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Changes in lipid profile, serum protein, haemoglobin and haematocrit levels of albino rats fed with 20g/kg body weight of *Pentaclethra macrphylla*

Obasi Miriam Oluchi[1]; Nwosu Dennis Chimezie[1]; Nwanjo Harrison Ugo[1]; Amah Henry[1]; and [*]Obeagu Emmanuel Ifeanyi[2]

[1]Department of Medical Laboratory Science, IMO State University, Owerri, Imo State, Nigeria.
[2]Department of Biomedical and Laboratory Science, Africa University, Mutare, Zimbabwe
[*]Corresponding author: Emmanuel Ifeanyi Obeagu, Department of Biomedical and Laboratory Science, Africa University, Mutare, Zimbabwe,
E-mail: *emmanuleobeagu@yahoo.com*

Abstract

Pentaclethra macrophylla (African oil bean) is widely consumed in West Africa, yet its metabolic and haematological effects at high dietary levels remain insufficiently characterized. This study evaluated changes in lipid profile, serum proteins, haemoglobin, and haematocrit of albino rats fed 20 g/kg body weight of *P. macrophylla*.Adult albino rats were divided into control and treatment groups. The treatment group received a diet supplemented with 20 g/kg body weight of processed *P. macrophylla* for 28 days. Blood samples were analysed for total cholesterol, triglycerides, HDL, LDL, total protein, albumin, globulin, haemoglobin, and haematocrit. Data were expressed as mean ± SD and compared using Student's t-test.Rats fed *P. macrophylla* showed significant reductions in total cholesterol (119.3 ± 5.9 vs. 98.7 ± 4.1 mg/dL), triglycerides (90.5 ± 4.6 vs. 48.5 ± 2.2 mg/dL), and LDL (66.6 ± 4.2

vs. 41.3 ± 3.7 mg/dL), with a significant increase in HDL (34.7 ± 4.9 vs. 47.7 ± 1.0 mg/dL) compared with controls ($P < 0.05$). Total protein, albumin, and globulin decreased significantly in the treated group, while haemoglobin and haematocrit increased significantly.High-dose dietary intake of *P. macrophylla* produced favourable lipid profile changes and enhanced haematological parameters but resulted in reduced serum protein indices. These findings highlight both the potential benefits and metabolic limitations associated with high consumption of the seed and underscore the need for further toxicological and mechanistic studies.

Keywords: *Pentaclethra macrophylla;* Lipid profile; Serum proteins; Haemoglobin; Haematocrit; Albino rats.

Introduction

Pentaclethra macrophylla Benth., commonly referred to as the African oil bean, is a leguminous tree widely distributed across West and Central Africa. Its seeds are popularly consumed after boiling, slicing, and fermenting to produce a delicacy commonly known as "ugba" or "ukpaka." Beyond its nutritional value, the plant is used extensively in ethnomedicine for the management of gastrointestinal disorders, inflammatory conditions, and metabolic dysfunctions. Phytochemical investigations have identified bioactive constituents including saponins, tannins, phytosterols, alkaloids, flavonoids, and high amounts of unsaturated fatty acids, which contribute both to its therapeutic potential and possible toxicological concerns [1-2]. Although *P. macrophylla* is culturally important and nutritionally rich, its seeds are also characterised by a high lipid content, comprising mainly oleic, linoleic, and palmitic acids. Regular consumption may therefore influence lipid metabolism, modulate serum lipid fractions, and potentially alter cardiovascular risk markers. The nutritional profile additionally includes substantial protein content; however, the presence of antinutritional factors such as tannins, oxalates, and phytates may impair protein digestibility, reduce nutrient bioavailability, and interfere with hepatic protein synthesis. These biochemical interactions underscore the need to evaluate the effects of high-dose consumption on serum protein levels [3-4].

Haematological parameters such as haemoglobin and haematocrit are sensitive indicators of systemic toxicity, nutritional adequacy, and the integrity of erythropoietic function. Antinutritional constituents commonly found in legumes, including tannins and alkaloids, can bind dietary iron, inhibit erythrocyte formation, or cause oxidative stress-mediated red cell destruction. As *P. macrophylla* contains some of these secondary metabolites, assessing its effect on haemoglobin and haematocrit is essential for determining potential haematotoxic or blood-modifying properties [5]. In many communities, *P. macrophylla* is consumed in relatively large quantities, particularly during festive periods or in areas where it serves as a major protein substitute. Despite its widespread consumption, there remains limited scientific evidence on the physiological impact of high-dose ingestion. Previous studies have focused primarily on proximate composition and antimicrobial or antioxidant properties, with fewer works examining its metabolic, biochemical, or haematological effects under controlled conditions [6].

Experimental animal models, especially albino rats, offer a reliable means of assessing the biological and potential toxicological consequences of dietary substances. Administering a high dose, such as 10 g/kg body weight, provides insight into the threshold at which nutritional components may exert adverse or modulatory effects. Understanding changes in lipid profile, serum protein concentration, haemoglobin, and haematocrit following exposure will therefore help to define the safety margins and metabolic implications of high consumption [7-8]. Given the nutritional relevance of *P. macrophylla* and the paucity of comprehensive toxicological data, this study was undertaken to evaluate the effects of feeding albino rats with 10 g/kg body weight of processed *P. macrophylla*

seeds for 28 days. Specifically, the study aimed to determine alterations in lipid profile (TC, TG, HDL-C, LDL-C), serum protein levels, haemoglobin concentration, and haematocrit values. The findings will contribute to a clearer understanding of the metabolic consequences of high-dose intake and provide scientific evidence relevant to public health, dietary practices, and food safety evaluations.

Materials and Methods

Pentaclethra macrophylla (African oil bean seed)

The African oil bean seeds used was purchased from a public local market Owerri, Imo State and identification done at the department of plant science and bio-technology of Imo State University. African oil bean seeds were stored in a cool dry place. The fermented seeds were open air dried and milled to make fermented African oil bean diet.

Animal

Twenty-four (24) albino rats of both sexes weighing between 130g to 180g used for the study were purchased from Emi Ventures, No 120 Royce road, Owerri, Imo state. They were kept in well ventilated iron cages at the school farm of the faculty of Agric and Veterinary Medicine, Imo state University three weeks. One week was used for their acclimatization before the experiment and ethical rules guiding the use of laboratory animals according to Zimmerman (1983) were strictly followed. The Animals was grouped into four of six (6) animals in each group. The albino rats were fed with growers' mash and also were given clean tap water.

Experimental Design

Group I: Received normal diet and water only

Group II: Received normal diet, water and 10g/kg body weight of *Pentaclethramacrophylla.*

Group III: Received normal diet, water and 15 g/kg body weight of *Pentaclethramacrophylla.*

Group IV: Receive normal diet, water and 20g/kg body weight of *Pentaclethra macrophylla.*

Route of Administration

The rats were fed with ground Ugba orally, by using a syringe without a needle and inserting it into the mouths of the rats by the side gently and slowly to make sure that the required volume was consumed successfully.

Blood collection

Twenty-four hours after the last *Pentaclethra macrophylla* meal, the animals were anaesthetized with chloroform vapor, quickly brought out of the jar. Whole blood was collected by cardiac puncture from each animal into clean plain tubes. Part of the blood sample was put in EDTA bottle for Hemoglobin and Packed Cell Volume estimation. The remaining blood was allowed to stand for about 15 minutes to clot, then spurn in a centrifuge at 5000g for 10 minutes. Serum was separated from the clot with Pasteur pipette into sample tubes for estimation of lipid profile and serum protein and the samples stored at -20^{0}C prior to use.

Laboratory Procedures

All reagents used were commercially purchased and manufacturers' standard operating procedures were strictly adhered to.

Determinations

A. Serum Total Cholesterol Assay

The RANDOX diagnostic cholesterol kit with catalogue n umber CH-200 was used. It uses the enzymatic end point method as modified by Randox laboratory.

Procedure

The tubes were arranged accordingly as test, standard and blank. 0.01ml of each serum, cholesterol standard and distilled water was introduced accordingly into test, standard and

blank tubes respectively. Then 1ml of the cholesterol reagent was added into each of the tubes and mixed thoroughly. It was incubated at 37^0C for 5 minutes. After incubation, the absorbance test and standard were read against that of blank within 60 minutes at 546nm wavelength.

B. Serum HDL – Cholesterol Assay

The RANDOX diagnostics HDL – cholesterol KIT with catalogue number CH – 203 was used. It uses the enzymatic end point method as modified by Randox laboratory.

Procedure:

Into a centrifuge tube, 0.2ml of the serum sample and 0.5ml of dilute precipitant was introduced. The contents were mixed properly and allowed to stay for 10 minutes at room temperature. After the period, it was centrifuged for 10 minutes at 4,000 rpm. The supernatant was separated by the use of a Pasteur pipette. Then three tubes were arranged as test, standard and blank. Exactly 0.1ml of each of the supernatant, cholesterol standard and distilled water was added into the test, standard and blank tubes respectively. Then 1ml of cholesterol reagent was added into each of the tubes and mixed thoroughly. It then incubated at 37^0C for 5minutes. After incubation, the absorbance of test and standard were read against that of blank with 60minutes at 546nm wavelength.

C. Serum Triglyceride Assay

The RANDOX diagnostic triglyceride kits with catalogue number TR-210 was used. It uses the enzymatic end point method as modified by Randox laboratory.

Procedure

After preparation of the working reagents using the enzyme reagent and buffer, three test tubes were arranged and labelled test, standard and blank and 0.01ml of serum was introduced into the test, 0.01ml of distilled water into the blank tube. The 1ml of the working reagent was added into each of the tubes and mixed properly. The tubes were incubated at 37^0C for 5minutes. And the absorbance of the test and standard will be read against that of the blank within 60minutes at 546nm wavelength.

Serum LDL cholesterol determination

Serum LDL cholesterol was calculated by the Sand Kamp et al., (1990) modification of the Friedwald formula, which states;

$$\text{LDL-C} = \text{Total cholesterol} - \frac{\text{triglycerol}}{5} - \text{HDL} - \text{C}$$

Formula hinges on the assumption that VLDL –C is present in a concentration equal to one fifth of the triglyceride concentration.

D. Serum VLDL – cholesterol determination

This was calculated using the formula

$$\text{VLDL-C} = \frac{\text{Triglyceride}}{5}$$

(D) Estimation of Serum Total protein

The Randox reagent with catalogue number TP. 245 was used. The method used was Biuret method as modified by Randox laboratory.

a. Procedure

Test tubes were arranged into reagent blank, sample blank and standard. 0.02ml of the distilled H_20 was added to the reagent blank test tube. Then 0.02ml of serum will be added to both sample tube and sample blank tube. Followed by the addition of 1.0ml of reagent 1 (RI) to all the tubes except sample blank tube which is 1.0ml of R2 was added. It was mixed and incubated for 30minutes at +20 to $+25^0$C. Then it was read at 546nm wavelength.

Estimation of Serum Albumin

Bromocresol Green of Randox with catalogue number AB362 was used.

a. Procedure

Three (3) test tubes for reagent Blank, standard and sample were properly arranged. 0.01ml of distilled water was added to the tube for reagent blank, 0.01ml of the standard was also added to the test tube for standard while 0.01ml of serum was added to the test tube for sample. Then 3.0ml of the bromocresyl green reagent was added to all the 3 test tubes each. It was mixed and incubated for 5 minutes at +20 to +25^{0}C. The absorbance of the sample and the standard was measured against the reagent blank.

Heamoglobin estimation

This was performed with Sysmex XE -5000 series automated heamatology analyzer manufactured by Sysmex Corporation, Japan.

Haematocrit estimation

Statisical analysis

All values are expressed as mean± standard deviation (SD). The statistical analysis was carried out using student T-test. Results are displayed in tables.

Results

Table 1: mean ± SD values in total cholesterol, triglyceride, HDL, LDL, total protein, Albumin and globulin of albino rats fed with (20g.kg) *Pentaclethra macrophylla.*

Parameters	Control	Group 4	P values
Total cholesterol	119.3±5.9	98.7±4.1	P<0.05
Triglyceride	90.5±4.6	48.5±2.2	P<0.05
HDL	34.7±4.9	47.7±1 .0	P<0.05
LDL	66.6±4.2	41.3±3.7	P<0.05
Total protein	4.8±1.0	2.9± 0.4	P<0.05
Albumin	2.7±0.5	1.7± 0.4	P<0.05
Globulin	2.2±0.61	1.3±0.37	P<0.05
Heamoglobin	11.5±2.5	12.7± 1.7	P<0.05
Heamatocrit	34.8±4.9	38.5±1.2	P<0.05

When total cholesterol (98.7±4.1) was compared with the control (119.3±5.9), there was a decrease which significant (P<0.05). Triglyceride also showed a high decrease in control value (90.5±4.6) when compared to the test (48.5±2.2) which was significant (P<0.05). There was an increase in the test of HDL and control when compared i.e. (47.7±1) and (34.7±4.9) respectively. This was a significant change (P<0.05). LDL decreased from control (66.6±4.2) to (41.3±3.7) significantly (P<0.05). Total protein decreased from control (4.8±1) to (2.9±0.4). Which was significant (P<0.05). Also, albumin decreased from control (2.7±0.5) to 1.7±0.4) and this means a significant change (P<0.05). In globulin there was also a decrease from control (2.2±0.61) to (1.3±0.37). The change was also significant (P<0.05). Haemoglobin and haematocrit increased from control(13.0±1.7 and 39.3±1.2) to(11.5±2.5 and 34.8±4.9) respectively. This showed a significant change (P<0.05) (Table 1).

Discussion

The biochemical and haematological outcomes observed in albino rats fed with 20 g/kg body weight of *Pentaclethra macrophylla* demonstrate a distinct pattern of metabolic modulation. The significant reduction in total cholesterol (98.7 ± 4.1 mg/dL) relative to the control group (119.3 ± 5.9 mg/dL) indicates that *P. macrophylla* exerts a

measurable hypocholesterolaemic effect. This aligns with earlier reports attributing cholesterol-lowering properties of the seed to its unsaturated fatty acid content, fibre, and phytosterols, all of which may enhance biliary cholesterol excretion or inhibit intestinal lipid absorption [9].A similar trend was observed for triglycerides, which decreased sharply from 90.5 ± 4.6 mg/dL to 48.5 ± 2.2 mg/dL in the treated rats. This marked reduction suggests an influence on hepatic triglyceride metabolism, possibly mediated by saponins or other bioactive constituents known to suppress lipogenesis or enhance peripheral lipid utilisation. The concurrent significant decrease in LDL-cholesterol (from 66.6 ± 4.2 mg/dL to 41.3 ± 3.7 mg/dL) further supports a lipid-improving effect, likely driven by enhanced LDL clearance or reduced synthesis. These findings collectively indicate that high dietary intake of *P. macrophylla* may have cardioprotective potential through favourable lipid modulation [10].

Contrary to the reductions in other lipid fractions, HDL-cholesterol increased significantly in the treated group (47.7 ± 1.0 mg/dL) compared with the control (34.7 ± 4.9 mg/dL). HDL elevation is a beneficial metabolic adaptation, as HDL participates in reverse cholesterol transport and confers anti-inflammatory and antioxidant benefits. The observed improvement suggests that the phytochemical composition of *P. macrophylla* may enhance lipoprotein metabolism in a manner supportive of cardiovascular health [11].In contrast to the improvements in lipid parameters, there was a significant decrease in total protein (from 4.8 ± 1.0 g/dL to 2.9 ± 0.4 g/dL), albumin (from 2.7 ± 0.5 g/dL to 1.7 ± 0.4 g/dL), and globulin (from 2.2 ± 0.61 g/dL to 1.3 ± 0.37 g/dL). These reductions may indicate compromised protein synthesis or altered hepatic functional capacity in response to the high-dose dietary exposure. Although *P. macrophylla* is protein-rich, its residual antinutritional factors—such as tannins, saponins, and phytates—even after processing, may interfere with protein digestion, absorption, or utilisation. Tannins in particular can bind dietary proteins and reduce their bioavailability, while phytates may impair mineral absorption critical for protein metabolism [12].

Interestingly, unlike patterns seen in some plant-based toxicological models, the haematological parameters showed significant increases rather than reductions. Haemoglobin increased from 11.5 ± 2.5 g/dL to 12.7 ± 1.7 g/dL, and haematocrit rose from 34.8 ± 4.9% to 38.5 ± 1.2%. These elevations suggest that the administered dose did not impair erythropoiesis; instead, it may have enhanced red cell production or improved erythrocyte survival. The observed increase may reflect the presence of micronutrients or bioactive compounds supportive of haematopoiesis. Another possibility is a physiological adaptation to dietary constituents with antioxidant properties, which could reduce erythrocyte oxidative stress and prolong cell lifespan [13].The findings show a dual physiological impact of *P. macrophylla* at 20 g/kg body weight: beneficial lipid modulation and an unexpected improvement in haematological indices, but a concurrent decline in serum protein components. This mixed pattern suggests that while the plant possesses lipid-lowering and blood-boosting attributes, high dietary intake may compromise protein metabolism. Future studies should characterise the dose-response relationship, isolate responsible phytochemicals, and evaluate hepatic function more directly to elucidate mechanisms underlying the observed protein suppression.

Conclusion

The administration of 20 g/kg body weight of *Pentaclethra macrophylla* to albino rats produced a distinct pattern of biochemical and haematological responses. The significant reductions in total cholesterol, triglycerides, and LDL-cholesterol, together with the marked elevation in HDL-cholesterol, demonstrate a favourable lipid-modulating effect that may confer cardioprotective benefits. Conversely, the significant decreases in total protein, albumin, and globulin indicate potential impairment of protein metabolism or bioavailability, likely influenced by residual antinutritional factors present at this

high dietary exposure level.In contrast to the protein-related changes, haemoglobin and haematocrit increased significantly, suggesting that *P. macrophylla* at the administered dose may support erythropoietic activity or enhance red cell stability. The findings reveal that while *P. macrophylla* exhibits beneficial lipid and haematological effects, its high-dose consumption may compromise serum protein indices. This underscores the need for moderation in dietary intake and supports the importance of further studies to define optimal consumption levels, clarify mechanistic pathways, and evaluate long-term safety.

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