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Effects of Sub-Chronic Administration of Garcinia kola Seed Extract on Erythroid Indices in Healthy Wistar Rats

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ABSTRACT

Garcinia kola (bitter kola) is widely consumed in West Africa and is traditionally regarded as a hematinic agent capable of improving blood parameters. Despite its extensive ethnomedicinal use, scientific evidence supporting its erythropoietic benefits remains inconsistent. This study evaluated the effect of sub-chronic administration of ethanolic seed extract of Garcinia kola on erythroid indices in healthy male Wistar rats. Thirty male Albino Wistar rats (130–180 g) were randomly assigned into three groups (n = 10 per group). Group A served as control and received standard chow and water only. Group B received 100 mg/kg body weight of ethanolic Garcinia kola seed extract orally for 28 days, while Group C received 200 mg/kg for the same duration. At the end of the treatment period, blood samples were collected via cardiac puncture and analyzed for hemoglobin concentration (Hb), packed cell volume (PCV), and red blood cell (RBC) count. Data were expressed as Mean ± SEM and analyzed using one-way ANOVA followed by post-hoc LSD test, with statistical significance set at $p \leq 0.05$. Sub-chronic administration of Garcinia kola extract produced slight, non-significant reductions in hemoglobin levels and packed cell volume in both treatment groups compared with control ($p > 0.05$). Red blood cell counts showed minimal variation, with a marginal increase in the low-dose group and a slight decrease in the high-dose group, neither reaching statistical significance. Overall, no dose-dependent erythropoietic enhancement was observed. The findings do not support the traditional claim that Garcinia kola exerts hematinic effects in healthy subjects. At doses of 100–200 mg/kg administered over 28 days, the ethanolic seed extract did not significantly alter erythroid indices in male Wistar rats. While the extract appears hematologically safe within the studied range, its purported blood-boosting properties warrant reconsideration. Further studies involving anemic or diseased models are recommended to determine whether its effects differ under pathological conditions.

INTRODUCTION

Garcinia kola (bitter kola) is a medicinal plant indigenous to the tropical rainforests of West and Central Africa and widely consumed in southeastern Nigeria for its perceived therapeutic and stimulant properties (1). It belongs to the family Clusiaceae and remains culturally significant in traditional medicine despite being classified as vulnerable due to overharvesting and limited domestication (2).

Phytochemical investigations have shown that Garcinia kola seeds contain flavonoids, tannins, saponins, benzophenones, and a biflavonoid complex known as kolaviron (3). Kolaviron has been reported to possess strong antioxidant, anti-inflammatory, and cytoprotective properties (4). Experimental studies indicate that these bioactive constituents exert their effects partly through modulation of oxidative stress pathways and inhibition of inflammatory mediators such as cyclooxygenase enzymes (5). Antioxidant assays further demonstrate significant radical scavenging activity, supporting its protective role against oxidative cellular damage (6).

With respect to hematological integrity, previous studies suggest that Garcinia kola extract exhibits minimal hemolytic activity and may protect erythrocyte membranes against oxidative damage (7). Investigations into its hemostatic influence also suggest possible modulation of clotting mechanisms (5). Acute toxicity studies report a relatively high LD_{50} value, indicating short-term safety; however, prolonged consumption has been associated with alterations in bleeding parameters (6).

Several animal studies have evaluated the hematological effects of Garcinia kola seed extract. Some reports indicate alterations in red blood cell count, hemoglobin concentration, and packed cell volume following administration in Wistar rats (8,9). Others, particularly in normal physiological models, show minimal or inconsistent changes in erythroid indices (10). In pathological models such as diabetes or chemically induced toxicity, improvements in certain hematological parameters have been observed (4,8). These findings suggest that the hematological effects of Garcinia kola may be context-dependent rather than intrinsically hematinic.

Despite widespread traditional claims that bitter kola “boosts blood levels,” there remains limited consensus regarding its direct erythropoietic effect in healthy subjects. Hematopoiesis is a tightly regulated physiological process involving erythropoietin signaling, bone marrow activity, and iron metabolism (5). Substances purported to possess hematinic properties should therefore demonstrate measurable enhancement of hemoglobin concentration, packed cell volume, or red blood cell count under controlled experimental conditions.

The present study was designed to reassess the hematinic claims of Garcinia kola by evaluating the effects of sub-chronic oral administration of its ethanolic seed extract on hemoglobin concentration, packed cell volume, and red blood cell count in healthy male Wistar rats. By focusing on a controlled normal physiological model, this study aims to clarify whether bitter kola exerts intrinsic erythropoietic stimulation or demonstrates hematological neutrality.

MATERIALS AND METHODS

Ethical approval

Ethical approval for this study was obtained from the Animal Ethics Committee, Faculty of Basic Medical Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, in accordance with the principles of laboratory animal care and use.

Location of Study

The study was conducted in the Animal House, Department of Human Physiology, Faculty of Basic Medical Sciences, Chukwuemeka Odumegwu Ojukwu University, Uli Campus, Anambra State, Nigeria.

Materials

The materials used include Garcinia kola, thirty (30) male Wistar rats, Randox reagent kits (England), Pyrex beakers (Techmel, USA), measuring cylinders (MINGHE), 2 mL hypodermic syringes, an electronic weighing balance (Mettler M311L, China), oral cannula, microscope slides, Olympus XSZ-107BN microscope, and Whatman qualitative filter paper No. 1 (Sigma Aldrich WHA1001042). Additional items included distilled water, standard plastic cages, cotton wool (KENS LINT, Benin City, Nigeria), latex hand gloves (Supermax Gloves, Selangor, Malaysia), chloroform (Guangdong Guandgua Chemical Factory Co. Ltd., Shatou, China), Vital Grower feed (Jos, Nigeria), dissecting kits, automatic water distiller (SZ-1 Search Tech Instrument), Nexus refrigerator, rotary evaporator (TT-52; Techmel & Techmel, USA), UV-VIS 752N spectrophotometer (Shanghai Yoke Instrument Co., Ltd., China), and thermostat oven (DHG-9023A, PEC MEDICAL, USA).

Experimental Animals

Thirty (30) healthy adult male Wistar rats weighing 130-180g were obtained from an accredited animal breeding facility. The animals were housed in well-ventilated cages under standard laboratory conditions (12-hour light/dark cycle, temperature 22–25°C) and allowed free access to standard rat chow and water ad libitum. The animals were acclimatized for two weeks before commencement of the experiment.

Preparation of Ethanolic Extract

Dried seeds of Garcinia kola (10g) were washed, air-dried, and pulverized into fine powder using an electric grinder. The powdered material was macerated in 400ml of 70% ethanol for 72 hours with intermittent shaking. The mixture was filtered using Whatman No. 1 filter paper, and the filtrate was concentrated using a rotary evaporator at reduced temperature. The semi-solid extract was further dried in a water bath to obtain a concentrated extract and stored in airtight containers at 4°C until use.

Experimental Design and Grouping

The rats were randomly allocated into three groups (n=10):
Group A (Control): Received only standard rat chow and water.
Group B (Low Dose): Received 100 mg/kg body weight of G. kola extract daily via oral gastric route for 28 days.
Group C (High Dose): Received 200mg/kg body weight of the extract daily for 28 days.

Specimen Collection and Laboratory Analysis

After 28 days, the rats were sacrificed. Venous blood (5 ml) was collected via cardiac puncture and divided into EDTA tubes for hematological indices and plain tubes for hemostatic parameters. Samples were meticulously labeled and analyzed for:
Hemoglobin (Hb) concentration
Packed Cell Volume (PCV)
Red Blood Cell (RBC) count

Statistical analysis

Statistical analysis was performed using GraphPad Prism version 9.5.1 (GraphPad Software, San Diego, CA, USA). Data were expressed as mean ± SEM. One-way ANOVA followed by Fisher's LSD post hoc test was used to compare groups. Statistical significance was set at $p \leq 0.05$.

RESULTS

Table1: Effect Garcinia kola on hemoglobin level, RBC level, and packed cell volume in Albino Wistar rats

	Haemoglobin level (g/dl)	Packed cell volume (%)	RBC (x10^6/uL)
	MEAN±SEM	**MEAN±SEM**	**MEAN±SEM**
Group A	9.40± 1.03	28.00±2.88	3.35±0.02
Group B (low dose)	9.20± 2.11	27.33±6.36	3.37±0.01
Group C (High dose)	9.17± 0.61	27.33±1.45	3.34±0.10
f-ratio	0.009	0.008	0.041

Data was analyzed using ANOVA followed by post Hoc LSD with Graph-pad prism 9.5.1. *: significant at p≤0.05.

Table 1 result reported a decrease in the mean hemoglobin level in groups B, and C compared to group A, which is not statistically significant. However, the packed cell volume result revealed a decrease in groups B and C compared to group A, which has no significant difference. Further, the RBC level indicates an increase in-group B and a decrease in-group C compared to group A, which indicates no significant difference statistically.

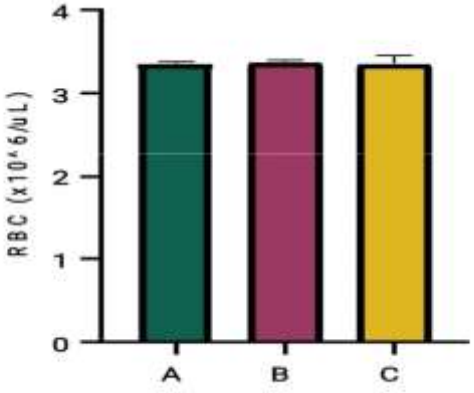

Fig1: Effect of *Garcinia kola* on RBC level in Albino Wistar rats

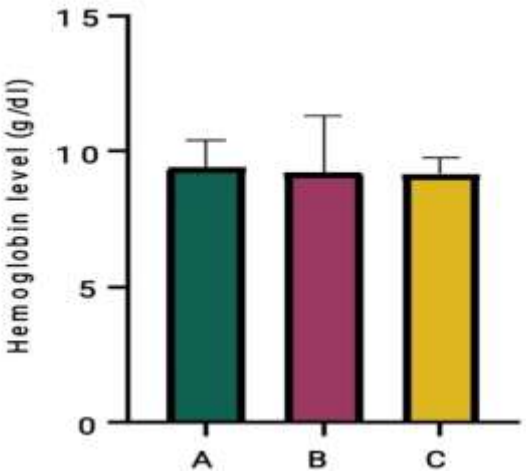

Fig 2: Effect of *Garcinia kola* on hemoglobin levels in Albino Wistar rats

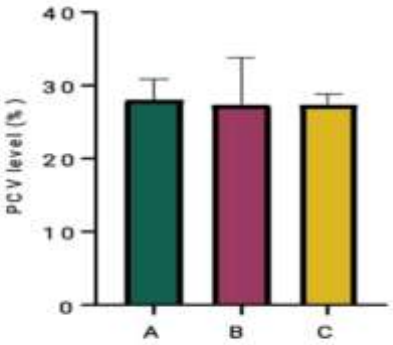

Fig 3: Effect of *Garcinia kola* on packed cell volume in Albino Wistar rats.

DISCUSSION

This study evaluated the hematinic potential of ethanolic seed extract of Garcinia kola in healthy male Wistar rats following 28 days of oral administration. The findings demonstrated that the extract did not produce any statistically significant alteration in hemoglobin concentration, packed cell volume, or red blood cell count compared with the control group ($p > 0.05$). These findings suggest that Garcinia kola does not stimulate erythropoiesis under normal physiological conditions.

Traditionally, bitter kola is widely consumed in West Africa and is believed to “boost blood levels” and improve vitality (9). However, ethnomedicinal claims do not always correlate with controlled experimental outcomes. The absence of significant increase in hemoglobin concentration observed in this study does not support the commonly held hematinic claim associated with bitter kola consumption.

Previous investigations into the hematological effects of Garcinia kola have reported inconsistent results. Some studies observed mild elevations in erythroid indices following administration of the extract, particularly in stress-induced or toxicant-exposed models (10,11). These findings suggest that the plant may exert protective or restorative effects under pathological conditions rather than directly stimulating erythropoiesis in healthy subjects.

Conversely, other researchers have reported no statistically significant change in red blood cell parameters following administration of Garcinia kola extract in normal animals (12). This aligns with the present findings and supports the view that the extract does not possess intrinsic erythropoietic properties.

The phytochemical constituents of Garcinia kola, including flavonoids, tannins, and biflavonoids such as kolaviron, are known for antioxidant and anti-inflammatory properties (13). Antioxidants may help protect erythrocytes from oxidative damage, but this mechanism differs from direct stimulation of bone marrow erythropoietin-mediated red blood cell production. It is therefore plausible that any perceived hematinic effect may arise from cytoprotective mechanisms rather than increased erythropoiesis.

Differences observed across studies may be attributed to variations in extraction solvent, dosage, duration of treatment, experimental design, and animal model used (10–13). Additionally, baseline hematological status plays a crucial role; agents that show benefit in anemic models may not produce measurable effects in healthy animals with normal erythroid indices.

Overall, the present findings indicate that while Garcinia kola appears hematologically safe at the administered doses, it does not demonstrate significant hematinic activity in healthy male Wistar rats.

CONCLUSION

Sub-chronic oral administration of ethanolic seed extract of Garcinia kola at doses of 100 mg/kg and 200 mg/kg for 28 days did not significantly alter hemoglobin concentration, packed cell volume, or red blood cell count in healthy male Wistar rats.

The findings therefore do not provide experimental support for the traditional hematinic claims associated with bitter kola consumption in healthy individuals. However, the extract did not exhibit hematological toxicity at the administered doses.

RECOMMENDATION

Based on the findings of this study, further research is recommended to evaluate the hematological effects of Garcinia kola in experimentally induced anemic or disease models where erythropoietic stimulation may be more evident. Longer-term investigations should also be conducted to determine the impact of chronic administration on hematological parameters. In addition, comparative studies using different extraction methods may help clarify whether solvent variation influences biological activity, while mechanistic studies focusing on the role of bioactive constituents such as kolaviron in erythrocyte protection and bone marrow function are warranted before any clinical extrapolation can be considered.

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