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Hematological Alterations Occurring in Culinary Exposure of Wistar Rats to Some Indigenous Plants

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ABSTRACT

Background: Traditional medicine has been regarded as a suitable alternative to modern medicine considering the wide acceptance and availability of herbal products across the globe. Many plants have shown hypoglycemic, hypolipidemic, and Insulinogenic properties. However, there is a dearth of information on the hematological alterations following acute culinary exposure of normal rats to these selected medicinal plants. **Objectives**: This study sought to examine the hematological alterations in Wistar albino rats after culinary exposure to some selected plants with a claim of having medicinal values**.** Testing of hematological indices can be used to determine the extent of the deleterious effect of foreign compounds including plant extracts on the blood composition of animals. 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. **Methods**: In this study, male albino rats of the Wistar strain were fed diets containing 30% and 70% of weight/weight of plant and animal feeds—*Mangifera indica*, *Peperomia pellucida*, *Momordica foetida*, and *Tapinanthus bangwensi* —for four days before being killed by cervical dislocation. By puncturing the heart, blood samples were obtained. Using the Auto-Haematology analyzer (URTI) 3300, the significant hematological parameters were examined. Packed Cell Volume (PCV), White Blood Count (WBC), Platelets, and other measurements are among the hematology parameters. **Results:** The extracts of *M. indica, M. foetida, and Viscum album* increased red blood cells (RBC), packed cell volume (PCV), and hemoglobin (Hb), among other hematological changes of importance that were seen in the data. Additionally, *M. foetida and V. album* extracts boosted platelet count. **Conclusions**: In addition to demonstrating the non-toxic effects of these plants when consumed in moderation, this study provides a key to unlocking novel therapeutic targets for the treatment of anemia and bleeding.

Keywords: *Hematological; Culinary; Alterations; Indices.*

INTRODUCTION

Hematology is the study of the quantities and morphologies of the biological elements of blood, such as the red cells (erythrocytes), white cells (leucocytes), and platelets (thrombocytes), and the use of these findings in the diagnosis and monitoring of disease[1]. According to Khan and Zafar (2005)[2], hematological parameters are strong markers of an animal's physiological health since they may be used to diagnose a variety of illnesses and determine the degree of blood damage[3]. Blood analysis offers the chance to clinically analyze the existence of various metabolites and other bodily components, and it also has a significant impact on the physiological, dietary, and pathological status of animals[4]. It also aids in separating the normal state from the stress-induced state, which can be brought on by outside influences like food, medication, or plant extract[5]. Due to their collection being comparatively non-invasive and the wide range of physiological activities they cover at any given time in the body, they are also good tools for the measurement of potential biomarkers. The physiological reactivity of the animal to its internal and external settings, such as diet, medication, or plant delivery, is reflected in the hematological components[5].

Hematological data could be used as a baseline for comparisons of animal physiology, health state, and nutrient insufficiency, according to Daramola *et al*., (2005)[6]. In order to maintain homeostasis, blood, a key particular circulatory tissue, contains cells suspended in plasma, an intercellular fluid substance[7]. Especially for plant constituents that have an impact on the blood as well as the health status of animals, hematological components, which include red blood cells (RBC), white blood cells (WBC) or leucocytes, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC). Hemoglobin is transported by red blood cells (erythrocytes), which combine with oxygen in the blood to generate oxyhemoglobin during respiration[8]. The red blood cell is important in the movement of carbon dioxide and oxygen throughout the body. Therefore, a lower red blood cell count means a lower amount of oxygen being transported to the tissues as well as a lower amount of carbon dioxide being exhaled back into the lungs[7, 9]. Red blood cell distribution width, also known as RDW, RDW-CV, RCDW, and RDW-SD, is a measurement of the volume range of red blood cells (RBCs) that are reported as part of a typical complete blood count. Red blood cells typically measure 6 to 8 micrometers in diameter. However, there are some illnesses that significantly alter cell size. Greater size variation is indicated by higher RDW values. RDW-CV in human red blood cells typically falls between 11.5 to 14.5%. If anemia is detected, RDW test results and mean corpuscular volume (MCV) findings are frequently combined to identify potential reasons. It serves to distinguish between anemia from multiple causes and anemia from a single cause[10]. All anemia does not exhibit an increase in the RDW. A normal RDW can indicate the presence of anemia, hereditary spherocytosis, acute blood loss, aplastic anemia (caused by the bone marrow's failure to make red blood cells), and various hemoglobinopathies, including some forms of thalassemia minor[10].

For the routine check of a complete blood count (CBC), factors such as platelet count and platelet indices like mean platelet volume (MPV) and platelet distribution width (PDW) are used. The platelets play a crucial role in a variety of processes, including inflammation, angiogenesis, tissue repair, and regeneration because they are natural sources of growth factors like insulin-like growth factor 1 (IGF-1), platelet-derived growth factor (PDGF), vascular endothelial growth factor (VEGF), and transforming growth factor (TGF)[11].

Previous research indicates that different cytokines affect platelet size and volume during inflammation. In low-grade inflammatory illnesses, the participation of big platelets in thrombi may cause MPV readings to rise. On the other hand, MPV levels drop in high-grade inflammatory diseases because big platelets are consumed at the inflammation site[11]. The primary roles of white blood cells and their differentials are to combat infections, protect the body from invasion by foreign organisms through a process known as phagocytosis, and generate, transport, and disseminate antibodies during an immune response. Animals with low white blood cell counts are therefore more susceptible to disease infection, whereas those with high counts are able to produce antibodies during the phagocytosis process and have a high level of disease resistance[9] which improves adaptability to the local environmental and disease prevalent conditions[12].

Blood clotting is attributed to blood platelets. Low platelet concentration means that the blood clotting process will take longer, leading to significant blood loss in the event of even a minor injury. Through their direct interaction with tumor cells, platelets play a crucial part in the initiation, growth, and spread of cancer. Platelet actions set off autocrine and paracrine activation procedures that alter stromal cells' phenotypes and aid in the growth of cancer. Increased platelets were linked to a worse prognosis in patients with a variety of cancers, including ovarian, gastric, colorectal, endometrial, and pancreatic cancers[13, 14, 15, 16]. However, the equilibrium between the rate of platelet creation and consumption determines platelet count. When there are effective compensatory mechanisms present, a normal platelet count may mask the existence of very hyper-coagulative and pro-inflammatory cancer characteristics[17].The most popular way to assess platelet size is mean platelet volume (MPV), which is also a clinically useful indicator of platelet activation[11]. According to Kaito (2005)[18], another platelet indicator called platelet distribution width (PDW) shows variation in platelet size. According to Gasparyan (2011)[11], breast cancer, lung cancer, ovarian cancer, stomach cancer, and colon cancer all have altered MPV levels.

The proportion (%) of red blood cells in blood is known as packed cell volume (PCV), also known as hematocrit (HCT) or erythrocyte volume fraction (EVF) [19]. The transfer of oxygen and ingested nutrients depends on packed cell volume[7]. Larger primary and secondary polycythemia is the result of larger packed cell capacity, which also exhibits improved transportation [7]. All vertebrate red blood cells, with the exception of those from the fish family Channichthylidae and invertebrate tissues, include hemoglobin, an iron-containing oxygen-transport metalloprotein[20]. Hemoglobin serves the physiological duties of carrying oxygen to animal tissues for the oxidation of ingested food to generate energy for other bodily activities as well as carrying carbon dioxide out of the animal's body[7, 9, 21].

According to earlier studies, packed cell volume, hemoglobin, and mean corpuscular hemoglobin are important indicators for assessing circulatory erythrocytes and are significant in the diagnosis of anemia[8, 22]. They also serve as useful indicators of the bone marrow's capacity to produce red blood cells as in mammals. High-packed cell volume (PCV) has also been hypothesized to be a marker for either an increase in the number of red blood cells (RBCs) or a decrease in the volume of circulating plasma[8]. Blood level conditions are indicated by mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC), anemia is indicated by a low level of this parameter. The effects of plant extracts on hematological indicators are used to determine if a plant is pharmacologically active, inactive, or poisonous. Assessing the hematological parameters is one of the crucial ways to gauge an animal's health. According to several research, after the administration of plant spices or extracts, rats' hematological parameters were affected.

This study aims to investigate the hematological alterations occurring in experimental albino Wistar rats exposed to these herbs: Gigantic bitter lemon cucumber *(Momordica foetida*), mango (*Mangifera indica*), mistletoe (*Tapinanthus bangwensi*), and silverbush (*Peperomia pellucida*). Leaves of *Mangifera indica* commonly known as mango (family *Anacardiaceae*), is a large evergreen tree of tropical and subtropical regions that has been used in traditional medicine by a number of people for centuries. The leaves of the *M. indica* plant are used as an antidiabetic agent in Nigerian folk medicine.

MATERIAL AND METHODS

Plant collection and identification

For this investigation, fresh leaves of the following four plants were used: Mango (*Mangifera indica*), sliver bush (*Peperomia pellucida*), gigantic bitter lemon cucumber (*Momordica foetida*) and mistletoe from a cocoa plant (*Tapinanthus bangwensi.* The leaves were harvested from several areas in Akure and Akungba-Akoko, Ondo State, Nigeria. These plant specimens were identified at the Forestry Herbarium, Ibadan (FHI) and later deposited as voucher materials at Adekunle Ajasin University (AAU) Herbarium with voucher numbers, *Mangifera indica* no 131, *Momordica foetida* no138, *Peperomia pellucida* no 165 and *Tapinanthus bangwensi* no 201.

Sample Preparation

The leaves of M. *indica, T. bangwensi, and M. foetida* were properly cleaned before being allowed to air dry for two months. The dried leaves were then ground into fine powder using an electric blender (Marlex CM/L7371373). While *Peperomia pellucida* was lyophilized, or frozen dried, using a lyophilizer. The ground plant components were measured using weight ratios of 30%weight/weight (30g leaf extract and 70g growers mash) and 70%weight/weight (70g leaf extract and 30g growers mash). The control group was composed entirely of growers mash. 100ml of honey was mixed with 100g of growers' mash in a graduated cylinder, then the powdered extract was measured. Honey and leaf extract powder were thoroughly mixed together. This is done to make extracts, particularly bitter ones like those from M. foetida, or bitter gourd, easier for the rats to eat. According to Fadipe and Saliu[28].

Ethical approval

The ethics committee (I R B) of the Adekunle Ajasin University, Akungba-Akoko Faculty of Science reviewed and approved all procedures.

Animal Treatment

Twenty Wistar rats were used, split into five groups of four each. The fifth group contains the control group. Before the experiment, the animals were weighed, and for seven days they were stabilized by being given water and growers mash produced by Guinea Feed Nig. Ltd. The powdered extract was fed to rats in varying weights for three days, after which they underwent an overnight 12-hour fast. Clean water and producers' mash were the only food options provided to the control group. After consuming the powdered leaves, the rats were weighed. Heart punctures were used to get blood samples for hematological analysis (packed cell volume PCV, white blood count WBC, platelets, hemoglobin estimation (HB) etc.

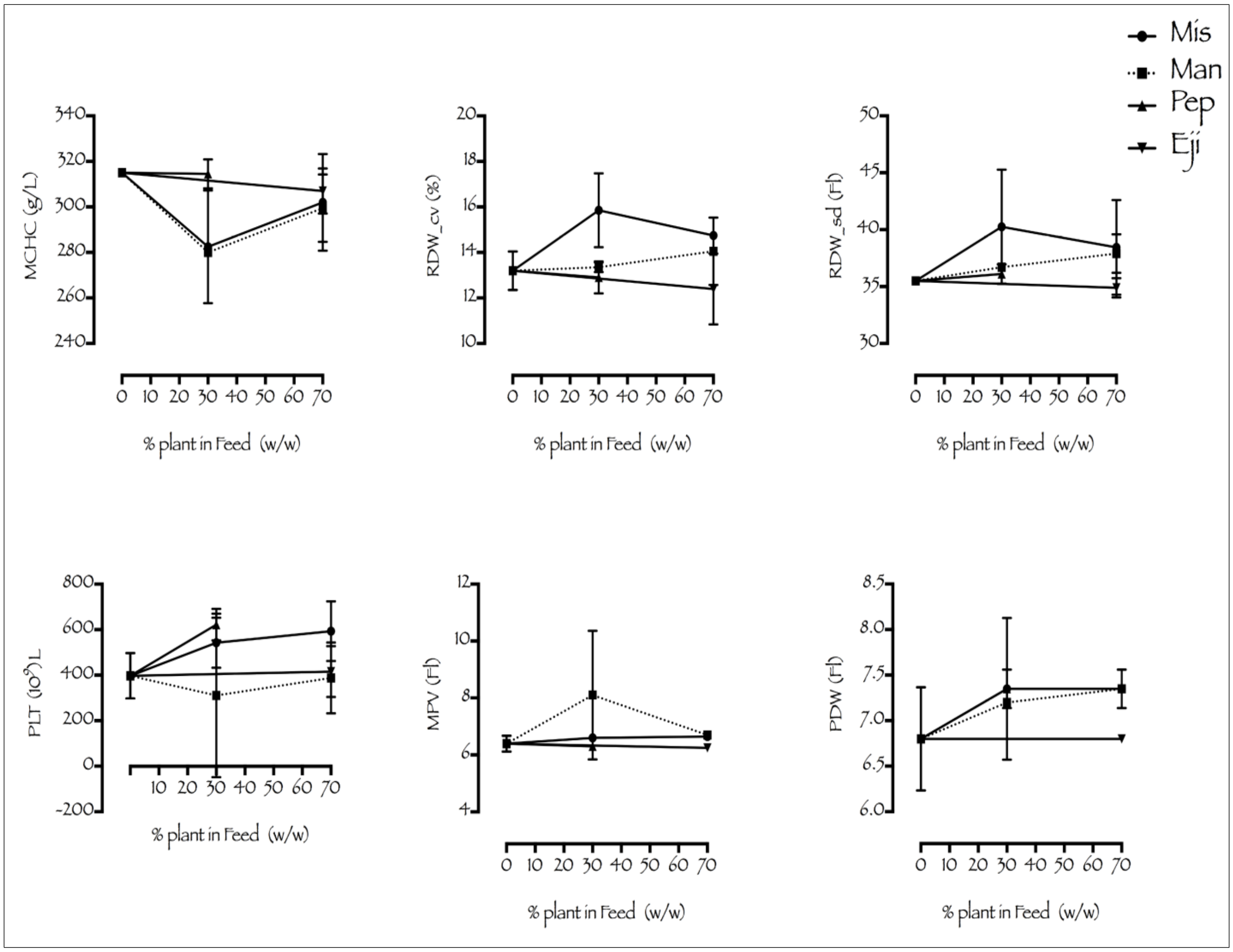

Figure 1. The effects of Plant extracts on platelets, mean platelet volume (MPV), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), and platelet distribution (PWD).
**Note: Gigantic bitter lemon cucumber is denoted 'Eji' on the chart.*

Laboratory analysis

The samples were kept in EDTA anticoagulated bottles and transported immediately to Inland Medical Centre, Ikare-Akungba for analysis. Auto-Hematology analyzer (URTI) 3300 was used for the analysis.

RESULTS

Haematological alterations that occurred on culinary exposure of normal albino rats to leaf extract of mistletoe (*Tapinanthus bangwensi*), mango (*Mangifera* indica), silver bush (*Peperomia pellucida*) and gigantic bitter lemon cucumber (*Momordica foetida*).

When compared to the control, *M. indica* and *T. bangwensi* decreased the production of MCHC at 30% concentrate but increased it at 70%. *M. indica* also enhanced the production of RDW and MPV at both 30% and 70% concentrate.

Platelet counts and PDW were both raised by *P. pellucida* and *T. bangwensi* at 30% and 70% concentrate, respectively. While *M. indica* at 70% boosted the production of RBC, HCT, MCV, and HB but decreased them at 30% concentrate, *P. pellucida* at 30% concentrate lowered the production of RBC, hemoglobin, HCT, PCV, MCH, and MCV. With the exception of granulocytes, which were marginally enhanced by *M. indica* and *T. bangwensi* at 30% and 70% concentrate compared to the control, *T. bangwensi*, *M. indica*, *P. pellucida*, and M. foetida all reduced WBC and LYM levels (**Figures 1, 2**, and **3**).

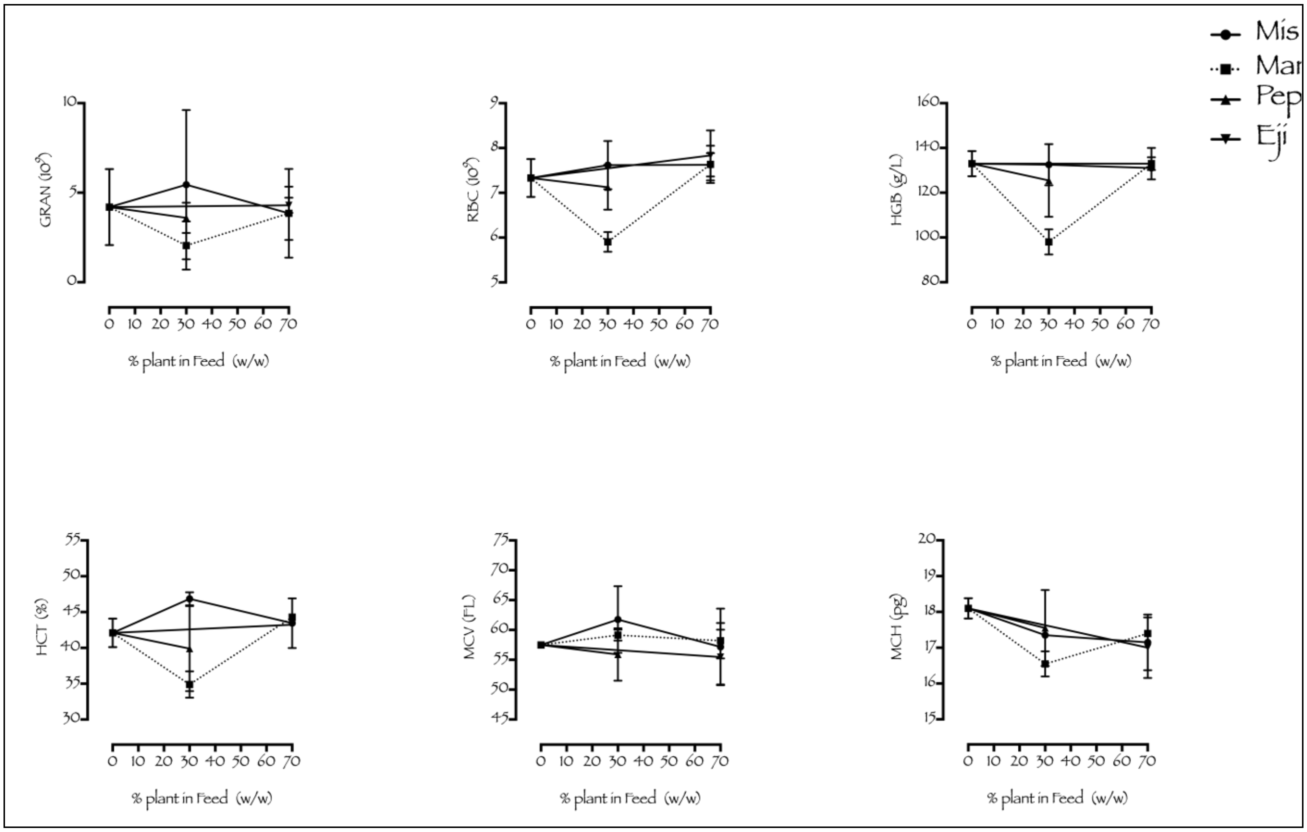

Figure 2. The effects of Plant extracts on red blood cells (RBC)mean corpuscular volume (MCV) and packed cell volume (HCT) of albino rats.

DISCUSSION

Anemia can be evaluated using mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). Low levels of these indicators are said to be a sign of anemia[23]. The current study clearly shows that *Mangifera indica* (M.I) at 30% concentration decreases the value of MCHC and MCH while increasing it at 70% concentration. This suggests that when *M. indica* leaf extract is ingested at a larger dose, it may have hematopoietic characteristics. This corroborates the early findings of Izunya *et al*., (2010) [30] on anti-anemia potentials of aqueous extract of stem bark of *M. indica* that 25, 50 and 75 mg/kg body weight of the extracts enhanced PCV, HGB, and RBC in a dose-dependent manner. Because MCHC, MCH, RBC, HCT, and HGB represent the state of the blood levels, blood platelets have been linked to the processing of blood clotting, according to an experimental model. Low platelet concentration predicts a prolonged clot-formation (blood clotting) process, which could result in considerable blood loss in the event of even a minor injury. Intriguingly, when compared to the control, *Tapinanthus bangwensi* (mistletoe) and *Peperomia pellucida* leaf extract boosted platelet production and platelet dispersion width in the experimental rats. *M. indica* only increased the mean platelet volume (MPV) at a low dose of 30% and decreased it with 70% concentrations, resulting in a decrease in platelet count. Given that platelets are involved in blood clotting and *M. indica* has the propensity to cause thrombopenia, it is logical to conclude that leaf extracts of *T. bangwensi* (mistletoe) and *P. pellucida* may aid in the stimulation of thrombopoietin production and can thus be used to manage the hemostatic activity of blood. Adedapo *et al*., (2007)[30] noted that lower blood platelet counts had an impact on blood viscosity, which is positively correlated with blood pressure.

This study supports Mishra and Tandom's[32] findings on Hibiscus Rosa Sinensis, which show that treatment with the plant negatively affects blood platelet count. Red blood cells (erythrocytes) serve as a carrier of hemoglobin, which reacts with oxygen carried in the blood to form oxyhemoglobin during respiration[8]. The red blood cell is involved in the transport of oxygen and carbon dioxide in the body. Thus, a reduced red blood

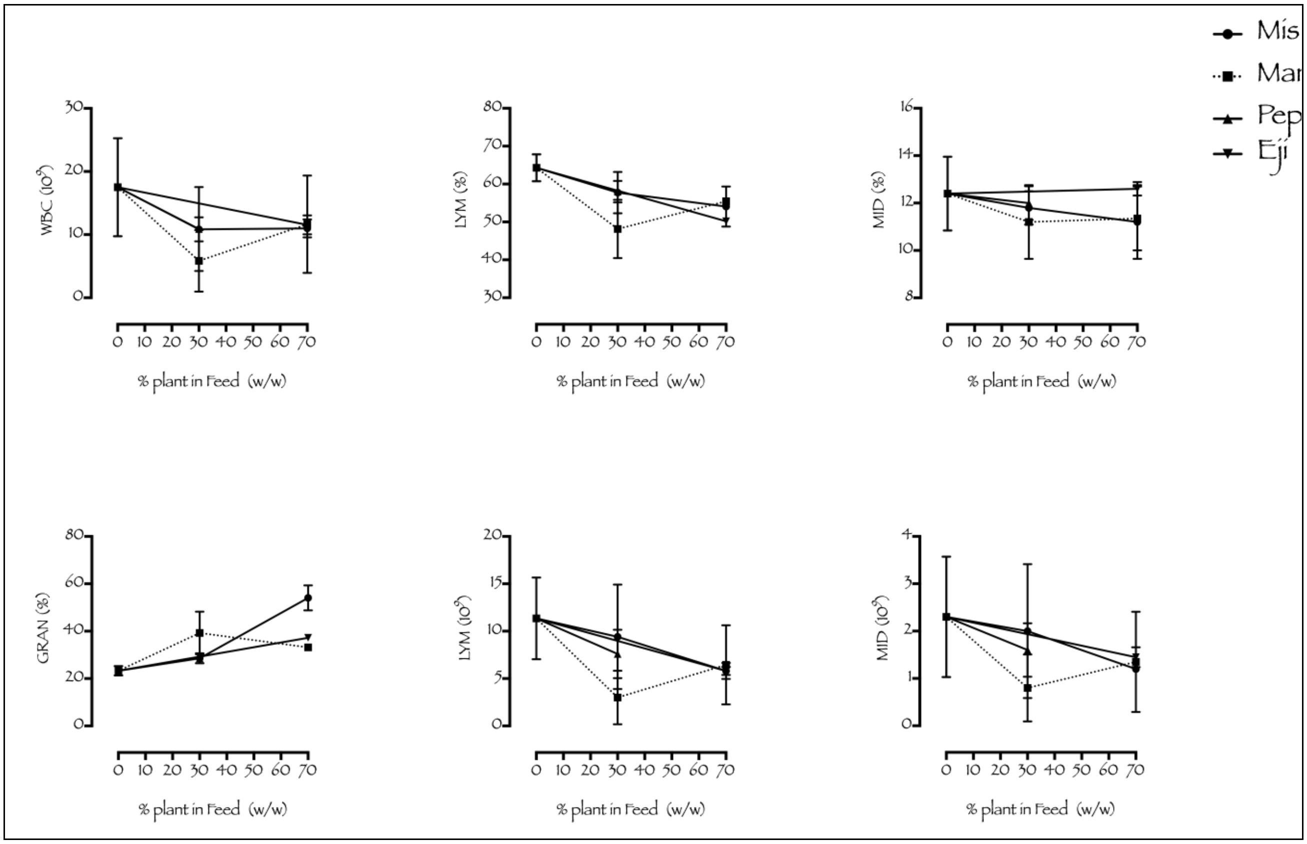

Figure 3. The effects of Plant extracts on white blood cells (WBC), lymphocytes (LYM) and granulocytes of normal rats.

cell count implies a reduction in the level of animals' blood volume[7, 9, 21]. In this study there is a notable increase in red blood cells (RBC) and red blood cell distribution width (RDW) of rats fed with leaf extract of *M. indica* and *T.bangwensi* (30%) compared to the control (Fig 2), While *P.pellucida* at 30% concentrate caused a decrease in the levels of RBC.

CONCLUSION

It can be concluded from this research that these selected herbs: *M.indica, P. pellucida, T.bangwensi and M. foetida,* were observed to cause some haematological alterations when administered orally to laboratory rats, in that extracts of *M. indica, T.bangwensi* and *M.foetida* can be said to boost red blood cells production, when administered at a slightly high dose of 70% concentrate i.e. erythropoeticability while the extracts of *P. pellucida* and *T. bangwensi* has the ability to boost platelets production i.e. thrombopoetic ability. There is a traditional claim that some of these plants can be used for medicinal purposes, by the outcome of this research *M.indica, P.pellucida, M. foetida* and *T. bangwensi* may be recommended for treatment of anemia and blood clotting disorder if further and comprehensive work is performed on them.

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Conflict of interest

The authors declare that they have no conflicts of interest regarding the publication of this paper.

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