

Hematological Changes Following Oral Administration of Aqueous Leaf Extract of *Ficus capensis* in Albino Rats

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Authors' contributions

This work was carried out in collaboration between all authors. Authors NNNO and CVN designed the study, wrote the protocol and wrote the first draft of the manuscript. Author UD managed the literature searches, statistical analyses of the study and editing of the manuscript. Authors NOI, LCA, SOM, OAS and RCU managed the literature searches and the experimental process. All authors read and approved the final manuscript

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ABSTRACT

Objective: This work was carried out to investigate the effects of oral administration of aqueous leaf extract of *Ficus capensis* on some hematological parameters in albino rats.

Methodology: Twenty-eight normal male rats weighing between 180-240 g were used for this study. They were randomly grouped into four groups, A- D of seven rats each. Group A was the control group and received distilled water only, while groups B, C and D were administered 50, 100 and 200 mg/kg body weight of aqueous extract of *F. capensis* leaves respectively via oral gavage for 28 days. Blood sample was collected from each animal by cardiac puncture using sterile needle

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into an ethylene-diamine-tetra-acetic acid (EDTA) bottle for determination of RBC, WBC, PCV and Hb.

Results: There was a significant ($p<0.05$) increase in RBC count in groups C ($7.55\pm 0.19 \times 10^6$) and D ($8.39\pm 0.21 \times 10^6$), when compared to the control ($6.44\pm 0.08 \times 10^6$). There was significant ($p<0.05$) increase in WBC count in group D ($13.43 \pm 0.50 \times 10^3$) when compared to control group ($9.47\pm 0.97 \times 10^3$). Groups C ($45.43\pm 1.31\%$) and D ($50.14\pm 1.94\%$) showed significant ($p<0.05$) increase in PCV when compared to control group ($35.57\pm 0.78\%$). There was a significant ($p<0.05$) increase in Hb concentration in groups C (15.21 ± 0.41 g/dl) and D (16.71 ± 0.67 g/dl) when compared to control group (11.89 ± 0.26 g/dl).

Conclusion: The present findings validated the claim that the leaf extract of *F. capensis* is useful in treating anemia.

Keywords: *Ficus capensis*; aqueous extract; hematological parameters; anemia.

1. INTRODUCTION

A large percentage of the world's population depends primarily on herbal medicine derived from indigenous plants for preventing, controlling, management and alleviating various disease conditions [1] especially in developing countries where modern Western medicine often is unavailable or is simply too expensive for the common man to afford. Specifically, green leafy vegetables occupy an important place among the food crops, as they provide adequate amounts of vitamins and minerals for humans [2]. Various vegetables have received recognition for their beneficial effects while others are termed underutilized vegetables, essentially due to paucity of scientific data to back up their reported traditional uses [2].

Ficus capensis, locally referred to as *Uwaryara* (Hausa), *Opoto* (Yoruba), *Rima bichehi* (Fulani), *Obada* (Edo) and *Akokoro* (Igbo) belongs to the family *Moraceae*, and has been regarded as an underutilized plant. It is used as a vegetable in foods with blood boosting effect. Phytochemical studies have revealed the presence of tannins, phytates, saponins, alkaloids, terpenoids and flavonoids in the leaf extract of this plant [3]. The LD₅₀ value of the aqueous leaf extract was found to be above 5000 mg/kg in albino rats when administered orally [4]. Traditionally, in Nigeria, decoctions and aqueous extract of *F. capensis* are used in the treatment of anemia, tuberculosis, convulsions, pains, and wounds. It is also used in treating circumcision wounds, gonorrhoea, respiratory disorders and emollient [5]. Apart from its traditional uses, other benefits of *F. capensis* have been reported based on modern scientific investigations which include; anti-sickling [6,7] antibacterial [8], anti-abortion [9], immune-stimulatory [10], anti-diarrhoea [11], antioxidant [12] and pro-fertility in treating azoospermia [13].

Seasonality is a major constraint to utilization of green leafy vegetables in the dry season. This usually leads to poor consumption of the vegetables and subsequent poor intake of micro nutrients from vegetables during the period. *F. capensis* leaves are abundant in the dry season due to the plant's resilience, adaptation and tolerance to adverse climatic conditions [2]. It can therefore serve as a good substitute by reducing the incidence of low consumption of green leafy vegetables experienced in the dry seasons.

This study was carried out to give scientific evidence to the claim that *F. capensis* has a positive hematological effect in folklore medicine.

2. MATERIALS AND METHODS

2.1 Plant Material and Extract Preparation

The fresh leaves of *F. capensis* were harvested from a local farm in Independence Layout, Enugu State, Nigeria. The leaves were identified and authenticated by Mr. P. O. Ugwuozor, the herbarium curator, Department of Botany, Nnamdi Azikiwe University, Awka, with a voucher Number: N. A. U. H. 32. The leaves were washed thoroughly to remove contaminants from the farmland. The leaves were dried in an airy shade for about 10 days, away from direct sunlight to avoid possible damage to their phytoconstituents. The dried leaves were grinded using a laboratory mill yielding 800 g of powder. This powder was macerated in 4 liters of lukewarm distilled water and poured into a beaker and sealed. The aqueous mixture was placed in the mechanical shaker for 24 hours and then sieved using filter paper into a clean glass tube. The aqueous leaf extract was then concentrated using the rotary evaporator and further concentrated using the laboratory oven at 45°C.

2.2 Experimental Animals and Extract Administration

Twenty-eight adult male albino rats weighing 180-240 g were used for this study. The rats were housed in well ventilated cages and acclimatized for 3 weeks in the animal house of the Department of Physiology, Nnamdi Azikiwe University, Nnewi campus under standard environmental conditions (29±2°C temperature, 40-55% humidity, good ventilation). The animals were provided standard rat pellet feed and tap water *ad libitum*. The animals were randomly grouped into four groups labeled A-D of seven rats each. Group A was the control group and received distilled water only. Groups B-D were the test groups and received 50 mg, 100 mg and 200 mg/kg body weight of the extract respectively for 28 days by oral gavage. All procedures used in this study conformed to the guiding principles for research involving animals as recommended by the Declaration of Helsinki and the Guiding principles in the Care and Use of animals [14]. The Research and Ethical Committee of the Faculty of Basic Medical Sciences of Nnamdi Azikiwe University approved the study.

2.3 Determination of Hematological Parameters

At the end of the 28 days of extract administration, blood collection was performed by placing each animal in airtight dissector jar with cotton soaked in diethyl ether anesthesia. Blood was collected from each animal by cardiac puncture using sterile needle and 5 ml syringe. The sample was put in an ethylene-diamine-tetra-acetic acid (EDTA) bottles. Determination of Packed Cell Volume (PCV) was carried out using the hematocrit method as described by Schalm et al. [15], and Dacie and Lewis [16]. Haemoglobin concentration was determined using the cynomethaemoglobin method [17]. The total white blood cell (WBC) and red blood cell (RBC) counts were estimated using the improved Neubauer counting chamber [16,17].

2.4 Statistical Analysis

All data were tabulated and statistically analyzed using SPSS version 20.0. Results were expressed as Mean ± standard error of mean (SEM). Comparative analysis amongst groups was done using one way analysis of variance (ANOVA). A post-hoc analysis using Bonferoni

multiple comparative test was performed to identify significant groups and $p < 0.05$ was taken as statistically significant.

3. RESULTS

Fig. 1 shows the effect of aqueous leaf extract of *F. capensis* on red blood cell count of male Wistar rats. Data indicated significantly ($p < 0.05$) greater mean RBC count in group C ($7.55 \pm 0.19 \times 10^6$) and group D ($8.39 \pm 0.21 \times 10^6$) compared to control group ($6.44 \pm 0.08 \times 10^6$). This shows an incremental effect of aqueous leaf extract of *F. capensis* on RBC on group C and D rats. In contrast, there was no significant ($p > 0.05$) difference in RBC count between group B ($6.41 \pm 0.13 \times 10^6$) and the control group.

Fig. 2 shows the effect of aqueous leaf extract of *F. capensis* on white blood cell count of male Wistar rats. Group D indicated significantly greater ($p < 0.05$) WBC count ($13.43 \pm 0.50 \times 10^3$) compared to the control group ($9.47 \pm 0.97 \times 10^3$), thus showing elevated effect of *F. capensis* on WBC. White blood cell count also showed an increase in group C ($9.98 \pm 1.61 \times 10^3$); on the other hand, there was a decrease in group B ($7.62 \pm 0.37 \times 10^3$). However, these findings in groups B and C indicated no significant differences when compared with the control group.

Fig. 3 expresses the effect of aqueous leaf extract of *F. capensis* on packed cell volume of male Wistar rats. Data indicated significantly ($p < 0.05$) greater mean PCV in group C ($45.43 \pm 1.31\%$) and group D ($50.14 \pm 1.94\%$) compared to control group ($35.57 \pm 0.78\%$). These findings in groups C and D indicate the potentiating effects of aqueous leaf extract of *F. capensis* on PCV. In contrast, no significant difference was found in PCV between group B ($35.86 \pm 1.42\%$) and control group ($35.57 \pm 0.78\%$).

Fig. 4 shows the effect of aqueous leaf extract of *F. capensis* on hemoglobin concentration of male Wistar rats. There were significantly greater ($p < 0.05$) mean Hb concentrations in group C (15.21 ± 0.41 g/dl) and group D (16.71 ± 0.67 g/dl) compared to the control group (11.89 ± 0.26 g/dl). This shows that *F. capensis* induced increase in Hb concentration in groups C and D respectively. In contrast, no significant ($p > 0.05$) difference was observed in Hb concentration between group B (11.94 ± 0.47 g/dl) and the control group (11.89 ± 0.26 g/dl).

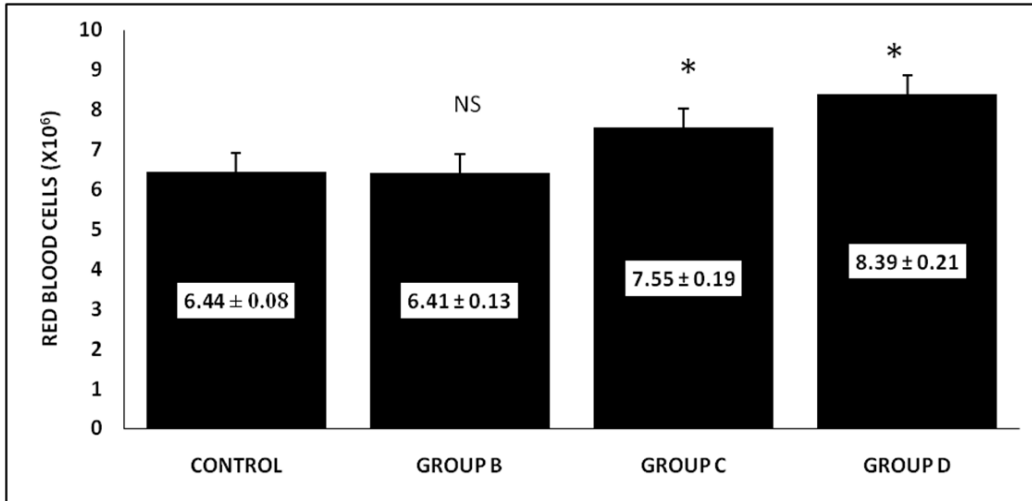


Fig. 1. Effect of aqueous leaf extract of *F. capensis* on red blood cell count of male wistar rats

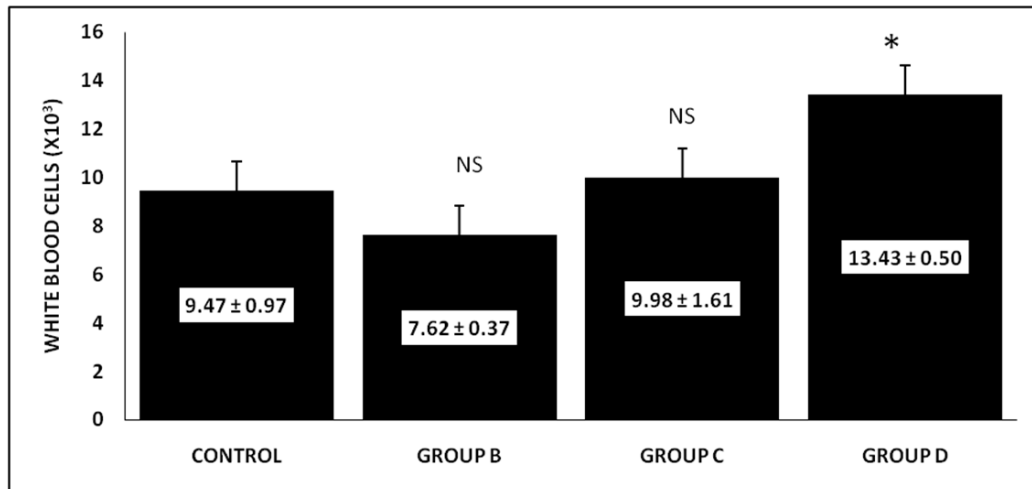


Fig. 2. Effect of aqueous leaf extract of *F. capensis* on white blood cell count of male wistar rats

4. DISCUSSION

Assessment of hematological parameters can be used to determine the extent of deleterious effect or beneficial effects of foreign compounds including plant extracts on the blood [18]. It can also be used to explain blood relating functions of chemical compounds or plant extracts [19]. In the present study we investigated various hematological parameters which are useful in assessing the potentials of plant extracts in living systems. Our findings indicated that oral administration of aqueous leaf extract of *F. capensis* increased some hematological parameters such as RBC, WBC, PCV and Hb in some experimental groups.

The mechanisms behind the increases observed in red blood cell, packed cell volume and hemoglobin concentration in this Study are not very clear. However, the presence of iron in *F. capensis* leaf extract has been reported in a previous study [20]. Iron is required for the production of hemoglobin and myoglobin and has the ability to improve bone marrow functions [21] thus increasing erythropoiesis. The elevated levels of the hematological parameters may also be due to the vitamin C content of the leaf extract [20], which is required for the absorption of iron component of *F. capensis*. In addition, vitamin C prevents formation of insoluble and unabsorbable iron compounds [22], which in effect oppose / override the anti-iron activity of

phytate and tannin components of the plant. These findings suggest a possible change in the oxygen carrying capacity of blood and transport of respiratory gases [23] in animals treated with the leaf extract of *F. capensis*.

Furthermore, polyphenolic compounds and flavanoids are reported to account for the strong antioxidant properties of *F. capensis* [24]. The presence of these antioxidant compounds help protect red blood cell membranes from free

radicals and oxidative damage of hemoglobin which leads to the release of hemin into the RBC membrane and resulting in the oxidation of the membrane proteins [25]. RBC membranes contain lipids, rich in unsaturated fatty acids and are frequently exposed to oxygen, thus making them susceptible to oxidative damage. Invasion of RBC membrane by free radicals may lead to hemolysis and reduction of RBC but antioxidants inhibit hemolysis and protect its membrane [26].

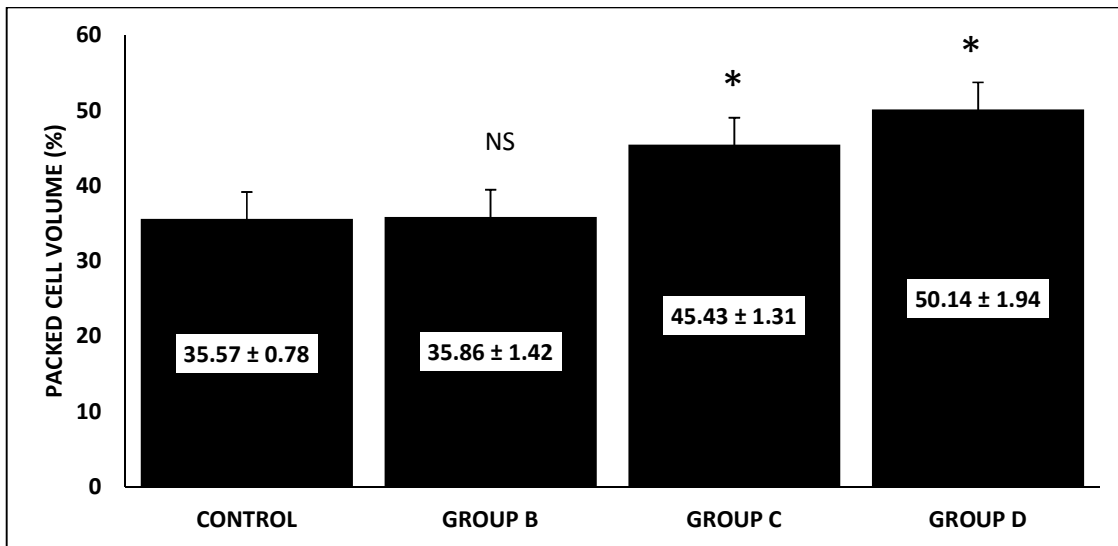


Fig. 3. Effect of aqueous leaf extract of *F. capensis* on packed cell volume of male wistar rats

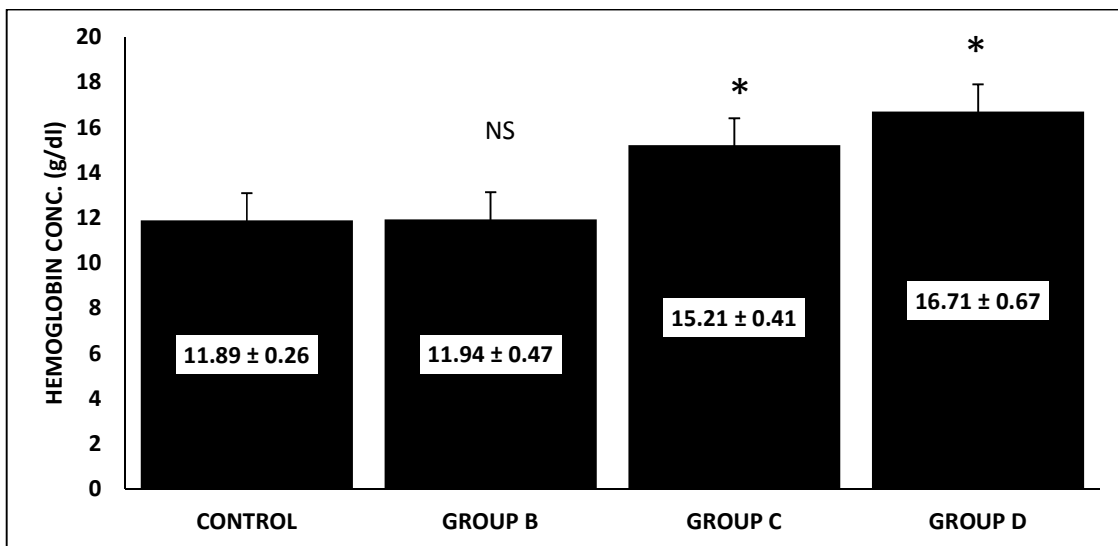


Fig. 4. Effect of aqueous leaf extract of *F. capensis* on hemoglobin concentration of male wistar rats

The elevated white blood cell count observed in group D indicates increased leukocyte mobilization and this may be indicative of the immune-boosting effect of the *F. capensis* extract and agrees with the findings of Daikwo et al. [10]. This elevated WBC count at the highest dose suggests a dose dependent effect of the leaf extract to stimulate increased production of leucocytes.

5. CONCLUSION

In conclusion, the present data indicated that administration of aqueous leaf extract of *F. capensis* increased some hematological parameters such as Hb, RBC, WBC and PCV in Wistar rats especially at higher doses. The present findings therefore suggest that the observed effects of *F. capensis* leaf extracts on blood parameters of Wistar rats could be suitably used to extrapolate the effects of consumption of this plant on the physiology of man under sub-lethal condition. The study also suggests that *F. capensis* leaf extracts may be of clinical relevance in the management of anemia and immunity-dependent disorders.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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