

# Original Research Article

## ASSESSMENT OF THE IMPACT OF AQUEOUS EXTRACT OF *Solanum aethiopicum* ON THE HAEMATOLOGICAL PROFILE AND BLOOD FILM OF WISTAR RAT

### ABSTRACT

**Aim:** The effect of *Solanum aethiopicum* SA on the blood film and haematological profile of Wistar rats was investigated in this study.

**Methodology:** After acclimation for two weeks, a total of 24 Wistar rats were randomly assigned to groups A through D. Group A served as the control, while groups B, C, and D were given aqueous extracts of SA at doses of 75 mg/kg body weight, 150 mg/kg body weight, and 225 mg/kg body weight, respectively, every 48 hours for 60 days. After the exposure period, a final evaluation and sacrifice of the remaining rats was performed. Blood sample collection was necessary for hemological analysis.

**Result:** A haematological study of Wistar rats that had been gavaged with SA revealed a considerable increase in their white blood cell and lymphocyte counts. Additionally, the platelet range and platelet count range increased, whereas the monocyte, granulocyte, and hematocrit ranges decreased. Red blood cells, mean corpuscular volume, mean corpuscular hemoglobin concentration, red blood cell distribution, and red blood cell distribution width standard deviation were not significantly different ( $p > 0.05$ ) between treatment and control rats. Blood film micrograph results confirm the little increase in white blood cells and lymphocytes, the adequate number and size of erythrocytes, and the absence of parasites in both the control and treated groups of rats.

**Conclusion:** The current study have demonstrated that the leaves of *Solanum aethiopicum* support rats' defense better. It has the potential to be a source of haematinics, which are extremely beneficial in the management of anemia or iron deficiency issues. These plant extracts may one day be utilized to control and treat those who have been exposed to harmful substances as well as to treat anemia-related disorders.

**Keywords:** blood film, haematology, full blood count, wistar rats, *Solanum aethiopicum*.

### 1. INTRODUCTION

*Solanum aethiopicum* is a complicated species with four unique morphological groupings that were formerly considered separate species (Polignano et al., 2010). It additionally qualifies as a hypervariable species since it has several forms and kinds that differ morphologically, as well as hundreds of local variants (Lester, 2010). *S. aethiopicum* is divided into four separate groupings based on its application. Gilo, Shum, Kumba, and Aculeatum are the four groupings (Lester, 2010). The Gilo group produces various ranged shaped edible fruits (varying from a circularly depressed form to an oblong outline); the Kumba group has a strong principal stem with enormous hairless leaves that is able to be harvested as a green vegetable, and subsequently produces huge edible fruits. The Shum family is a brief, much-branched species with little hairless leaves and branches that are widely plucked as an attractive green vegetable, but the small (1.5 cm across) highly unpleasant fruits are not edible (Plazas et al., 2014). The plant is often grown as an ornamental plant.

It has a greater concentration of anthocyanin, phenols, glycoalkaloids (solasodine), and amide proteins. The presence of glycoalkaloids accounts for its bitterness. Patients with liver problems and/or diabetes benefit from eggplant's therapeutic characteristics (Agoreyo et al., 2012). However, due to the plant's association with the Solanaceae (nightshade) family, the fruit was once thought to be exceedingly poisonous. Solanum species (eggplants) are members of the Solanaceae family and the genus Solanum. The plant is an economically significant vegetable that is widely produced throughout the world's tropical regions (Agoreyo et al., 2012). Solanaceae is a flowering plant family comprised of about 75 genera and 2000 species. This includes herbaceous plants, but the fruit of Solanum species is a berry, and the seeds have a larger endosperm, and they are mostly produced for food and medicine (Das et al., 2013). Solanum aethiopicum's low soluble carbohydrate content has the capacity to limit glucose absorption into the bloodstream, hence managing blood sugar levels, making it an excellent dietary alternative for diabetics (Polignano et al., 2010).

*S. aethiopicum* juvenile fruits are eaten fresh or cooked as vegetables in stews. The leaves and shoots are prepared in the same way that vegetables are. They are collected from the same plants as the fruit or from distinct leafy cultivars. The fruits of bitter cultivars are used as medicine in several African countries. The roots and fruits can be used as a carminative and sedative, as well as to treat colic and high blood pressure; a sedative to treat uterine issues; an alcoholic extract of the leaves can be used as a sedative, anti-emetic, and to treat tetanus after abortion; as well as crushed and macerated fruits can be used as an enema. In south-eastern Nigeria, the Igbo tribe traditionally greet visitors by offering fruits. *S. aethiopicum* is occasionally grown as an ornamental plant. Some cultivars are used as rootstock for tomatoes and eggplant on occasion.

*S. aethiopicum* is one of the plants sought for due to its availability and cost. As a result, *S. aethiopicum* has a wide range of applications in ayurvedic medicine. Concurrently, another pertinent scientific concern is the adverse effects of *S. aethiopicum*. Interestingly, no study documented the detrimental potentials of OG after a thorough literature search, although other studies reported promising outcomes in the application of *S. aethiopicum* in therapeutic medicine. Keeping in mind that herb usage can have a variety of consequences A few research have indicated that *S. aethiopicum* fruit extracts exhibit anti-inflammatory, lipid-lowering, hypotensive, antibacterial, and anticancer effects (Tyagi et al., 2020). However, no investigations on the effects of this vegetable's aqueous extract on hematological parameters have been conducted to our understanding. The goal of this study is to see how an aqueous extract of *S. aethiopicum* affects the hematological profile and blood film of Wistar rats.

## **2. MATERIAL AND METHODS**

### **2.1 Collection, identification and preparation of *Solanum aethiopicum* leaf extract**

Fresh leaves of *Solanum aethiopicum* (African garden eggplant) were purchased from Effurun Market in Effurun, Delta state in January, 2021; the taxonomic identity of the plant was confirmed at the Department of Plant Biology and Biotechnology, Faculty of Life Science, University of Benin, Benin City, Edo State, Nigeria.

The purchased leaves were air-dried to crispness in the laboratory (prevailing room temperature of  $30 \pm 2^\circ\text{C}$ ) for two weeks. The dried materials were reduced to coarse form using a pestle and mortar and further pulverized to very fine particles using Viking Exclusive Joncod pulverizing machine (Model: YLH2M2 - 4). The crude aqueous extract was prepared by decoction; in which 50g of the leaf powder extracted with 500mls of distilled water (via maceration) for 48hrs. The mixture was decanted and filtered using sterile whatman paper No 1. The filtrate was evaporated to dryness using a freeze dryer and reconstituted in distilled water to appropriate concentrations.

## 2.2 Experimental setup

Male wistar rats (6-7 weeks old) weighing within the range of 100g to 150g were obtained from the Anatomy Department, University of Benin, Nigeria. The rats were distributed randomly into four groups of six animals each for group A to D and allowed to acclimatized for 2 weeks. During acclimatization, the animals were housed in wooden cages with wire mesh covers and fed with standard rodent chow (Bendel Livestock Feeds Limited, Ewu, Edo state, Nigeria) and given distilled water *ad libitum*. After acclimatization, the rats were given different treatment protocol: Group A which was the Control (CTR) was given distilled water; Group B, C and D rats were gavaged 75 mg/kg b/w (EGG 1), 150 mg/kg b/w (EGG 2), 225 mg/kg b/w (EGG 3) of aqueous extract of SM for 60 consecutive days (once every 48 hour) respectively. The rats were maintained in laboratory conditions; and had access to drinking water and standard rodent chow (Bendel Livestock Feeds, Ewu, Edo state, Nigeria®) *ad libitum*.

At the end of exposure period, survivors were fasted overnight and sacrificed under slight Anesthesia; then blood was collected from the inferior vena cava of the rats with plain 5ml sterilized syringe into a vial containing 0.5 ml EDTA for haematological analysis under a light anaesthesia. The blood sample was gently homogenised to ensure proper mixing of the blood with the anticoagulant, before taking it to the laboratory.

## 2.3 Laboratory analysis

In the laboratory, hematological analysis was carried out using SysmX KX-21N automated machine (SysmX corporation kobe, Japan) following the manufacturer's instructions. Briefly the sample was mixed and placed in contact with the sample probe for aspiration, when the buzzer sounds twice "beep, beep" and when the LCD screen displays ANALYZING, the sample was removed. Following this, the unit executed automatic analysis, and the result was displayed on the LCD screen and printed out.

## 2.4 Data Analysis

All statistical analyses were conducted with Statistical Package for Social Scientists (SPSS) and Microsoft Excel computer software. Data are presented as mean±SE (n=5). One-way ANOVA was used to determine the differences among various groups. When the corresponding F test for differences among the treated group means was significant pair wise, comparisons between treated groups and corresponding negative control were determined using multiple comparison procedure of the Dunnett post-hoc test and differences were considered significant at  $p < 0.05$  levels of significance.

## 3. RESULT AND DISCUSSION

The results of the haematological studies is as shown in table 1. There were no significant difference increase in white blood cells (WBC), especially lymphocytes (LYM) in group of rats administered leaf extract of SA. While the reverse was the case in red blood cells (RBC), hemoglobin (HGB) mean platelet volume (MPV), red cell distribution width (RDW-SD), and mean corpuscular hemoglobin (MCH) as there were no significant difference reduction in their value when compared to the control. Platelet (PLT) was significantly higher in treated group when compared to the control, while the reverse was the trend for Plateletcrit (PCT), mean platelet volume and platelet distribution width when compared with control.

**Table 1: Hematological profile of male wistar rats administered crude aqueous extract of SA leaves**

	CTR	EGG 1	EGG 2	EGG 3
WBC ( $\times 10^3/\mu\text{l}$ )	18.18±0.78 <sup>a</sup>	24.45±0.95 <sup>b</sup>	25.25±1.15 <sup>b</sup>	27.08±2.68 <sup>b</sup>
LYM ( $\times 10^3/\mu\text{l}$ )	13.58±2.48	19.60±0.40	21.10±0.10	30.95±4.65
MID ( $\times 10^3/\mu\text{l}$ )	3.36±0.44	2.65±0.25	2.50±0.50	2.73±0.28
GRA ( $\times 10^3/\mu\text{l}$ )	2.08±0.42	1.20±0.20	1.65±0.65	1.40±0.70

LYM (%)	77.73±13.83	66.40±1.40	83.70±4.10	59.95±16.45
MID (%)	17.50±4.40	14.30±0.80	9.85±1.65	7.28±3.63
GRA (%)	9.43±4.77	15.30±0.60	6.45±2.45	22.78±12.83
RBC (x 10 <sup>6</sup> /μl)	7.78±0.04	7.73±0.41	7.33±0.20	7.19±0.45
HGB (g/dl)	16.92±0.62	15.75±0.05	15.35±0.05	14.55±0.95
HCT (%)	41.49±0.29	40.55±0.25	39.05±0.75	38.38±1.68
MCV (μm <sup>3</sup> )	53.41±0.71	52.65±3.05	53.35±2.45	52.85±0.15
MCH (pg)	21.71±0.91	20.45±1.15	21.00±0.50	20.30±0.10
MCHC (g/dl)	40.85±1.25	38.85±0.15	39.30±0.90	38.40±0.30
RDW-CV (%)	16.00±0.50	17.20±0.10	18.95±1.55	17.43±0.07
RDW-SD (μm <sup>3</sup> )	30.93±0.73	30.00±1.90	33.00±0.90	31.15±1.05
PLT (x 10 <sup>3</sup> /μl)	451.25±87.25	456.50±1.50	443.00±53.00	724.75±249.25
MPV (μm <sup>3</sup> )	8.21±0.31 <sup>a</sup>	6.75±0.15 <sup>b</sup>	7.80±0.30 <sup>a</sup>	6.98±0.07 <sup>b</sup>
PCT (%)	0.36±0.07	0.31±0.01	0.34±0.03	0.50±0.17
PDW (%)	18.68±1.38	16.20±1.30	17.70±1.90	15.93±0.73
P-LCR (%)	11.14±0.86 <sup>a</sup>	5.85±0.65 <sup>b</sup>	11.80±1.60 <sup>a</sup>	7.00±0.70 <sup>b</sup>

All values are expressed as Mean ± S. E., N = 5,

The structure, function, metabolic transformation, and concentration of biomolecules, enzymes, and even metabolic pathways can all be significantly altered by the injection of a chemical agent (Polignano et al., 2010). These changes, which could occur quickly or gradually, could trigger various biochemical processes that result in comparable pathological, clinical, and laboratory findings (Murray et al., 2000). The magnitude of a foreign compound's harmful effect on the blood, including plant extract, can be assessed using haematological measures. It can also be used to illustrate how plant extracts with chemical compounds work in relation to the blood (Afolabi et al. 2018). Hematology, which includes the diagnosis, treatment, and prevention of illnesses of the blood, bone marrow, immune, hemostatic, and vascular systems, is the study of blood and blood-forming organs. Animal diseases are frequently diagnosed and treated using hematologic analysis. Hematology has grown in importance for disease detection and treatment in smaller laboratory animals as analytical methods have gotten more sensitive, necessitating smaller sample volumes. It can be challenging to create reference values for hematologic assays due to a number of physiologic and physical parameters (Olafedehan et al., 2010). Age, breed and strain, gender, the season as well as the time of day, nutrition, illness, stress, and trauma are all examples of physiological influences. The location of the blood draw, the type and amount of anticoagulant used, and sample preparation and handling are all crucial physical aspects (Dyer and Cervasio, 2008).

The iron concentration in SA may be responsible for the study's non-significant difference in RBC, with the rise in hemoglobin and hematocrit in both treated and control rats. According to Agoreyo *et al.*'s (2012) research, Solanum fruit aids in the transportation of oxygen by RBCs through hemoglobin, which remained unaffected. This study concurs with that of Agoreyo *et al.* (2012), who noted comparable tendencies brought on by SA fruit extract. According to Gracelin *et al.* (2019), SA may have blood detoxifying potentials, as has been seen in various vegetables (Elatrash and El-haleim 2015), which may have played a physiological role in maintaining the levels of RBC, HCT, and HCB of wistar rats treated with fruit extract of SA. The considerable drop in red blood cell count found is consistent with findings from Alhassan et al. (2012) who reported that rats given *S. aethiopicum* extract saw a significant drop in red blood cell count. According to a study by Ossamulu et al. (2014), saponins, an abundant bioactive ingredient in eggplant, may trigger hemolysis in red blood cells (Kar, 2007). According to Lopez and Martos (2004), eggplants have a high concentration of dietary fiber that can bind cations like iron. As a result, iron's bioavailability may be compromised, which could reduce red blood cell production (Reinhold

et al., 1981). According to Fuschia (2006), the non-significant decrease in MCV, MCH, and MCHC values indicates that eggplant (*Solanum aethiopicum*) may not actually have any hemopoietic properties and may not even have any substantial haematotoxicity or general toxic effect. Our current findings are (roughly) in agreement with those of Adamson and Longo (2001).

White blood cells, or leucocytes, are a crucial part of the immune system (host defense), which works to defend the body from infectious disorders brought on by bacteria, fungi, viruses, and parasite invasion (Stock and Hoffman, 2000). The large rise in white blood cell count seen in this study is consistent with the findings of Alhassan et al. (2012), who examined the impact of *S. aethiopicum* on the circulation of Wistar rats and discovered an increase in white blood cell count. Both Lowenthal, Connick, McWater, and York (1994) and Saba, Olayinka, and Ofuegbe (2009) reported that eggplant may play a role in cellular immunity. The response to numerous stimuli, such as changes in hormone levels, stress, shock, infection, drug use, allergic reactions, and inflammations, can cause changes in white blood cell count. Alkaloids, phytosterol, and certain pigments that may occasionally trigger allergies have all been linked to eggplants (Ossamulu et al., 2014; Patnaik, 1993). White blood cells may become mobilized as allergic reactions progress, raising their concentration. The differential cell analysis and white blood cell count both indicated that the mean lymphocyte values had increased. An improvement in the body's immunological state, particularly the cell-mediated immune response, is correlated with an increase in the number of white blood cells and lymphocytes in circulation. The results here are consistent with those of (Saba et al., 2009) and (Lowenthal et al., 1994), who proposed that administering an aqueous extract of eggplant leaf may benefit the cells engaged in immunity.

The main job of platelets is to stop and stop bleeding, repair wounds, and help the body mend itself. This suggests that *Solanum aethiopicum* has the potential to be therapeutic. and low readings may point to the development of antibodies, liver illness, or issues with blood coagulation (Yilmaz et al., 2004). As seen in this study, when compared to the control group, the platelet count was higher in the group that received an aqueous extract of *Solanum aethiopicum* meals. PDW and MPV are two platelet indices that could be helpful markers for the early detection of thromboembolic illnesses (Vagdatli et al., 2010). Animals in the control group that were exposed to air pollution without receiving any therapy had significantly higher PDW levels ( $p < 0.05$ ) than the control. MPV levels were greater but not substantially ( $p < 0.05$ ) different. According to Amin et al. (2004), PDW increases in sickle cell anemia, which may be a factor in erythrocyte abnormalities and platelet dysfunction. High MPV concentrations have been linked to vascular diseases such atherosclerosis, coronary artery disease, and ischemic stroke. (Yilmaz et al., 2004; Karagöz et al., 2009). All of the animals who received *Solanum aethiopicum* exhibited elevated PLT. This might be due to the polyphenols and vitamins included in this vegetable (Olajire and Azeez 2011).

#### **4. CONCLUSION**

The results of this study demonstrate that eggplant improves cell-mediated immunity, which in turn strengthens the body's immune system. Also, according to the findings of this thesis, chronic administration of *Solanum aethiopicum* extract does not appear to have a hemotoxic impact. Additionally, it implies that S.A. might improve immunity, particularly cell-mediated immunity. According to this study, *Solanum aethiopicum* is a potential source of haematinics, which are extremely beneficial in the treatment of anemia or iron deficiency issues. Other fruits in the Solanaceae family include tomatoes, carrots, and garden eggs. Plant extracts from S.A. may be employed in the future to manage and treat those who have been exposed to harmful substances and to treat disorders brought on by anemia.

## 8. ETHICAL APPROVAL

This research design was reviewed and approved by the College of Science Ethical board, Federal University of Petroleum Resources, Effurun (CS/EMT/2021/006).

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