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Original Article

# ESTIMATION OF MEAN CORPUSCULAR VOLUME, MEAN CORPUSCULAR HAEMOGLOBIN AND MEAN CORPUSCULAR HAEMOGLOBIN CONCENTRATION EFFECT OF AQUEOUS PULP EXTRACT OF *Raphia hookeri* FRUIT IN FEMALE WISTAR RATS

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## ABSTRACT

This research aimed at estimatiing mean corpuscular volume, mean corpuscular haemoglobin, mean corpuscular haemoglobin concentration effect of aqueous pulp extract of *Raphia Hookeri* fruit in female wistar rats. A total of 28 female Wistar rats, weighing 130g to 200g, were grouped into 4 groups, Group 1 as control. The control group was provided standard feed and water, while Group 2 received 1000 mg/kg, Group 3 received 2000 mg/kg, Group 4 received 3000 mg/kg of APERHF daily for 28 days. After the treatment period, blood samples were collected, MCV, MCH, MCHC were analyzed using standard

haematological techniques. Statistical analysis was conducted with SPSS version 21.0, results were expressed as SEM, with $p<0.05$ considered statistically significant. MCV levels increased significantly across treatment groups, with control at 72.00 ± 1.73, compared to 110.33 ± 2.60, 159.00 ± 2.31, and 125.00 ± 1.15 for Groups 2, 3, and 4, respectively. MCHC values decreased significantly in treated groups, with 412.00 ± 4.04 for control, and reductions to 272.00 ± 1.15, 191.00 ± 2.31, and 233.00 ± 1.73 for Groups 2, 3, and 4, respectively. These findings indicate that higher doses of APERHF may significantly impact parameters, suggesting potential haematological risks associated with prolonged high-dose administration.
**KEY WORD:** Mean Corpuscular Volume, Haemoglobin Concentration

## INTRODUCTION

Erythrocyte indices are key indicators of red blood cell (RBC) health and function, including mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) (Rodak *et al.,* 2016). Each of these indices provides critical insights into the physiological status of red blood cells. MCV, the average volume of red blood cells, helps classify anaemia as either microcytic (smaller than normal), normocytic (normal size), or macrocytic (larger than normal) (Hoffbrand *et al.,* 2011). Deviations in MCV can reveal nutritional deficiencies—such as those of iron, folic acid, or vitamin B12—or chronic diseases that impact RBC development and lifespan. MCH and MCHC provide further insights into haemoglobin content and concentration within erythrocytes, respectively. MCH measures the average amount of haemoglobin per red blood cell, while MCHC assesses the concentration of haemoglobin in a given volume of packed erythrocytes. These metrics are useful in identifying several types of anaemia and evaluating oxygen-carrying capacity, which is essential for maintaining cellular energy and health throughout the body (Roberts & Fulwood, 2018). A healthy erythrocyte index reflects sufficient oxygen transport to tissues, while abnormalities may indicate conditions such as iron deficiency anaemia (often microcytic), folate or B12 deficiency anaemia (often macrocytic), and hereditary or acquired disorders that influence RBC morphology (Hoffbrand et al., 2011).

Studies show that the antioxidants found in *Raphia hookeri*, such as vitamins C and E, flavonoids, and phenolic compounds, can help protect erythrocytes from oxidative damage. By stabilizing erythrocyte indices, these antioxidants can potentially mitigate oxidative stress, thereby preserving erythrocyte stability, improving oxygen transport, and enhancing cellular health (Hebbel *et al.,* 1982; Egbono *et al.,* 2023). Haemoglobin is a protein that is responsible for the delivery of oxygen ($O_2$) to peripheral tissues. Haemoglobin is present in blood at concentrations of 13.5–18.0 g/dL in men and 11.5–16.0 g/dL in women. Each erythrocyte contains around 200–300 million molecules of haemoglobin. The haemoglobin molecules are a set of very closely related proteins formed by symmetric pairing of a dimer of polypeptide chains, the α- and β-globins, into a tetrameric structural and functional unit. The $\alpha_2\beta_2$ molecule forms the major adult haemoglobin. Their main function is to transport oxygen ($O_2$) from the lungs to tissues, but they also specifically interact with the 3 other gases, carbon dioxide ($CO_2$), carbon monoxide (CO), and nitric oxide (NO), that have important biological roles. Haemoglobin combines with oxygen as the blood passes through the lungs and releases it to the tissues as the blood passes them. It tightly regulates the amount of $O_2$ available to the tissues through its oxygen-buffering function.

Raphia is a plant belonging to the Palmaceae family (Abimbola *et al.,* 2018) that grows in swampy and semi-swampy environments of the equatorial rain forest or derived savannas (Ngatchoua Noubanguea *et al.,* 2020). All parts of the *Raphia hookeri* palm tree have an economic value (Oluwaniyi *et al.,* 2014).

The *Raphia hookeri* Plant is of the Arecaceae family (palms) (Gruca *et al.*, 2015) to which it is commonly known as Raphia Palm, and to the indigenous people of Abua/Odual local government area, Rivers, Nigeria known as Oghol. *Raphia hookeri* plant is a monocotyledonous plant, it has a trunk covered with attractive unusual coils, usually reproduces through seeds, and grows up to 12 m tall and 60 cm in trunk diameter (Hutchinson *et al.,* 1993). From scientific reports and investigations, it has been shown that the origin of Raphia palms is traceable to West Africa, particularly along swampy and semi swampy area of tropical and equatorial rain forest or derived savannas (Ndon, 2003). Endemic to Africa, its distribution covered many countries of the tropical area like Cameroon, Burkina Faso, Nigeria, Madagascar, Gambia, Ghana, Guinea, Ivory Coast and Kenya. *Raphia hookeri* produces fruits that are oblong ellipsoid in a scaly cone comprised of rhombus triangular reddish-brown scales (Keay and Hepper, 1953). The fruits contain an important part called pulp or mesocarp which is considered edible when boiled, in addition the pulp is used as a bitter flavouring in meals. Due to its hypothesized medicinal qualities, the pulp is used as a form of native medicine in certain parts of Africa (Liu, 2004; Altiok *et al.,* 2010). The boiled fruit pulp *Ogbusi* is taken as a snack and mostly eaten with tapioca (processed cassava) commonly known as 'Ataka' by the Abua people of Rivers State in Nigeria (Egbono *et al.,* 2023). Every part of *Raphia hookeri* tree is useful economically, both in the food industry sector and the art sector. In the food industry sector, the mesocarp of the ripe *Raphia hookeri* fruit pulp which is rich in many nutrients such as lipid (40-52%), protein (6.1%), carbohydrate (61.4%), vitamins such as niacin (0.27 mg), vitamin A (0.15 mg) and minerals (3%) (Liu, 2004; Altiok *et al.,* 2010), cannot only be used as food supplement. It can also be a main source of lipids since it yields edible oil, which can be used and exploited as a cheap and local product which leads to a decrease of resource wasting and environmental pollution (Ndon, 2003). The *Raphia hookeri* Plant has a fruit mesocarp commonly called *Ogbusi* which is boiled and processed for consumption by the people Abua/Odual LGA, Rivers State, Niger Delta Region, southern Nigeria, this fruit pulp is hypothesized to have a wide range of Health impacting effects which include hyperlipidaemia, boost immunity, inhibit plasma glucose, reduce blood pressure, boost hematopoiesis, and boost fertility etc. (Egbono *et al.,* 2023). The *Raphia hookeri* fruit pulp contains very special constituents that affect blood cell parameters. It is shown to contain vitamins C and E, carotenes, niacin, alkaloid, saponins, flavonoids and phenols (Egbono *et al*., 2023). *Raphia hookeri* fruit pulp is a good source of phytochemicals and some micronutrients and is locally consumed as a snack (Tatianan *et al.,* 2023). Its fruit is large, cone-shaped with a single hard nut having an outer layer of overlapping reddish brown scales and in-between the outer layer of scales and the hard seed is a yellow, mealy, oil-bearing mesocarp or pulp (Mbaka *et al*., 2012). Similarly, Ndon (2003) described *Raphia hookeri* fruit as large, cone-shaped with a hard nut having an outer layer of rhomboid-triangular and overlapping reddish-brown scales. Between the outer layer and the seed, is a yellow, oil-bearing mesocarp or pulp (Ndon, 2003).

Erythrocyte indices are individual components of a routine blood test called the full blood count (FBC). The erythrocyte indices measure the size, shape, and physical characteristics of the erythrocytes. They are mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and the erythrocyte shape. These parameters are an indication of how healthy the erythrocytes are. Mean corpuscular volume is the measure of the average size of the circulatory erythrocyte, and it is principally used as an index for the differential diagnosis of anaemia. The measure is obtained by multiplying a volume of blood by the proportion of blood that is cellular (the hematocrit) and dividing that product by the number of erythrocytes in that volume (Wikipedia, 2024). In patients with anaemia, it is the MCV measurement that allows classification as either a microcytic anaemia (MCV below normal range), normocytic anaemia (MCV within normal range) or macrocytic anaemia (MCV above normal range). Normocytic anaemia is usually deemed so because the bone marrow

has not yet responded to the condition with a change in cell volume. Normally, MCV is expressed in femtoliters (fL, or $10^{-15}$ L), and [erythrocyte] in millions per microliter ($10^6/\mu L$). The normal range for MCV is 80–100 fL. Not to be confused with mean corpuscular haemoglobin concentration, although they are predictably correlated in healthy states, mean corpuscular haemoglobin is the average mass of haemoglobin (Hb) per erythrocyte in a sample of blood (Wikipedia, 2024). The mass of haemoglobin always determines the colours of the erythrocyte, making them either normochromic or hypochromic. However, they cannot become hyperchromic, since and elevated MCH levels only makes the erythrocyte larger, not darker (Loscalzo *et al.*, 2022). A normal MCH value is 27-33 picograms (pg)/cell. The amount of haemoglobin per erythrocyte depends on haemoglobin synthesis and the size of the erythrocyte (Loscalzo *et al.*, 2022). The mass of the erythrocyte is determined by the iron (as part of the haemoglobin molecule), thus MCH in picograms is roughly the mass of one erythrocyte. In iron deficiency anaemia, the cell mass becomes lighter, thus a MCH below 27 pg is an indication of iron deficiency.

The MCH decreases when Hb synthesis is reduced, or when erythrocytes are smaller than normal, such as in cases of iron-deficiency anaemia (Wikipedia, 2024). Not to be confused with mean corpuscular haemoglobin (MCH) per erythrocyte, although they are predictably correlated in healthy states, the mean corpuscular haemoglobin concentration (MCHC) is a measure of the concentration of haemoglobin in a given volume of packed erythrocyte (Wikipedia, 2024). Measured in g/L, g/dL, or mmol/L, it is calculated by dividing the haemoglobin by the hematocrit. Normal ranges are 32 to 36 g/dL (320 to 360g/L), or between 4.81 and 5.58 mmol/L (Wikipedia, 2024).

A low MCHC can be interpreted as identifying decreased production of haemoglobin. MCHC can be normal even when haemoglobin production is decreased (such as in iron deficiency) due to a calculation artifact. MCHC can be elevated ("hyperchromic") in hereditary spherocytosis, sickle cell disease and homozygous haemoglobin C disease, depending upon the haemocytometer (Hill *et al.*, 2017; Rifkind and Cohen, 2002). MCHC can be elevated in some megaloblastic anaemias. MCHC can be falsely elevated when there is agglutination of erythrocytes (falsely lowering the measured erythrocyte count) or when there is opacification of the plasma (falsely increasing the measured haemoglobin). Causes of plasma opacification that can falsely increase the MCHC include hyperbilirubinemia, hypertriglyceridemia, and free haemoglobin in the plasma (due to haemolysis). Despite the abundance of natural remedies available in Nigeria, including the *Raphia hookeri* plant, these resources remain significantly underutilized. This lack of widespread knowledge about their medicinal properties contributes to the low consumption of these natural treatments. Many Nigerians, regardless of socioeconomic status, tend to rely on expensive synthetic drugs, unaware that affordable and accessible alternatives like *Raphia hookeri* can offer substantial health benefits, including the improvement of blood cell parameters and overall well-being. The underuse of these natural remedies highlights a gap in awareness and education, underscoring the need for greater recognition of *Raphia hookeri* and its therapeutic potential.

**Materials**

The materials involved in this study includes Syringe, Hand Gloves, Cages, Dissecting Blade, Dissecting Board, Permanent Marker, Animal Feeds, Water, Chloroform, EDTA Bottles, Cannula, matured female Wistar rats, Lab coats, Disinfectants, Dry saw dust etc.

**Animal Preparations**

A total of 28 healthy female Wistar rats, weighing between 130g and 200g, were utilized for this study. These rats were housed in the Experimental Pharmacology and Toxicology Animal House of the Faculty of Pharmaceutical Sciences at the University of Port Harcourt, Nigeria. The animals were kept in a well-ventilated environment with optimal humidity and temperature conditions, and a natural light-dark cycle. They were provided with unrestricted access to food and water.

**Acclimatization of Animals**

Following identification, the animals were weighed using a precise weighing balance. They were then housed in clean plastic cages for a period of two weeks. This acclimatization period was designed to ensure the animals adjusted to the environmental conditions of the Animal House, which included factors such as temperature, humidity, and light-dark cycles.

**Experimental Extract and Preparation**

The extract of *Raphia hookeri* fruit pulp was utilized for the experiment. The preparation of the extract was carried out using the maceration method. Initially, the fruit pulp was carefully air-dried to avoid degrading the active ingredients. After drying, the pulp was thoroughly crushed and then placed in a maceration jar for soaking. Approximately 1000 grams of the dried pulp were mixed with 2000 ml of water. This mixture was allowed to stand for a period of 72 hours, during which it was continuously agitated to maximize the extraction yield.

Following this maceration period, the mixture was filtered to separate the solid residues from the liquid extract. The obtained filtrate was then transferred to a water bath, where it was heated to a temperature of 65 degrees Celsius to evaporate the liquid content. This evaporation process concentrated the extract. After the evaporation was completed, the final weight of the extract was measured. The concentrated extract was then stored properly for subsequent use in the experimental procedures.

**Study Design**

A total of twenty-eight healthy female Wistar rats were used for this study. The rats were divided into four groups: a control group consisting of 7 animals and three experimental groups with 7 animals each. Following a 14-day acclimatization period in the Experimental Pharmacology and Toxicology Animal House of the Faculty of Pharmaceutical Sciences at the University of Port Harcourt, Nigeria, the experimental groups (Groups 2, 3, and 4) were administered the extract for 28 days.

**Sample Collection**

The *Raphia hookeri* fruit pulp used for this study was purchased from the *Ayeezi* local market in Abua/Odual LGA, Rivers State, Nigeria.

**Mode of Administration of Extract**

Aqueous pulp extract of *Raphia hookeri* was administered orally in low, medium, and high doses daily for 28 days. During this period, the following doses were given to each group, except the control group. The lethal dose (LD50) of the aqueous pulp extract of *Raphia hookeri* fruit was calculated using Lorke's method, with 5000 mg/kg body weight of female Wistar rats being established as the maximum. Therefore, the female Wistar rats were not given doses exceeding 5000 mg/kg body weight:

- Group 1 (Control Group): Received standard animal feed and water.
- Group 2 (Low dose): Received 1000 mg/kg body weight of the extract.
- Group 3 (Medium dose): Received 2000 mg/kg body weight of the extract.
- Group 4 (High dose): Received 3000 mg/kg body weight of the extract.

**Estimation of the erythrocyte indices**

**Materials:** Microscope and Slide

**Procedures:**

- Place a small drop of blood on a clean glass slide.
- Use another slide to spread the drop by holding it at a 30° – 45° angle and swiftly moving it across the first slide to create a thin smear.
- Allow the smear to air dry.
- Fix the cells by dipping the slide in methanol.

- Stain the smear using a Romanowsky stain (e.g., Wright-Giemsa stain). This process will make the erythrocytes more visible under the microscope.
- Place the stained slide under the microscope.
- Start with a low magnification to locate the optimal area where the cells are evenly spread and not overlapping.
- Switch to a higher magnification (usually 100x with oil immersion) to closely examine the erythrocytes.

**Estimation of mean corpuscular volume (MCV)**

- Use an ocular micrometre calibrated with a stage micrometre to measure the diameter of several erythrocytes.
- Measure the diameter of at least 20-30 erythrocytes to get a representative sample.
- Use the obtained diameter to calculate the mean corpuscular volume using the following formula:

$$MCV = \frac{4}{3}\pi r^3$$, where r = diameter ÷ 2.

**Estimation of mean corpuscular haemoglobin (MCH)**

- Evaluate the colour of the erythrocytes. Normochromic cells (normal haemoglobin content) will have a pinkish red colour. Hypochromic cells (low haemoglobin content) will appear paler with a larger central pallor.
- Using the colour of the erythrocyte of a known value of haemoglobin, compare the haemoglobin contents of the viewed erythrocytes to estimate the mean corpuscular haemoglobin.

**Estimation of mean corpuscular haemoglobin concentration (MCHC)**

- Estimate the hematocrit in the sample using known values as reference.
- Calculate the MCHC using $MCHC = \frac{Hb}{Hct} \times 100$, where Hb is the MCH, and Hct is the hematocrit value.

**Estimation of erythrocyte shape**

- Observe normal erythrocytes.
- Identify erythrocytes with shapes differing from the normal.
- Estimate the proportion of the abnormally shaped cells.
- Note the distribution of the abnormally shaped cells.

**Statistical Analysis**

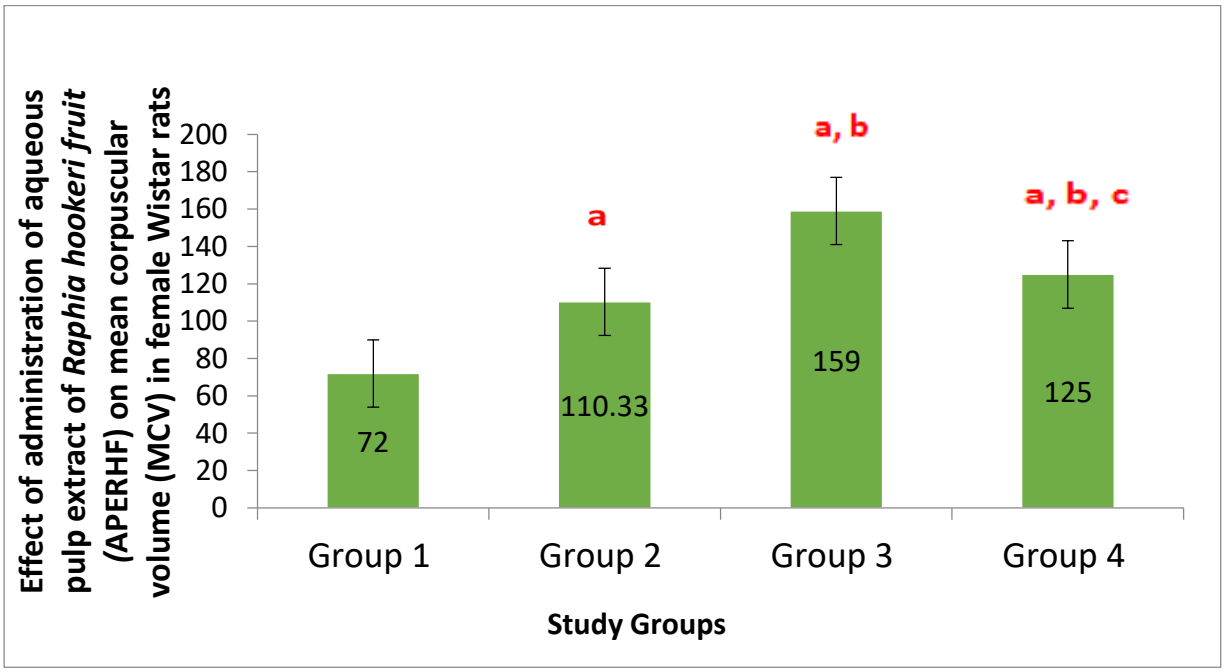
The data collected from the current study were analyzed using the Statistical Package for Social Sciences (SPSS) software, specifically version 21.0. To determine statistical significance, we employed one-way analysis of variance (ANOVA) followed by a post-hoc multiple comparison test to identify significant differences between groups. A P value of less than 0.05 ($P<0.05$) was used as the threshold to denote statistical significance. All results were reported as mean values with their corresponding standard error of the mean (SEM), providing a measure of the variability around the mean estimates.

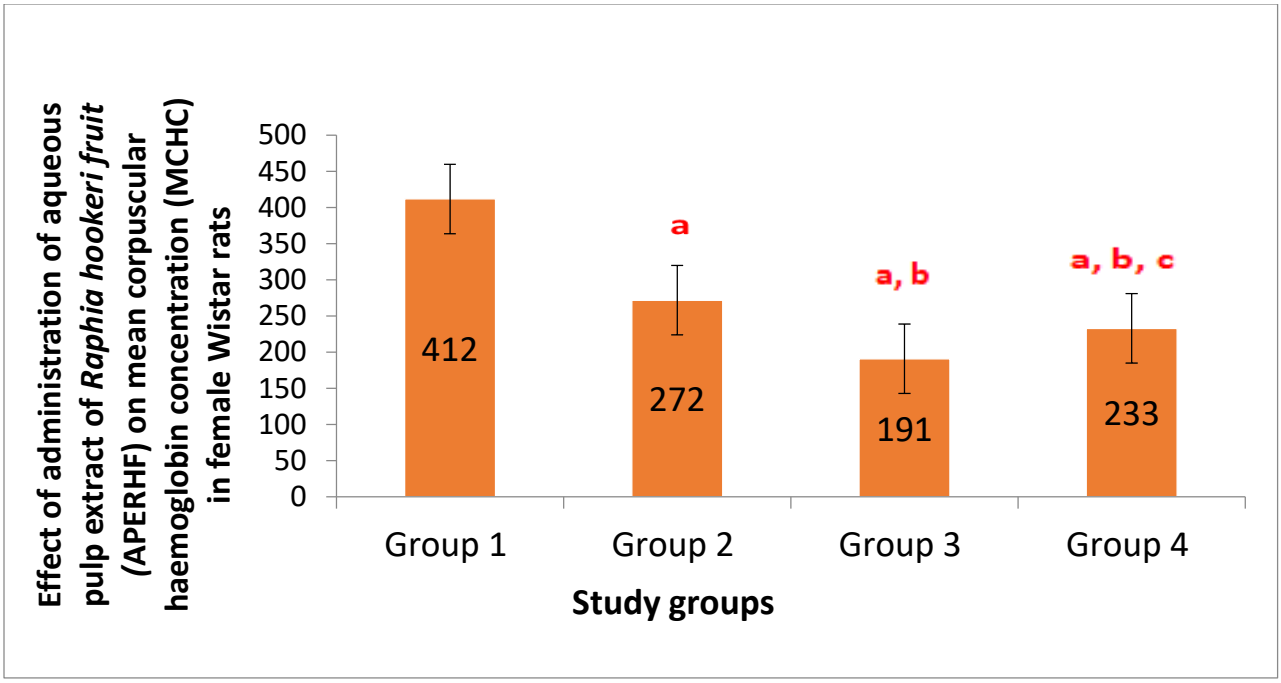
## RESULTS

The results of the study are presented in tables and charts.

**Table 1: Effect of administration of aqueous pulp extract of *Raphia hookeri* fruit (APERHF) on in female Wistar rats**

| Group and Treatment | Erythrocyte ($X10^{12}$/L) | MCV (fL) | MCH (pg) | MCHC (g/L) |
|---|---|---|---|---|
| **Group 1: Control Group** | 5.80 ± 0.12 | 72.00 ± 1.73 | 30.33 ± 1.45 | 412.00 ± 4.04 |
| **Group 2: Low Dose treated (1000mg/kg b.w APERHF)** | 5.00 ± 0.58 | 110.33 ± 2.60 [a] | 30.00 ± 0.58 | 272.00 ± 1.15 [a] |
| **Group 3: Medium Dose treated (2000mg/kg b.w APERHF)** | 4.40 ± 0.17 [a] | 159.00 ± 2.31 [a, b] | 30.00 ± 1.15 | 191.00 ± 2.31 [a, b] |
| **Group 4: High Dose treated (3000mg/kg b.w APERHF)** | 4.80 ± 0.12 | 125.00 ± 1.15 [a, b, c] | 29.00 ± 1.15 | 233.00 ± 1.73 [a, b, c] |






## Discussion

The outcome in the mean corpuscular volumes (MCV) of all treated rats were significantly ($p<0.05$) elevated when compared to that of the control group. These elevations did not follow any uniform pattern across the different doses of the APERH. Considering the outcome on the changes in the mean corpuscular haemoglobin (MCH), all treated groups did not show any significant ($p>0.05$) variation when respectively compared to that of the control group. Looking at the result of the effect of the different doses of APERHF on the mean corpuscular haemoglobin concentration (MCHC), all treated groups had significant reductions ($p<0.05$) with respect to that of the control group. The most with these reductions was seen in the medium dose APERHF treated group (group 3) and followed by that of high dose treated (group 4). The variations of MCHC amongst the treated groups of rats were statistically significant ($p<0.05$) when compared to themselves. A significant increase in mean corpuscular volume (MCV) across all treated groups compared to the control. The control group maintained a stable MCV, indicating normal erythrocyte size. In contrast, the low, medium, and high doses of APERHF resulted in progressively larger red blood cells, with the medium dose showing the highest increase. This enlargement suggests macrocytosis, which often indicates impaired erythrocyte maturation or abnormal cell development. The antioxidants in *Raphia hookeri* may disrupt normal cellular processes, leading to larger but potentially less functional erythrocytes. These results highlight the complexity of antioxidant effects, which, while beneficial in moderation, might cause adverse changes in erythrocyte morphology when administered in high doses. There is a clear, dose-dependent reduction in mean corpuscular haemoglobin concentration (MCHC) across all treated groups. The control group maintained a stable MCHC, reflecting normal haemoglobin concentration within red blood cells. In contrast, the low, medium, and high doses of APERHF significantly reduced MCHC levels, with the most substantial decrease observed at the medium dose. This reduction indicates a lower concentration of haemoglobin per erythrocyte, suggesting potential disruptions in haemoglobin synthesis or retention. Such changes could impair the oxygen-carrying capacity of red blood cells, potentially leading to hypochromic anaemia. These findings emphasize the need for careful dosing, as excessive intake of APERHF may negatively impact haemoglobin concentration and overall blood health.

Higher concentrations resulted in a significant reduction in mean corpuscular haemoglobin concentration (MCHC), while increasing mean corpuscular volume (MCV) These effects suggest potential implications for blood health and highlight the importance of understanding how natural compounds like APERHF interact with erythrocytes and platelets at varying dosages. The increase in MCV, particularly at higher APERHF doses, implies a potential macrocytic effect, whereby erythrocytes become larger but are fewer in number. Macrocytosis, often linked to oxidative stress, can be associated with elevated levels of certain vitamins or antioxidants (Hoffbrand *et al.,* 2011). Components within APERHF, such as vitamins E and C, are known to combat oxidative stress; however, their excessive presence may disrupt erythrocyte metabolism and contribute to changes in cell size, likely through alterations in cell maturation and membrane stability (Hebbel *et al.,* 1982). A notable reduction in MCHC was observed with increasing APERHF doses, especially in the medium- and high-dose groups. Lower MCHC levels suggest a possible decrease in haemoglobin concentration per erythrocyte, potentially impacting the cells' oxygen transport capacity. This effect could be linked to interactions between APERHF's antioxidant-rich profile and erythrocyte functionality. High antioxidant levels, while protective at moderate doses, might interfere with the reactive oxygen species (ROS) balance and affect cellular haemoglobin retention, as reported in studies on antioxidant impacts on red blood cells (Roberts & Fulwood, 2018). Similar findings have been documented in studies where antioxidant-rich compounds affected cellular iron metabolism, influencing haemoglobin synthesis and storage within erythrocytes (Ganz, 2019).

The haematological effects observed in this study may be attributed to the high lipid and antioxidant content of APERHF, including vitamins C and E, flavonoids, and phenolic compounds. While these constituents provide significant health benefits, they may also impact blood parameters, particularly when consumed in high quantities. For instance, the lipid content in *Raphia hookeri* could potentially influence cell membrane composition, contributing to changes in membrane stability, as well as the risk of dyslipidaemia if consumed excessively (Pappan & Rehman, 2021). Such dyslipidaemia could lead to oxidative stress in erythrocytes, affecting their survival and morphology. Furthermore, although antioxidants like vitamins C and E are effective in neutralizing ROS, high levels may create an overly reduced cellular environment, impacting cellular processes essential for erythropoiesis and thrombopoiesis (Greco, 2005). Greco's (2005) research illustrated that while moderate doses of vitamins C and E strengthen cellular resilience, high doses can disrupt cellular balance, particularly in blood cells that undergo high oxidative turnover. APERHF may offer antioxidant benefits at lower doses; however, high-dose administration could adversely impact haematological health by altering parameters. These findings emphasize the importance of dose regulation to maximize the therapeutic potential of APERHF while minimizing risks associated with excessive antioxidant intake.

## Conclusion

This study provides evidence that aqueous extract of *Raphia hookeri* fruit (APERHF) significantly affects erythrocyte indices in female Wistar rats, particularly at high doses. Notably, high-dose APERHF administration reduced, MCHC, while increasing MCV. These results indicate that, although APERHF contains beneficial antioxidants, its overuse could have detrimental effects on haematological parameters and underlines the dual nature of natural antioxidants in promoting health, reinforcing the need for controlled doses to ensure their safe use. This study contributes to a nuanced understanding of how antioxidant-rich natural extracts like APERHF affect blood health, providing a foundation for balanced, regulated use in traditional and complementary medicine.

## Limitations

The *Raphia hookeri* fruit is ideally harvested during the dry season, as this period is marked by lower rainfall and minimal flooding, ensuring optimal collection conditions. However, due to the scheduling of this research, adjustments had to be made, resulting in the fruit being harvested in the rainy season of June 2024. This compromise, while necessary, may have influenced certain aspects of the study, though it did not prevent valuable findings related to the fruit pulp's potential effects on erythrocyte indices. Unfortunately, the limited period allocated for this research imposed certain restrictions, hindering a more thorough investigation into the broader effects of *Raphia hookeri*. The financial aspect of the study also played a significant role but strictly influenced the scope and depth of the research, as acquiring the necessary materials and equipment required careful budgeting. Despite these challenges, the study succeeded in laying important groundwork, but it highlights the need for further, more expansive research with better financial and time support.

## Recommendations

Based on the results of this study, the following recommendations are proposed:

1. **Moderation in Therapeutic Use**: Individuals using *APERHF* for health benefits should limit intake to moderate doses (500–1000 mg/kg) to avoid adverse haematological effects.
2. **Caution for Vulnerable Populations**: Patients with conditions affecting erythrocytes or platelets or those at risk of bleeding disorders should consult healthcare providers before using APERHF, particularly at high doses, as it may lower platelet counts and haemoglobin concentrations.
3. **Further Research Directions**: Future studies should investigate the long-term effects of APERHF on haematological health across various dosages to evaluate its therapeutic potential in chronic applications and its effects on other blood parameters.

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