

Status of some biochemical indices related to metabolic distress in rats administered *Mangifera indica* and *Balanites aegyptiaca* aqueous leaves extract combination

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ABSTRACT

Background: Plants have been vital to human society since ancient times, serving as rich sources of bioactive compounds for medicines. Their therapeutic properties have long been recognized, with many modern drugs derived from plant-based remedies. Recently, the use of plant-derived drugs and supplements has surged, though concerns about side effects and toxicity from high concentrations persist. **Methods:** This study evaluated the serum lipid profile and fasting blood glucose levels of Wistar rats administered combined aqueous leaf extracts of *Mangifera indica* (mango) and *Balanites aegyptiaca* (desert date). Twenty-four (24) male Wistar rats were divided into four groups: Group I (control, no extract), Group II (500 mg/kg body weight of extract), Group III (1000 mg/kg body weight of extract), and Group IV (1500 mg/kg body weight of extract). The extracts were administered orally via gavage daily for 28 days. **Results:** Treatment with 500 and 1000 mg/kg doses significantly ($P < 0.05$) elevated total cholesterol, triglycerides, and HDL while LDL was significantly ($P < 0.05$) reduced. The 1500 mg/kg dose significantly ($P < 0.05$) increased total cholesterol and HDL. Fasting blood glucose levels did not differ significantly ($P > 0.05$) across treatment groups, relative to control. **Conclusion:** These findings suggest that the combined *Mangifera indica* and *Balanites aegyptiaca* leaf extracts may exert hypolipidemic effects by improving HDL and reducing LDL at moderate doses, while maintaining glucose homeostasis. Further studies are recommended to clarify the mechanisms of action, explore potential synergistic interactions, and assess long-term safety and toxicity at higher doses.

Keywords: *Balanites aegyptiaca*, hypolipidemic, Lipid profile, *Mangifera indica*

INTRODUCTION

Plants have been integral to human society since ancient civilizations, serving as a vital source of bioactive compounds used in various medicines. For centuries, plants have

been recognized for their therapeutic potential, harboring chemical agents that offer healing properties. The use of herbal medicines as dietary supplements to address a range of human ailments has gained significant popularity (Sabandar *et al.*, 2013).

Green plant leaves, in particular, contribute to human health by serving as natural remedies and nutritional sources. Their cleansing, soothing, healing, and revitalizing qualities have been valued for centuries, with many modern pharmaceuticals rooted in ethno-pharmacological traditions (Al-Akeel *et al.*, 2013).

Medicinal plants represent one of the oldest forms of healthcare, utilized in traditional medicine across cultures for millennia. Knowledge of their therapeutic benefits has been passed down through generations, shaping community health practices. Many contemporary drugs, derived from traditional herbal remedies, continue to play a significant role in modern pharmacotherapy.

Mangifera indica leaves, widely used in ethno-medicine, are employed to treat conditions such as fever, diarrhea, fainting, lymph node disorders, and diabetes (Oladipo, 2023). Phytochemical analysis of these leaves reveals the presence of flavonoids, tannins, alkaloids, terpenoids, anthraquinones, saponins, cardiac glycosides, and steroids, with mangiferin identified as a key bioactive compound. Studies have reported anti-inflammatory, antioxidant, hypoglycemic, and hypolipidemic properties of *M. indica* leaves (Chewchinda *et al.*, 2018).

Balanites aegyptiaca, a tree belonging to either the Zygophyllaceae or Balanitaceae family, is native to Africa and parts of the Middle East (Shinde *et al.*, 2025). Known by various names such as desert date (English), lalob or heglig (Arabic), aduwa (Hausa), mduguyu (Swahili), and bedena (Amharic), this tree grows up to 10 meters tall with thorny branches and dark green, compound leaves composed of two variably sized leaflets. Common in Senegal, it thrives in diverse habitats, tolerating a range of soil types (sand to heavy clay) and climatic conditions (arid to sub-humid). It is also resilient to flooding, livestock grazing, and wildfires (Mukherjee, 2002).

The lipid profile, a blood test assessing fat metabolism, measures total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides, and very low-density lipoprotein (VLDL) cholesterol. These biomarkers help evaluate the risk of coronary heart disease. Lipid levels vary across populations due to differences in geography, culture, diet, socioeconomic factors, and genetics. Typically, blood lipid levels peak 30 minutes to three hours post-meal and return to baseline within five to six hours, depending on meal size and composition (Aregay *et al.*, 2017).

Blood glucose regulation is equally critical in assessing metabolic health, as dysglycemia is a hallmark of metabolic disorders including diabetes mellitus and metabolic syndrome (Kalra *et al.*, 2021). Fasting blood glucose levels provide insight into glucose homeostasis and are commonly used to screen for and monitor diabetic conditions. Despite the documented therapeutic properties of *Mangifera indica* and *Balanites aegyptiaca* individually, limited research has explored the combined effects of these plants on metabolic parameters. This study investigated both the lipidemic and glycemic

effects of aqueous extracts from *Mangifera indica* and *Balanites aegyptiaca* leaves, administered in combination, on Wistar rats.

MATERIALS AND METHODS

Plant Collection and Identification

Leaves of *Mangifera indica* and *Balanites aegyptiaca* were collected from Darawa village, Dutsin-Ma Local Government Area, Katsina State, Nigeria. The Department of Biological Science at Federal University Dutsin-Ma, Katsina State verified their authenticity.

Experimental Animals

Twenty-four male Wistar rats, weighing 80–150 g, were obtained from the National Institute for Trypanosomiasis Research (NITR) and housed in wooden cages at the animal house, Department of Biochemistry, Federal University Dutsin-Ma. The rats were allowed two weeks for acclimatization before the start of experiment. They were kept under standard conditions (12-hour light/dark cycle, $30 \pm 10^\circ\text{C}$) and provided with standard pelleted rat feed and drinking water. Animal handling adhered to the guidelines outlined in the National Research Council (NRC, 2008).

Plant Extract Preparation

Following the method by Osibemhe *et al.* (2015), leaves of *Balanites aegyptiaca* and *Mangifera indica* were washed in tap water, dried at room temperature for two weeks, and ground into powder using mortar and pestle. The powder from both plants was mixed (50:50) with distilled water (1:10 w/v), macerated at 4°C for 72 hours with occasional stirring, and filtered to obtain a cold extract. Doses of 500 mg/kg, 1000 mg/kg, and 1500 mg/kg body weight were prepared for the experimental animals.

Experimental Design

The rats were divided into four groups of six animals each:

- Group I (control): No extract administered.
- Group II: Received 500 mg/kg body weight of extract.
- Group III: Received 1000 mg/kg body weight of extract.
- Group IV: Received 1500 mg/kg body weight of extract.

The extract was given orally via gavage once daily for 28 days.

Blood Collection

Weekly blood glucose levels were measured by pricking the rats' tails and using an Accu-Chek glucometer. On day 28, the rats were anesthetized with chloroform, sacrificed, and blood was collected via the abdominal aorta with a 5 ml syringe into plain sample bottles. Serum was obtained on centrifuging the clotted blood samples at 3500 rpm for 15 min, for estimation of lipid profile (Total cholesterol, triglycerides, LDL, and HDL).

Fasting Blood Glucose Measurement

Blood glucose levels were determined using an Accu-Chek glucometer. The procedure involved inserting a glucometer strip into the device, obtaining a blood sample from the rat's tail, applying it to the strip, and recording the glucose level (in mg/dL) after 5 seconds.

Lipid Profile Analysis

Total cholesterol, triglycerides, and HDL were measured using an automated machine at the Federal Medical Center, Katsina. LDL levels were calculated using the Friedewald formula (Friedewald, 1972): $LDL = Total\ Cholesterol - HDL - (Triglycerides/5)$ (mg/dL).

Statistical Analysis

Data were analyzed using SPSS software (version 16). Results were presented as mean \pm standard error of the mean (S.E.M). One-way analysis of variance (ANOVA) followed by Duncan's post-hoc test was used to evaluate significant differences between control and administered groups at a 95% confidence level ($P < 0.05$).

RESULTS

Serum Lipid Profile Results

Table 1 shows results for serum lipid profile in rats administered *Mangifera indica* and *Balanites aegyptiaca* aqueous leaves extract combination. Administration of extract at 500 mg/kg body weight and 1000 mg/kg body weight significantly ($P < 0.05$) increased total cholesterol, triglycerides and HDL while LDL was significantly ($P < 0.05$) reduced, relative to control. Administration of 1500 mg/kg body weight extract significantly ($P < 0.05$) increased total cholesterol and HDL, relative to control.

Table 1: Serum lipid profile results (mg/dL) in rats administered *Balanites aegyptiaca* and *Mangifera indica* aqueous leaves extract.

GROUPS	T.CHOL (mg/dL)	TG (mg/dL)	HDL-C (mg/dL)	LDL-C(mg/dL)
NC	144.17 \pm 1.34 ^a	64 \pm 1.69 ^a	33.17 \pm 1.14 ^a	98.00 \pm 0.58 ^c
NRBA/M A 500mg	160.50 \pm 2.50 ^c	99.0 \pm 1.0 ^c	47.00 \pm 1.00 ^c	93.5 \pm 1.50 ^a
NR BA/MA 1000mg	163.83 \pm 1.08 ^c	100.50 \pm 2.23 ^c	49.6 \pm 0.95 ^c	94.16 \pm 0.54 ^{ab}
NR BA/MA 1500mg	150.17 \pm 1.13 ^b	72.33 \pm 4.95 ^{ab}	40.33 \pm 0.55 ^b	95.16 \pm 1.44 ^{abc}

Values are mean \pm SEM (n=6)

Values with different superscript in the same column represent significant difference ($P < 0.05$).

NC= normal control; NRBAMA = normal rats administered *Balanites aegyptiaca* and *Mangifera indica* aqueous leaves extract.

T.chol= total cholesterol, TG= triglyceride, HDL= High Density Lipoprotein, LDL= Low Density Lipoprotein.

Fasting Blood Glucose (mg/dL)

Table 2 shows the results of fasting blood glucose. Administration of extract at (500mg/kg body weight) significantly ($P < 0.05$) increased fasting blood glucose in week 2 relative to basal value.

Table 2: Fasting blood glucose levels in rats administered *Balanites aegyptiaca* and *Mangifera indica* aqueous leaves extract.

GROUPS	Basal	Week 1	Week 2	Week 3	Week 4
NC	73.67±5.50 ^{ab}	79.16±4.52 ^{ab}	82.83±2.24 ^{ab}	66.67±5.15 ^a	84.16±7.20 ^b
NR: BA/MA 500mg	70.83±1.53 ^a	73.50±2.12 ^a	91.50±4.44 ^b	88.32±14.07 ^{ab}	86.50±5.50 ^{ab}
NR: BA/MA 1000mg	75.60±5.98 ^a	78.83±4.84 ^a	71.50±2.48 ^a	75.66±4.24 ^a	72.83±3.56 ^a
NR: BA/MA 1500mg	69.60±4.55 ^a	68.66±4.04 ^a	78.3±4.20 ^a	71.50±4.58 ^a	74.33±7.06 ^a

Values are Mean ± SEM (n=6)

Values with different superscripts within a row differ significantly from each other ($P < 0.05$).

Values with same superscripts within a row do not differ significantly from each other ($P > 0.05$).

NC= normal control; NRBAMA = normal rats administered *Balanites aegyptiaca* and *Mangifera indica* aqueous leaves extract.

DISCUSSION

Lipid profile assesses fat metabolism by quantifying lipids and their associated lipoproteins. Blood lipid levels typically peak 30 minutes to three hours post-meal and return to near-baseline within five to six hours, influenced by meal size, composition, and gastric emptying time (Aregay *et al.*, 2017). Similarly, blood glucose homeostasis is a critical indicator of metabolic health, with fasting blood glucose measurements serving as a primary tool for assessing glycemic control. Plants have been utilized for their medicinal properties for centuries, with many modern drugs tracing their origins to ethno-pharmacological practices (Al-Akeel *et al.*, 2013).

The present study investigated the effects of combined aqueous leaf extracts of *Mangifera indica* and *Balanites aegyptiaca* on serum lipid profile and fasting blood

glucose in normal rats. Administration of the extract combination at 500 mg/kg and 1000 mg/kg significantly ($P < 0.05$) increased total cholesterol, triglycerides, and HDL-C, while LDL-C was significantly ($P < 0.05$) reduced compared to the control group. The increase in HDL-C is particularly noteworthy, as elevated HDL-C is generally associated with cardioprotective effects due to its role in reverse cholesterol transport (Gordon *et al.*, 2014). The reduction in LDL-C at these doses further supports a potential hypolipidemic effect, since high LDL-C is a major risk factor for atherosclerosis (FERENCE *et al.*, 2017).

Interestingly, at 1500 mg/kg, although total cholesterol and HDL-C were significantly ($P < 0.05$) increased, triglycerides and LDL-C did not show consistent reductions compared to lower doses. This suggests that higher concentrations of the extract may alter lipid metabolism differently, possibly due to saturation of bioactive compounds or metabolic feedback mechanisms (Akinmoladun *et al.*, 2020). The phytochemicals present in *Mangifera indica* (such as mangiferin and flavonoids) and *Balanites aegyptiaca* (such as saponins and alkaloids) have been reported to modulate lipid metabolism by enhancing lipoprotein lipase activity and reducing cholesterol absorption (Abdel-Rahman *et al.*, 2016). Thus, the observed lipid profile changes may be attributed to synergistic actions of these bioactive compounds.

The fasting blood glucose results demonstrated that administration of 500 mg/kg extract significantly ($P < 0.05$) increased glucose levels at week 2 compared to basal values. This transient hyperglycemic effect may be due to stimulation of hepatic gluconeogenesis or reduced peripheral glucose uptake at lower doses (Kumar *et al.*, 2012). However, at 1000 mg/kg and 1500 mg/kg, glucose levels remained relatively stable across the weeks, suggesting a possible dose-dependent regulatory effect. Previous studies have shown that *Mangifera indica* extract possesses hypoglycemic properties through enhancement of insulin secretion and glucose utilization (Ojewole, 2005), while *Balanites aegyptiaca* has been reported to improve glycemic control by modulating pancreatic β -cell function (Abdel-Rahman *et al.*, 2016). The lack of significant reduction in glucose at higher doses in this study may indicate that the combination of the extracts exerts a balancing effect, preventing excessive hypoglycemia in normal rats.

CONCLUSION

The combined aqueous leaf extracts of *Mangifera indica* and *Balanites aegyptiaca* demonstrated notable effects on lipid metabolism and glucose regulation in normal rats. At moderate doses (500–1000 mg/kg), the extracts significantly increased HDL-C while reducing LDL-C, suggesting a cardioprotective potential through improved lipid balance. Although total cholesterol and triglycerides were elevated at these doses, the favorable shift in lipoprotein fractions indicates possible therapeutic benefits in managing dyslipidemia. At higher doses (1500 mg/kg), the extracts maintained elevated HDL-C but showed less consistent effects on triglycerides and LDL-C, highlighting the importance of dose optimization.

In terms of glycemic control, the extract at 500 mg/kg produced a transient rise in fasting blood glucose, whereas higher doses maintained relatively stable glucose levels,

suggesting a regulatory rather than a strongly hypoglycemic effect in normal rats. This outcome aligns with previous evidence that both plants possess bioactive compounds capable of modulating insulin secretion and glucose utilization. Overall, the findings support the potential of *Mangifera indica* and *Balanites aegyptiaca* leaf extracts as natural agents for improving lipid profiles and maintaining glucose homeostasis. However, the dose-dependent variations observed underscore the need for further studies to establish their therapeutic efficacy and safety.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest

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