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In Vivo Determination of Serum Lipid Profile, Haematological Parameters, and Sperm Fertility Indicators in Men Fertility Using Male Wistar Albino Rats Fed With Brachystegia Eurycoma (Achi) Seeds

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Perspective

Keywords: Brachystegia eurycoma, legumes, male fertility, lipid profile, haematological parameters, medicinal plants

Posted Date: December 8th, 2025

DOI: https://doi.org/10.21203/rs.3.rs-8271643/v1

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Additional Declarations: No competing interests reported.

Abstract

Male infertility is a growing global health issue, affected by environmental, nutritional, and occupational factors that reduce semen quality. This research examined how Brachystegia eurycoma seed intake impacts serum lipid profiles, blood parameters, and sperm fertility in male Wistar rats. Rats received 0 (control), 200, 400, or 800 mg/kg of seed extract daily for 14 days. Semen results showed dose-dependent effects: the 800 mg/kg group had the highest sperm motility (45%) and normal morphology (75%), while the 400 mg/kg group experienced lower motility (25%) and sperm count (25 million/ml). Lipid analysis revealed significant rises in total cholesterol (299 mg/dl) and triglycerides (442 mg/dl) at 800 mg/kg, along with the lowest HDL (33 mg/dL) and highest LDL (178 mg/dL). Conversely, the 400 mg/kg group had reduced TC (120 mg/dl) and TG (132.5 mg/dl). Blood tests indicated maximum PCV (22.5%) and Hb (112.03%) at 400 mg/kg, but the 800 mg/kg group showed moderate PCV (20.5%), Hb (102.26%), and increased WBC (117.46%). The rise in cholesterol and triglycerides at 800 mg/kg might support steroid production, while intermediate doses disturbed lipid balance and damaged sperm quality. Hematological results suggest that improvements in oxygen and red blood cell production alone couldn't offset damage to lipid metabolism or testicular health. These findings show that B. eurycoma seeds have complex, dose-dependent impacts on male reproductive health, emphasizing the important relationship between lipid metabolism, blood health, and spermatogenesis.

INTRODUCTION

Increasing scientific evidence points to a rising global prevalence of infertility in recent decades. Infertility, defined as the failure to achieve pregnancy after at least one year of regular unprotected intercourse, affects an estimated 15% of couples of reproductive age. Male factors independently account for about 20–30% of cases and contribute to nearly half of all infertility diagnoses, yet a substantial proportion remains idiopathic despite improved diagnostic and therapeutic approaches (Igwe et al., 2024). Infertility can arise from reduced sperm count, poor motility, abnormal morphology, or a combination of these defects (Aiyeyika et al., 2025). Current concerns focus on the documented decline in semen quality and the growing incidence of male reproductive abnormalities worldwide. Although the precise causes of the rising burden of male infertility remain uncertain, a range of environmental, nutritional and socioeconomic influences have been proposed as contributing factors to the progressive deterioration in semen parameters (Igwe et al., 2024).

The use of herbal remedies for managing human and animal health conditions has become increasingly widespread worldwide. As the oldest known form of medical practice, it remains particularly prominent in developing countries such as Nigeria, where numerous medicinal plants are employed for the treatment of various ailments, often based on traditional knowledge and with limited scientific validation (Ganiyu et al., 2022). Plants and their derivatives have long served as globally accessible therapeutic resources, supporting both human and animal health as well as basic needs such as food and shelter. For centuries, various cultures have used indigenous plants to enhance vitality and male sexual performance. However, many plants are also documented to exert negative effects on male fertility. The

antifertility actions of certain medicinal plants are attributed to ecbolic, estrogenic, or spermicidal properties, often linked to toxic effects of plant extracts on reproductive tissues (Aiyeyika et al., 2025). Medicinal plants contain diverse phytochemicals—such as flavonoids, phenolics, alkaloids, terpenoids, and glycosides—that may play significant roles in managing fertility disorders. Many of these compounds have been shown to enhance sperm parameters, including motility, count and viability, and to improve antioxidant biomarkers like superoxide dismutase, catalase and glutathione peroxidase. They also support normal testicular histoarchitecture in experimental models. Given the widespread reliance on plant-based therapies in Central and West Africa, further investigation into their potential to improve male fertility is warranted (Adeniyi et al., 2025).

Legumes, belonging to the Fabaceae family and its three subfamilies, constitute the third-largest angiosperm group with over 20,000 species (Looi and MohdMaidin, 2023). The growing global population has intensified the demand for food, while protein deficiency remains prevalent in many regions. Consequently, in both developed and developing nations, legume seeds serve as an important and affordable source of dietary protein (Poteraș et al., 2024). They are nutritionally valuable, offering high protein (Wang et al., 2024; Yanni *et al.*, 2024; Singh et al., 2025), complex carbohydrates, fibre (Torheim *et al.*, 2024), essential fats, vitamins and minerals (Sandhu et al., 2025). Nevertheless, global consumption remains low (under 3.5 kg per capita annually), largely due to gastrointestinal discomfort and prolonged cooking times caused by their tough seed coats. Moreover, legumes contain antinutritional bioactive compounds, often considered food toxicants, that may produce adverse physiological effects and further limit intake (Looi and MohdMaidin, 2023).

Brachystegia eurycoma (Caesalpiniaceae), a leguminous seed (Njoku et al., 2025), is a native African plant with a well-established ethnopharmacological background. Its leaves and bark have long been used in traditional medicine for managing diabetes mellitus and a variety of other health conditions (Akawa et al., 2025). Commonly known as *Achi* in eastern Nigeria, *Brachystegia eurycoma* is extensively cultivated in the tropical rainforest zones of West Africa. In this region, its edible seeds are used as a thickening agent in popular traditional soups (Emembolu et al., 2024; Bello et al., 2024) and also serve functional roles in meat formulations and various baked products (Emembolu et al., 2024). The seeds are reported to ease constipation and have been linked to a lower risk of colon and rectal cancers. Their flour is rich in carbohydrates and dietary fibre. Traditionally, the seeds are used to regulate body temperature, enhance digestion, and promote gastrointestinal health. Phytochemical studies have identified various bioactive compounds, including flavonoids, phenolics, alkaloids, saponins, and tannins. Furthermore, the seeds provide substantial macronutrients, such as proteins, lipids, and essential minerals (Eraga & Osiobe, 2025). The aqueous seed extract of *Brachystegia eurycoma* has been studied for its pharmacological activities, including anti-inflammatory, antioxidant, and antimicrobial effects. Research indicates that the extract possesses favourable rheological properties, enabling efficient particle suspension in formulations. Its gel-forming ability and capacity to enhance liquid viscosity make it a viable natural substitute for synthetic excipients. The present study evaluated the effects of *Brachystegia eurycoma* seed consumption on male reproductive health by assessing serum lipid profiles, haematological parameters, and sperm fertility indicators in male Wistar albino rats.

MATERIALS AND METHODS

Plant collection and preparation

Dried *Brachystegia eurycoma* seeds were bought from Eke-Onuwa market in Owerri, and were identified by a Botanist. The seeds were ground into fine powder using an electric blender. They were labelled and kept in an airtight container, after which they were subjected to extraction.

Extraction of Plant Material

Extraction was performed using the maceration method. 1 kg of the ground plant material was soaked in 3 L of distilled water for 3 days. It was then filtered using a clean muslin cloth to get the crude. The crude extract was concentrated on a vacuum rotary evaporator at 40^{oC}, and evaporation was completed to dryness using a water bath at 60^{oC}.

Experimental animals

For this study, adult male Wistar rats weighing 75–130 g were used. The animals were procured from a local breeder in Aba and were acclimatized in an airy pen at room temperature, fed with standard rat feed, and given water *ad libitum* for two weeks. The NIH recommendations for the care and use of laboratory animals were followed in the experimental procedures.

Experimental design

Groups	Group label	Number of Rats	Treatment	Duration of treatment
1	Normal control	5	Feed and water	14 days
2	Test group 1	5	200 mg/kg b.w. plant extract	14 days
3	Test group 2	5	400 mg/kg b.w. plant extract	14 days
4	Test group 3	5	800 mg/kg b.w. plant extract	14 days

Body weight measurements and Sacrifice of animals

The body weights of the rats were taken before treatment and at the end of the experiment, using a Top loader weighing balance. At the end of fourteen days, a transverse incision was made through the ventral

wall of the abdomen of each rat following a cervical dislocation. Blood samples were obtained through cardiac puncture and homogenized in plain bottles for hormonal assay estimation.

Semen analysis

Sperm samples collection

Each rat was euthanized by cervical dislocation, and its epididymis was harvested. Sperm samples were collected from the epididymal reserve at the caudal portion of the epididymis, and a smear of the same was prepared on the preheated glass slides for evaluation.

Microscopic Examination

The sperm quality of the rats was examined by counting the sperm cells, determining the percentage sperm motility and carrying out the morphological assessment of the sperm. The movement and swimming ability of sperm (motility) was determined using a microscope, and the sperm cells were counted using a haemocytometer (Ashidi et al., 2019).

Lipid profile analysis

Lipid analysis was performed on a fully automated analyser based on spectrophotometric principles using kits. The serum lipid profile was analyzed on the same day as the collection of blood samples. Three laboratory measures were determined: Total cholesterol, HDL, and Triglycerides. From these three data points, LDL was calculated. According to Friedewald's equation (Friedewald et al., 1972), LDL = Total cholesterol - HDL – (Triglycerides/5).

The blood samples were centrifuged at 3000rpm for five minutes to obtain the serum, which was then analyzed for the lipid profile. The analysis of the different samples was performed using the auto-analyser according to the manufacturer’s operational guidelines. Three different reagents were employed in the determination of the lipids: TC reagent for Total cholesterol, TGL reagent for Triglyceride and HDL precipitating reagent for high-density lipoprotein determination. All the samples were analyzed within thirty minutes of collection.

Haematological profiling

Haematological parameters of rat blood were analyzed using the haematological Swe lab auto counter 920E+ (UK) system. The parameters considered were PCV, HB, and WBC.

Statistical analysis

Data were expressed as mean ± standard deviation (SD). Comparisons were made by using the student’s t-test at $p = 0.05$.

RESULTS

Table 1
Effect of Treatments on Semen Parameters

Parameter		Treatment			
		Control	200 mg/kg	400 mg/kg	800 mg/kg
Motility	Active (%)	35.0 ± 2.0	40.0 ± 2.0^{c}	25.0 ± 1.0	45.0 ± 1.0^{d}
	Sluggish (%)	20.0 ± 0.0	30.0 ± 0.0^{b}	35.0 ± 1.0^{c}	40.0 ± 0.0^{d}
Morphology	Normal (%)	50.7 ± 1.0	64.7 ± 1.5^{c}	45.0 ± 1.0	75.0 ± 1.0^{d}
	Abnormal (%)	45.2 ± 0.0	35.3 ± 1.5	55.0 ± 1.0	25.0 ± 1.0
Count (million)		50 ± 0.0^{d}	40.0 ± 2.0	25.0 ± 1.0	30.0 ± 1.0

Values are expressed as Mean ± SD. Values with different superscript letters in the same row differ significantly ($p < 0.05$).

The aqueous seed extract of *Brachystegia eurycoma* showed a dose-dependent effect on male fertility parameters. The extract improved sperm motility from 20% in the control to 40% at 400 mg/kg, while normal morphology rose from 50.7% (control) to 75% at 800 mg/kg, indicating that the extract enhanced sperm quality.

Table 2
Effect of treatments on the lipid profile of the experimental animals

Groups	Doses	LIPID PROFILE (mg/dl)			
		TC	TG	HDL	LDL
1	Control	154.00 ± 59.00	207.50 ± 105.56	50.00 ± 8.00	66.00 ± 27.00
2	200 mg/kg	165.50 ± 90.59	224.00 ± 168.15	42.50 ± 11.64	78.50 ± 45.61
3	400 mg/kg	120.00 ± 51.24	132.50 ± 55.86	45.50 ± 16.57	48.50 ± 7.57
4	800 mg/kg	299.00 ± 254.00	442.00 ± 387.07	33.00 ± 20.00	178.00 ± 159.00

Values are expressed as Mean ± SD (n = 3). Means in the same column with the same superscript letter are not significantly different at $p > 0.05$.

The bar chart shows fluctuations in TC, TG, HDL, and LDL levels across the groups, with higher values for TC and TG and lower HDL at 800 mg/kg. However, as reflected in the table, these variations were not statistically significant ($p > 0.05$). The overlapping error bars in the chart and uniform superscripts in the

table confirm that the extract did not significantly alter lipid profile parameters, though dose-related trends were observable.

Table 3
Effect of treatments on the Haematology profile of the experimental animals.

Groups	Doses	Haematological Parameters		
		PCV (%)	HB (%)	WBC (%)
1	Control	20.00 ± 2.00	100.00 ± 9.77	100.00 ± 11.11
2	200 mg/kg b.w.	15.50 ± 4.50	76.69 ± 22.55	120.63 ± 41.27
3	400 mg/kg b.w.	22.50 ± 0.50	112.03 ± 2.26	65.08 ± 17.46
4	800 mg/kg b.w.	20.50 ± 0.50	102.26 ± 3.01	117.46 ± 50.79

Table 3 presents the effects of varying doses of the extract on haematological parameters (PCV, HB, WBC) in experimental groups. Values are expressed as mean ± standard deviation (n = 3). Different superscripts within the same column indicate statistically significant differences between groups at $p < 0.05$ according to Tukey's post hoc test.

The bar chart shows that PCV was highest at 400 mg/kg and lowest at 200 mg/kg. Haemoglobin (HB%) increased markedly at 400 mg/kg but dropped at 200 mg/kg, while the 800 mg/kg group remained close to control. WBC% rose at 200 and 800 mg/kg but decreased at 400 mg/kg, indicating a dose-dependent modulation of haematological parameters by the extract.

DISCUSSION

Reproduction is a vital biological process essential for creating new individuals and crucial for the survival and evolution of species. Infertility has become a major global health concern, affecting roughly 15% of couples of reproductive ages. This issue is increasingly associated with environmental and occupational exposure to harmful substances (Ama et al., 2023). Notably, there is rising interest worldwide in herbal medicines, with evidence indicating that certain medicinal plants can improve male fertility by enhancing antioxidant activity, reducing free radical formation, and limiting lipid peroxidation, thereby protecting sperm from oxidative damage. These plants may also improve blood flow to the testes, extend sperm lifespan, and preserve germ cell health. Furthermore, they can influence the hypothalamic-pituitary-gonadal axis, affecting the secretion of luteinizing hormone (LH) and testosterone. Through these mechanisms, medicinal plants may boost sperm quality and reproductive hormone levels, although more clinical studies are needed to confirm their safety and effectiveness (Boroujeni et al., 2022). This study examined how Brachystegia eurycoma seed administration affects serum lipid profiles, blood parameters, and sperm fertility markers in male Wistar rats. Results showed a dose-dependent response across all measured indices, emphasizing the complex links between lipid regulation, blood health, and male reproductive performance. Sperm are specialized haploid cells,

routinely evaluated via semen analysis, with sperm motility being a key indicator of semen quality and a predictor of fertilization success, including in assisted reproductive techniques (Chakraborty & Saha, 2022). The study revealed clear dose-related differences: rats given 800 mg/kg showed the highest motility (45%), exceeding the control group (35%) and the 200 mg/kg group (40%). Conversely, the 400 mg/kg group had significantly reduced motility (25%) and sperm count (25 million/ml), suggesting potential toxicity or impaired sperm production at this dose. Sperm morphology assessment offers insights into male fertility potential and overall reproductive health, with abnormalities possibly caused by genetic factors or reversible stressors, such as physiological, psychological, or environmental triggers. While testes can recover from isolated stress events, repeated or chronic stress might lead to lasting damage to sperm structure. Therefore, evaluating sperm morphology is critical for diagnosing male infertility and guiding treatment (Menkveld et al., 2010). The highest normal sperm morphology was observed in the 800 mg/kg group (75%), while the lowest was in the 400 mg/kg group (45%). Hyperlipidemia, characterized by increased serum cholesterol, LDL, VLDL, or triglycerides, or decreased HDL levels (Zubi & Alfarisi, 2021), is associated with decreased sperm motility and higher rates of abnormal sperm morphology, especially when induced via a high-cholesterol diet in rats. Conversely, higher HDL levels correlate with more viable, normally shaped sperm (Zubi & Alfarisi, 2021). Cholesterol homeostasis is vital for male reproductive function, as it serves as a precursor for steroid hormone synthesis, which is essential for normal spermatogenesis (Sèdes et al., 2018). Administering achi seeds increased total cholesterol (TC) and triglycerides (TG) at 800 mg/kg (TC: 299 mg/dl; TG: 442 mg/dl), while the 400 mg/kg dose significantly lowered both parameters relative to controls. HDL was lowest at 800 mg/kg (33 mg/dl), and LDL was highest (178 mg/dl). Elevated TC and TG at this dose may supply substrates for steroid production, potentially enhancing sperm development and motility. The reduction in lipids at 400 mg/kg might hinder steroidogenesis or disturb membrane lipid balance, contradicting Sèdes et al. (2018), and impairing sperm parameters. These findings highlight the need for adequate lipid stores to support optimal reproductive function and suggest that lipid deficiency could harm testicular health. Despite decreased HDL and increased LDL at 800 mg/kg, sperm function remained intact, implying that other components in B. eurycoma might counteract lipid-related oxidative stress in reproductive tissues. Hematological parameters reflect systemic health and reveal the links between overall wellbeing and reproductive function. Spermatogenesis requires ample oxygen; even mild hypoxia can temporarily impair sperm count, motility, density, and viability, indicating reduced sperm quality (Al-Jubouri et al., 2024). The 400 mg/kg group showed the highest packed cell volume (PCV) (22.50%) and hemoglobin (Hb) (112.03%), indicating improved oxygen-carrying capacity. WBC counts were highest in the 200 mg/kg and 800 mg/kg groups. At 800 mg/kg, PCV and Hb levels increased moderately, supporting better oxygen delivery to testes, which enhances energy metabolism and spermatogenesis (Al-Jubouri et al., 2024), consistent with improved sperm function noted earlier. Lower PCV and Hb at 200 mg/kg may limit oxygen supply, possibly explaining the slight decrease in motility. The peak PCV and Hb at 400 mg/kg indicate increased erythropoiesis, but these blood improvements did not translate into better fertility outcomes, as shown in the data. Subpar sperm metrics at this dose confirm that improved blood parameters alone cannot restore spermatogenesis when lipid balance or testicular function is compromised, such as in high-fat diet or dyslipidemia models (Pan et al., 2025).

CONCLUSION

The study shows that *Brachystegia eurycoma* seed extract has dose-dependent effects on male Wistar rats across multiple systems. At 800 mg/kg, the extract increased sperm motility (45%) and normal morphology (75%), while significantly raising total cholesterol (299 mg/dL) and triglycerides (442 mg/dL); these lipid increases likely provided extra substrate for steroid hormone production, aiding spermatogenesis. Conversely, the 400 mg/kg dose decreased cholesterol and triglycerides and lowered HDL, which correlated with the worst sperm parameters (2 % motility, 25 million sperm/mL, 4 % normal morphology), indicating that inadequate lipid levels impair testicular function. Haematological data revealed the highest packed-cell volume and haemoglobin at 400 mg/kg, but these erythropoietic improvements did not translate into better sperm quality, highlighting that increased blood oxygen alone cannot restore disrupted lipid balance or testicular homeostasis.

Overall, the results emphasis the important relationship between lipid metabolism, blood health, and spermatogenesis. Future research should identify the active phytochemicals, explore longer treatment periods, and investigate mechanisms to determine if a narrow therapeutic window exists to maximize the seed's metabolic benefits without harming male fertility.

Declarations

We hereby declare that all experimental procedures involving animals were conducted in accordance with the ethical standards and guidelines for the care and use of laboratory animals.

The study protocol was approved by the Committee of the Department of Biochemistry, Federal Polytechnic Nekede, Owerri, Imo State (approval reference no: FPN/SIAS/BCH/024) in compliance with the principles of the Protection of Animals Used for Scientific Purposes.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the Management of the Institution and Directorate of Research, Innovation and Development for their providing enabling environment to access the funding. The authors thank the Department of Pharmaceutical technology and Chemistry for granting access to their laboratory for analyses. Their contributions and support were invaluable to the success of this study.

AUTHOR CONTRIBUTIONS

NIE and ORN conceptualized and designed the study, with EUO and AO providing supervision. EUO, NIE, and AO established the research methodology. AO and ORN conducted the study, while EUO and NIE performed validation. The original manuscript draft was prepared by ORN, with AO and EUO responsible for reviewing and editing the draft. All authors reviewed and approved the final version of the manuscript for submission.

FUNDING

Tertiary Education Trust Fund fully funded the research work.

DATA AVAILABILITY

The datasets generated during and/or analyzed during the study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

All ethical guidelines have been adhered. There are no studies by any of the authors in this article that used human subjects.

Consent for publication

All authors have reviewed and approved the final version of this manuscript and consent to its publication in Discover Chemistry.

Competing interests

The authors declare no competing interests.

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Figures

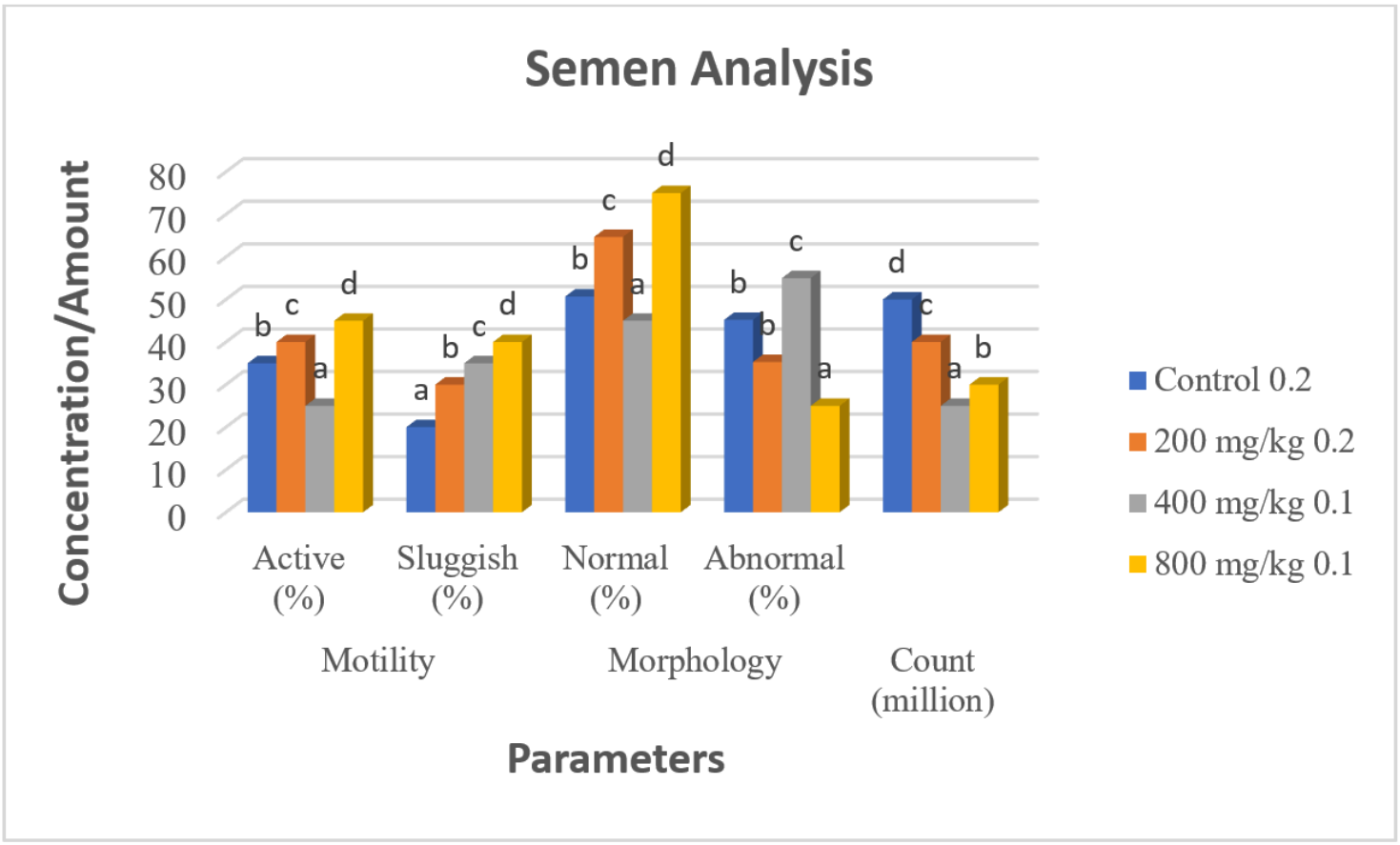


Figure 1

Bar chart showing the effect of treatments on the semen parameters of the experimental animals

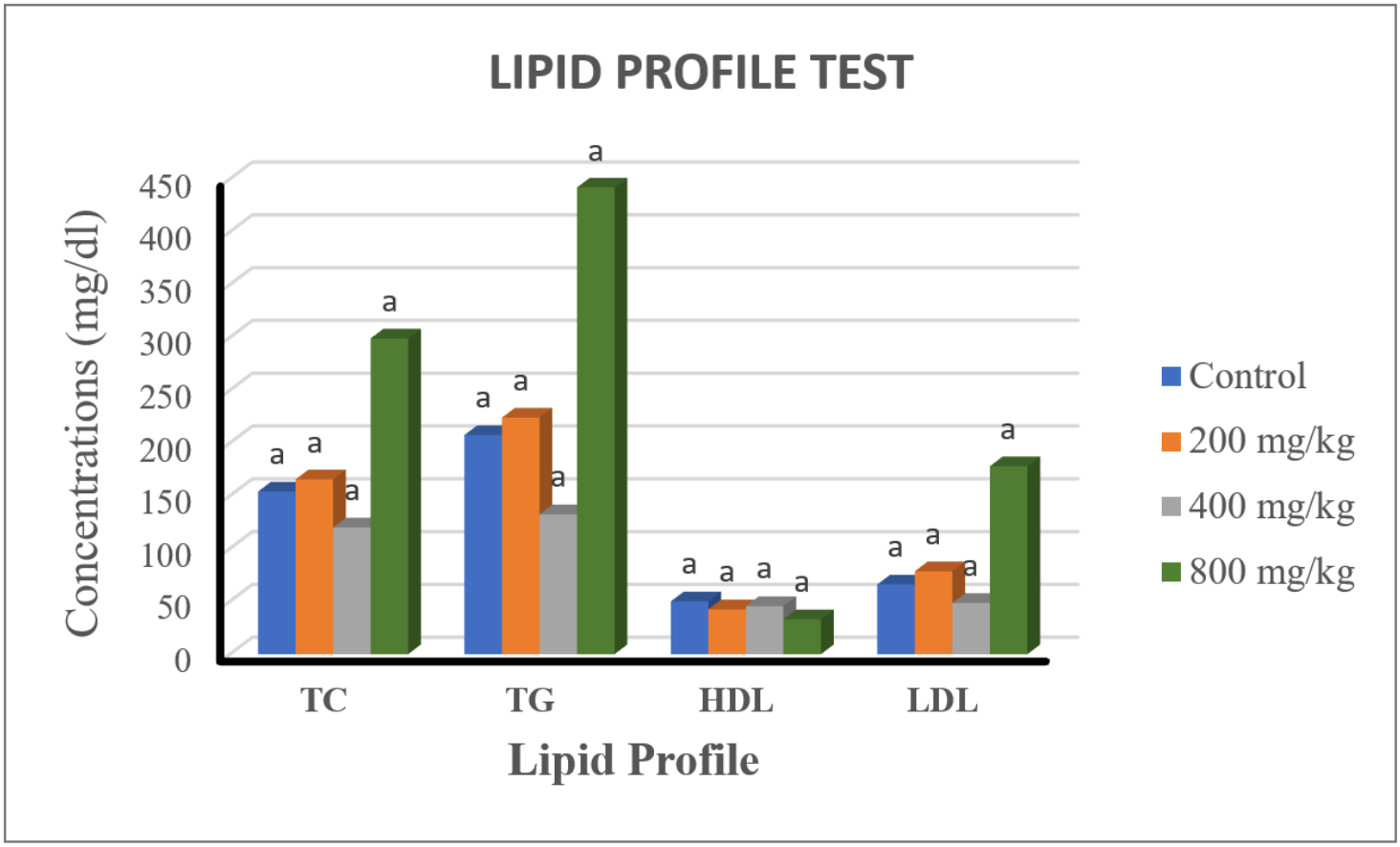


Figure 2

Bar chart showing the effect of treatments on the lipid profile of the experimental animals

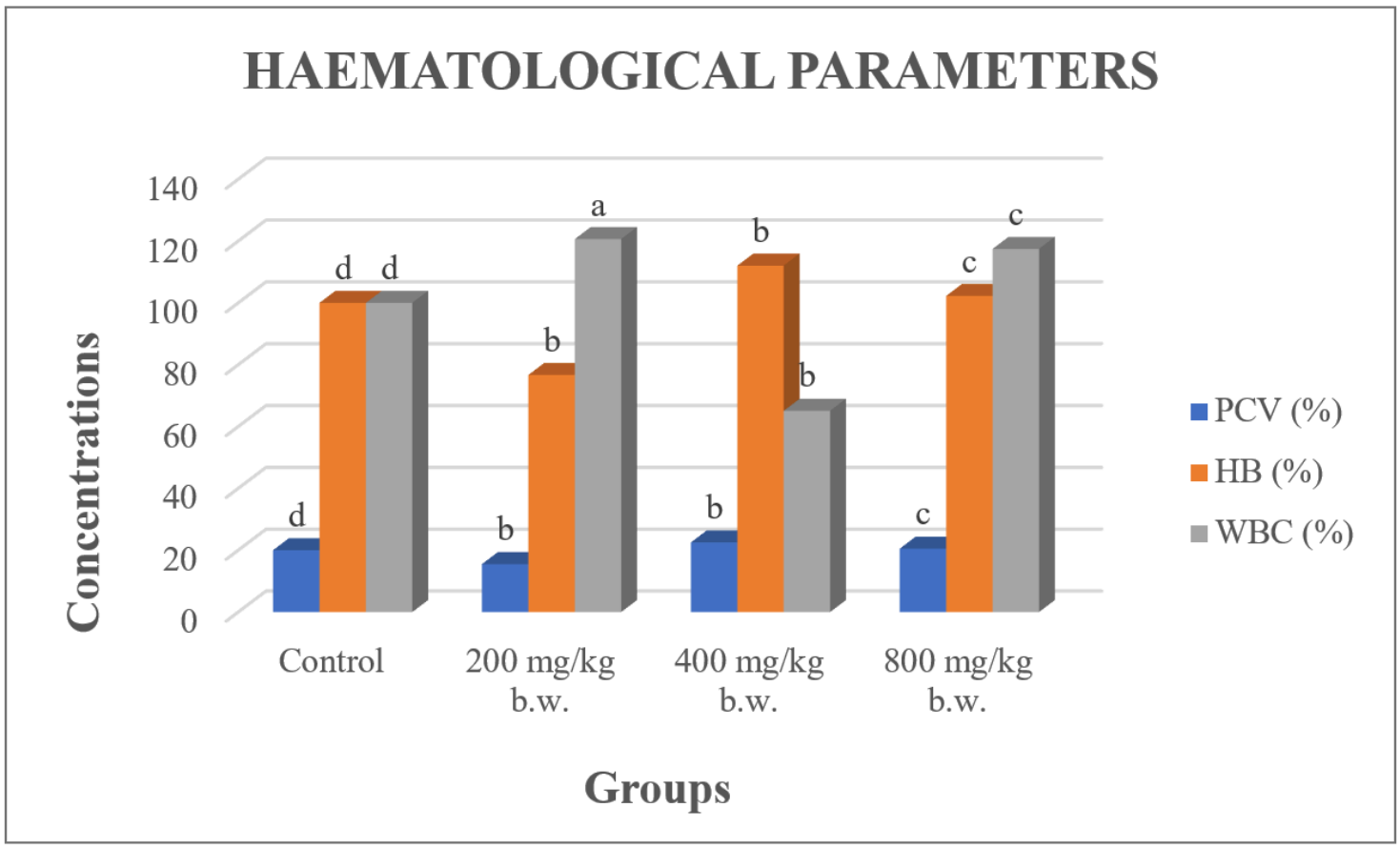


Figure 3

Bar chart showing the effect of treatments on the haematology profile of the experimental animals.