte at higher concentration within the groups in the wistar rat.

There was no statistically significant difference ($p>0.05$) in neutrophil count of the rats in groups treated with 200 mg, 400 mg and 800 mg of the extract per kg of body weight when compared with that of the control group and also within the group. There was no statistically significant difference ($p>0.05$) in mixed cells count (monocyte, eosinophil and basophil) of the rat in groups treated with 200 mg, 400 mg, and 800 mg of the extract per kg of body weight when respectively compared with that of control group rats and among the groups (table 4, table 5 and figure1).

Total and differential leukocyte count increase or decrease in various types of immune reaction, including infections. The finding of this study reveals that; there is significant decrease ($p<0.05$) in lymphocyte and total leucocyte count of the treated rats compared to the control group. Within the group, there was a significant increase of lymphocyte and total leukocyte

counts of group II compared to other groups (III and IV). However, this study revealed no significant differences (p>0.05) in neutrophil and mixed cells count of control group compared to treated groups and also within the groups. The finding in this study is partially consistent with a previous report in Nsukka, Enugu by Joseph *et al.* (2013) who reported no significant change (p>0.05) in the WBCs of the rats in treatment groups when compared with those of the control group, and a significant increase (p<0.05) of white blood cell count within the groups when treated with aqueous root extract of *Vernonia amygdalina*. The findings of the present study were also in partial agreement with a finding in a study carried out in Calabar, Nigeria by Ofem *et al.* (2012) who reported no significant changes (p>0.05) in the total white blood cells (WBCs) count, but significantly (p<0.05) lower lymphocyte in rats treated with aqueous leaves extract of *Ocimum gratissimum*. However, the finding in the present study is at variance with the findings of a study carried out in New-Delhi, India by Bin-Hafeez *et al.* (2001**)** who reported a significant increase in total leukocyte count in mice when treated with *Cassia occidentalis* methanolic leaf extract. Our finding is also at variance with the study carried out in Kenya by Muriithi *et al*. (2015) who reported a significant increase in neutrophil, lymphocyte, basophil and total leukocyte count in mice treated with methanolic leaf extract of *Vernonia lasiopus*. Similarly, studies **of** Tiwari *et al*. (2004) on aqueous extract of *Tridax procumbens in experimental animals also showed a* significant increase in total leukocyte count. Our finding is at variance with the study carried out in Maiduguri by Abdulrahman *et al*. (2010) who reported a significance increased in lymphocyte and total leukocyte count and a significant decreased in neutrophil, basophil, eosinophil and monocyte in rats treated with aqueous root-bark extract of *Vitex doniana* sweet. Considering the importance of white blood cells in maintaining the integrity of the immune system, their increase in the blood may result in an increase in defence system of mammals (Okonkwo *et al*., 2019). However, their decrease in the blood may result in decreased immune function of mammals. The variation observed may be due to the difference in the aqueous root extract used and differences in phytochemical constituents present in the extract. In the future, more investigations are required using *E. tremula* root extract to ascertain its effect on white cells and other haematological parameters in-vivo.

Conclusion

From the findings of the present study, it is concluded that aqueous root extract of *Eragrostis tremula* is non-toxic as seen in acute toxicity study. The phytochemical analysis indicates that the extract possessed many bioactive compounds that are known to have some potential impact on total and differential leukocyte counts in rats. The impact of the extract is time and dose dependent as seen in the groups. Further study should be carried out to ascertain the potential impact of the extract on other haematological parameters, perhaps, using a 5-part differential Haematology analyzer to assess the impact of the plant extract on each of the mixed cells count (monocyte, eosinophil and basophil). We also need to study if the extract has a positive impact on tumor cells, with the view to exploit it cytotoxic effect to treat people with haematological malignancies.

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