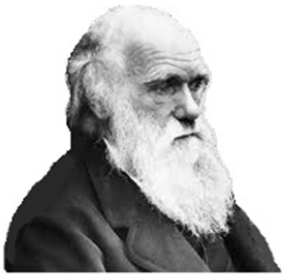
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Effect of aqueous extract of *Raphia vinifera* P.Beauv. mesocarp on glucose and triglyceride levels of Wistar albino rats

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ABSTRACT

The aim of this study was to evaluate the effect of *Raphia vinifera* mesocarp extract on glucose and triglyceride levels in Wistar albino rats. A total of 12 healthy female rats were randomly assigned into four groups of three animals each. The control group received 2 ml of distilled water, while Groups 1, 2, and 3 received 2 ml each of *Raphia vinifera* mesocarp extract at concentrations of 25%, 20%, and 15%, respectively. Following a 10-day treatment period, blood samples were collected for the determination of plasma glucose and triglyceride levels. Data were analysed using one-way ANOVA. The results revealed a statistically significant increase in glucose levels in the extract-treated groups ($P < 0.05$), while no significant differences were observed in triglyceride levels across groups ($P \geq 0.05$). Conclusively, the findings suggest that aqueous extract of *Raphia vinifera* mesocarp may elevate plasma glucose levels, indicating its potential utility in the management of hypoglycemia rather than hyperglycemia or dyslipidemia.

***Keywords*:** *Raphia vinifera*, Extracts, Diabetes, triglyceride profile, Glucose, Mesocarp

1. INTRODUCTION

Medicinal plants exist everywhere, especially in Africa which has vast reservoir of plants that had been categorized and used traditionally for various health purposes. It is estimated that Africa has between 40,000 and 45,000 plant species, with about 5,000 of those being used

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medicinally. These plants are often the most accessible healthcare resource for communities in many parts of Africa. According to WHO, medicinal plants would be the best source to obtain variety of drugs. Diabetes mellitus, a chronic metabolic disorder characterized by persistent hyperglycemia, remains a significant global health concern. It arises either from an absolute insulin deficiency (Type 1) or a combination of insulin resistance and inadequate insulin secretion (Type 2). The global burden of diabetes continues to rise, with over 537 million people currently affected worldwide, and this number is projected to exceed 640 million by 2045 (International Diabetes Federation [IDF], 2021).

One of the most common forms of diabetic dyslipidemia is hypertriglyceridemia, a condition characterized by elevated triglyceride levels that significantly increases the risk of atherosclerosis and cardiovascular diseases (ADA, 2022). Although synthetic drugs such as insulin, metformin, and statins are effective in managing diabetes and its complications, they are often associated with side effects and economic barriers in low-income regions (Zheng et al., 2021).

These limitations have encouraged the search for safer, cost-effective, and more accessible alternatives, particularly from natural sources. Alongside hyperglycemia, lipid abnormalities particularly elevated plasma triglyceride (TG) levels are frequently observed in diabetic patients, a condition referred to as diabetic dyslipidemia (Zheng et al., 2021). Triglycerides are the main constituents of body fat and serve as a major form of energy storage. However, excessive circulating triglycerides contribute to insulin resistance, hepatic steatosis, and atherosclerotic cardiovascular disease (ADA, 2022).

The dual burden of uncontrolled blood glucose and triglycerides significantly increases morbidity and mortality in individuals with diabetes. Hence, any effective therapeutic approach must target both glycemic and lipid regulation. While synthetic antidiabetic and lipid-lowering drugs such as insulin, metformin, sulfonylureas, fibrates, and statins are widely used, their high cost, side effects, and limited accessibility in low-income settings present major drawbacks (Sibuyi et al., 2021). As a result, there is increasing interest in natural and plant-based remedies with the potential to manage both glucose and triglyceride levels with minimal adverse effects. Medicinal plants are rich in bioactive compounds including flavonoids, saponins, polyphenols, and alkaloids, which have shown significant hypoglycemic and hypolipidemic activities in both in vitro and in vivo studies (Nguyen et al., 2020).

These phytochemicals can improve glucose uptake in peripheral tissues, enhance insulin sensitivity, inhibit carbohydrate-digesting enzymes, and suppress hepatic lipid synthesis (Oladunmoye et al., 2020). Their multi-targeted mechanisms make them promising candidates in the development of complementary therapies for diabetes and dyslipidemia. Plants with antidiabetic and antihyperlipidemic potentials have been at the center of recent pharmacological research. Traditional medicine, especially in sub-Saharan Africa, has utilized various indigenous plants in the management of chronic diseases, including diabetes mellitus (Sibuyi et al., 2021).

The therapeutic efficacy of these plants is often attributed to bioactive compounds such as polyphenols, flavonoids, alkaloids, and saponins, many of which exhibit antioxidant, insulin-like, and lipid-lowering properties (Nguyen et al., 2020).

Raphia vinifera, commonly known as raffia palm, is a tropical African plant belonging to the Arecaceae family. Though widely recognized for its economic value in the production of palm wine and handicrafts, the mesocarp of *Raphia vinifera* is traditionally used in West African herbal medicine for the treatment of diabetes, ulcers, and inflammatory conditions

(Ajayi et al., 2022). Recent phytochemical studies have identified the presence of flavonoids, phenols, triterpenes, and steroids in the mesocarp extract compounds known to influence glucose and lipid metabolism (Ugbogu et al., 2023).



Figure 1(a-c). *Raphia vinifera* P.Beauv. plant and seeds.

Raphia vinifera is grown in Nigeria and Cameroon. It is found in swamps and other moist locations, especially on the edges of creeks of Delta, Cross River, Lagos and Ikorodu in Nigeria. The boiled solution of apical bud of Raphia vinifera is used to treat some diseases like genitourinary infections and gonorrhea in West Cameroon. Palm has been proven to have minerals like calcium (N. R. SikameTagne et al., 2020).

However, the medicinal significance especially the mesocarp part of the *Raphia vinifera* fruit has not been extensively explored in modern pharmacology. Ethnobotanical reports suggest that *Raphia vinifera* has been used in traditional medicine for managing diabetes, inflammation, and digestive disorders in parts of West Africa (Ajayi et al., 2022). Recent phytochemical analyses of *Raphia vinifera* mesocarp extracts have revealed the presence of pharmacologically active constituents such as flavonoids, phenolic compounds, and triterpenoids, all of which are known for their role in modulating glucose and lipid metabolism (Ugbogu et al., 2023). These bioactive agents may promote insulin sensitivity, enhance glucose uptake, and reduce hepatic lipid synthesis thereby playing a role in glycemic and lipid control (Oladunmoye et al., 2020).

Multiple studies have confirmed the antidiabetic and hypolipidemic potential of indigenous African plants. For instance, *Vernonia amygdalina*, *Azadirachta indica*, and *Moringa oleifera* have shown significant reduction in blood glucose and triglyceride levels in diabetic rats, often attributed to their antioxidant and insulin-sensitizing properties (Okoduwa et al., 2021). Despite traditional claims of its efficacy, there is limited scientific data validating the hypoglycemic and hypolipidemic effects of *Raphia vinifera* mesocarp, particularly in experimental models.

The choice of Wistar albino rats as an animal model stems from their physiological and metabolic similarities to humans, which make them suitable for preclinical evaluations of antidiabetic and antihyperlipidemic agents (Singh & Sharma, 2020). Therefore, the aim and objective of this study was to evaluate the effect of aqueous extract of *Raphia vinifera* mesocarp on blood glucose and triglyceride levels in Wistar albino rats.

2. MATERIALS AND METHODS

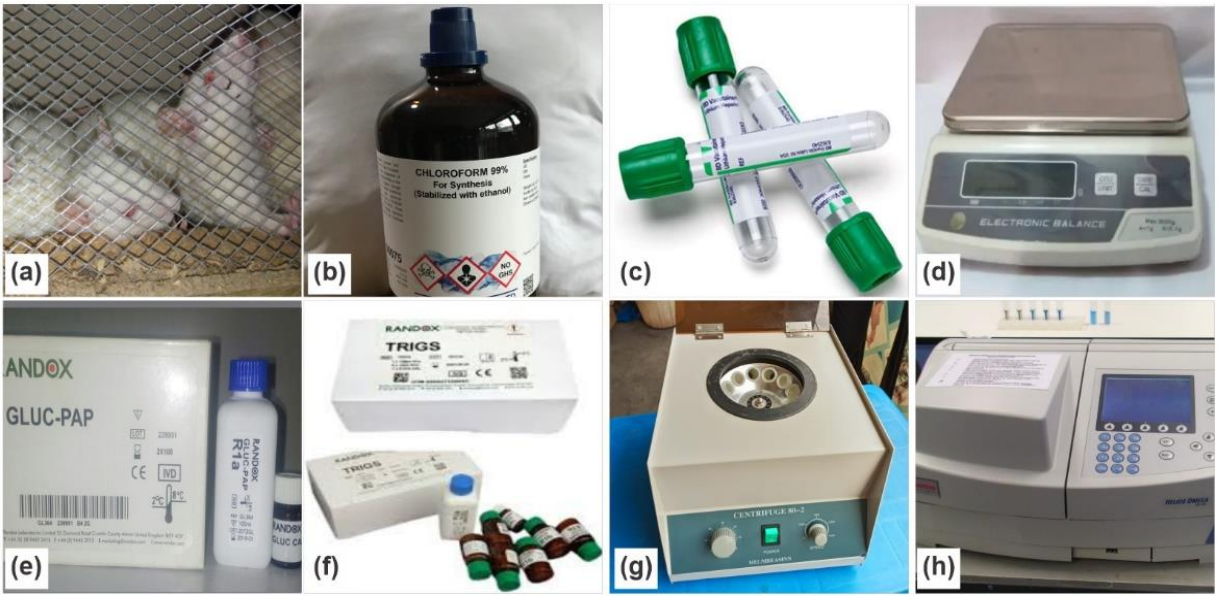


Figure 2(a-h). Some of the materials used in the study: **(a)** Wistar albino rats housed in experimental cages; **(b)** Chloroform used for anaesthesia; **(c)** Lithium heparin sample tubes for blood collection; **(d)** Analytical weighing balance for sample measurement; **(e)** Glucose assay kit (GLUC-PAP); **(f)** Triglyceride assay kit (TRIGS) **(g)** Laboratory centrifuge for plasma separation; **(h)** UV-Visible spectrophotometer for biochemical analysis.

2. 1. Chemicals/reagents used

All chemicals and reagents used were of analytical standard. They include distilled water, Methylated spirit, Glucose kit (GLUC-PAP), Triglyceride (TRIGS) kit and chloroform.

2. 2. Preparing Aqueous extract

Raphia vinifera fruits were harvested from the environs of College of Health Sciences, Niger Delta University and washed thoroughly. The fruits were broken and the shells removed to harvest the mesocarp. The mesocarp was oven dried and afterwhich, the net weight was obtained using a weighing balance. The dry *Raphia vinifera* mesocarp was then milled using a mechanical blender. 256 g of the dry *Raphia vinifera* mesocarp was accurately measured using a weighing balance and placed into a suitable container, after which 100mls of distilled water was added to the container and kept for 24 hours and then filtered with Whatman filter paper to get a clear filtrate. Serial dilution was prepared thereafter of concentrations 25%, 20% and 15% from the stock extract.

2. 3. Grouping of experimental animals

In this study, 12 healthy female Wistar albino rats weighing 160-199g were used. They were procured from the Animal House of the Department of Pharmacology, Faculty of Basic

medical Sciences, Niger Delta University, Bayelsa State, Nigeria. They were assigned by randomization into four groups of three (3) of which animal food and water were administered to them for an acclimatization period of 14 days. Thus: control received 2ml each of distilled water daily by gavage. Group 1: received 2ml each of plant extract of 25% concentration daily. Group 2: received 2ml each of plant extract of 20% concentration. Group 3: received 2ml each of plant extract of 15% concentration daily throughout the period of experiment (10 days).

2. 4. Sampling

At the end of the period of experiment (10 days), blood samples were collected directly from the interior of the rats after been sacrificed. Rats were anesthetized with chloroform for easy dissection and a clean syringe of 5ml was used to collect blood samples from the rats into pre-labelled lithium heparin sample tubes. Blood samples were collected and were taken to the laboratory for blood glucose and triglyceride tests. The glucose and triglyceride assay were done in agreement with the procedure described by Randox laboratories limited, United Kingdom.

2. 5. Statistical Analysis

Results are presented as mean ± standard deviation (SD) of triplicate determinations. Statistical analysis was performed using one-way ANOVA. $P < 0.05$ was considered statistically significant. Means with the same superscript letters within the same column are not significantly different at the 95% confidence level ($P \geq 0.05$).

3. RESULTS

Table 1 presents the effect of oral administration of aqueous *Raphia vinifera* mesocarp extract on blood glucose levels in Wistar albino rats over 10 days. There was a statistically significant change in glucose levels across all extract-treated groups ($P < 0.05$). The glucose elevation was concentration-dependent, with the 25% extract group showing the highest effect (6.93 ± 0.08, 7.38 ± 0.35, 7.59 ± 0.31, and 10.58 ± 0.52 mmol/L on Days 0, 3, 6, and 10, respectively), and the 15% extract group showing the least effect (6.05 ± 0.48, 6.99 ± 0.16, 7.36 ± 1.12, and 10.46 ± 0.74 mmol/L).

Table 1. Effect of oral administration of aqueous extract of *Raphia vinifera* mesocarp on glucose level.

Treatment	DAY 0	DAY 3	DAY 6	DAY 10
Control (0%)	7.11 ± 0.40^{a}	6.95 ± 0.76^{b}	7.15 ± 1.35^{c}	11.01 ± 0.25^{d}
25% Extract	6.93 ± 0.08^{a}	7.38 ± 0.35^{b}	7.59 ± 0.31^{c}	10.58 ± 0.52^{d}
20% Extract	6.59 ± 0.67^{a}	6.90 ± 0.49^{b}	7.41 ± 0.35^{c}	10.49 ± 0.62^{d}
15% Extract	6.05 ± 0.48^{a}	6.99 ± 0.16^{b}	7.36 ± 1.12^{c}	10.46 ± 0.74^{d}

Values are expressed as mean ± standard deviation (SD) of triplicate determinations. Means within the same column sharing the same superscript letters ([a], [b], [c], [d]) are not significantly different at the 95% confidence level ($P \geq 0.05$).

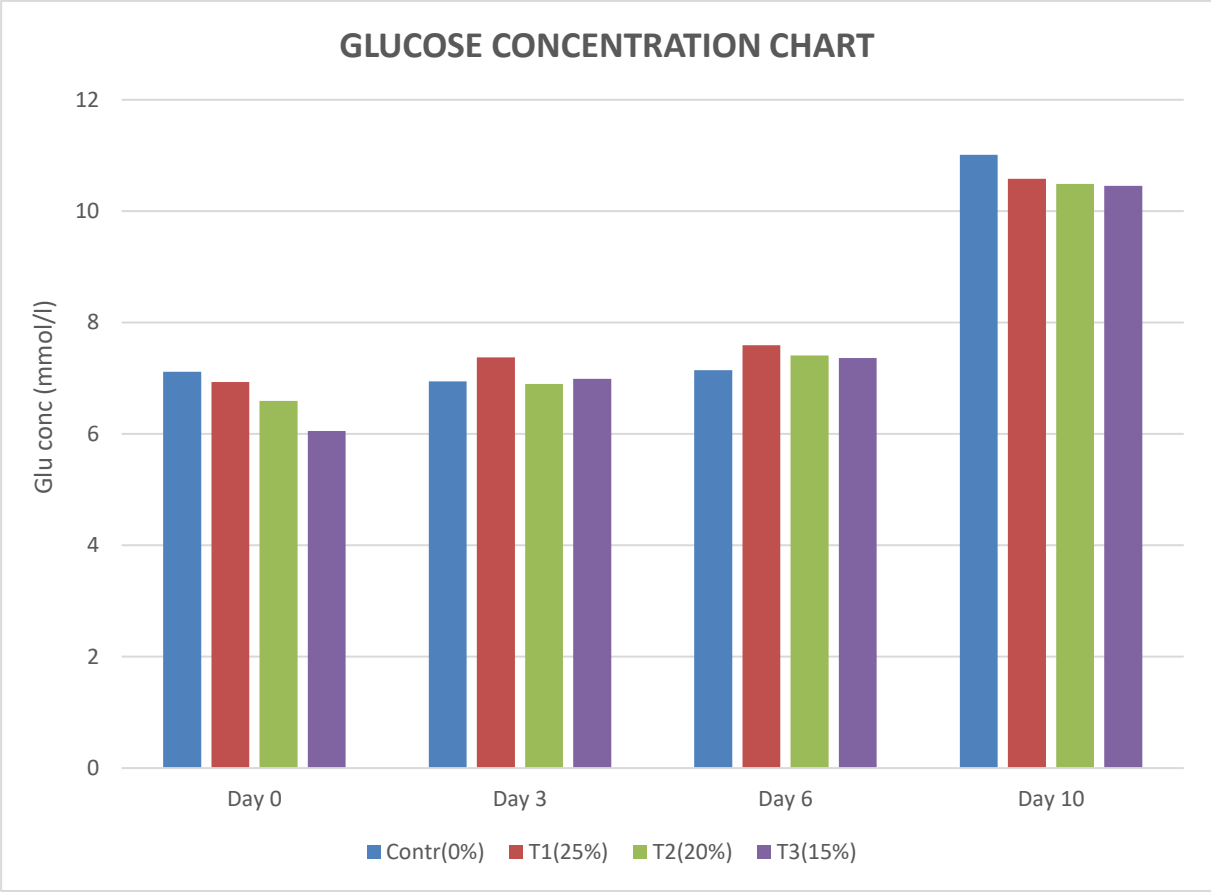


Figure 3. Glucose concentration chart.

The glucose concentration chart illustrates the effect of 15%, 20%, and 25% concentrations of *Raphia vinifera* mesocarp extract on blood glucose levels over the 10-day treatment period (Figure 3). The 25% concentration group consistently recorded the highest glucose levels (6.93 ± 0.08, 7.38 ± 0.35, 7.59 ± 0.31, and 10.58 ± 0.52 mmol/L), while the 15% concentration group showed the least effect (6.05 ± 0.48, 6.99 ± 0.16, 7.36 ± 1.12, and 10.46 ± 0.74 mmol/L). This pattern suggests a concentration-dependent increase in glucose levels, with the 25% extract having the most pronounced effect throughout the treatment duration.

Table 2 shows the effect of the same extract on triglyceride levels. In contrast to the glucose results, no statistically significant differences were observed among the treated groups and the control ($P \geq 0.05$). Although a concentration-dependent trend was noticed, especially at Day 10, the changes were not statistically significant. The 25% extract group recorded the highest triglyceride levels throughout the study period, while the 15% extract group showed the lowest.

Table 2. Effect of Oral Administration of Aqueous Extract of *Raphia vinifera* Mesocarp on Triglyceride Levels (mg/dL).

Treatment	DAY 0	DAY 3	DAY 6	DAY 10
Control (0%)	20.60±3.86[a]	29.93±2.76[b]	31.84±1.62[c]	33.93±0.69[d]
25% Extract	22.19±4.86[a]	31.11±1.11[b]	31.88±0.92[c]	32.04±3.56[d]
20% Extract	23.27±4.31[a]	30.86±1.30[b]	31.06±1.62[c]	30.09±2.25[d]
15% Extract	25.17±2.08[a]	26.65±3.56[b]	28.19±2.18[c]	32.45±1.34[d]

Values are expressed as mean ± standard deviation (SD) of triplicate determinations. Means within the same column sharing the same superscript letters ([a], [b], [c], [d]) are not significantly different at the 95% confidence level ($P \geq 0.05$).

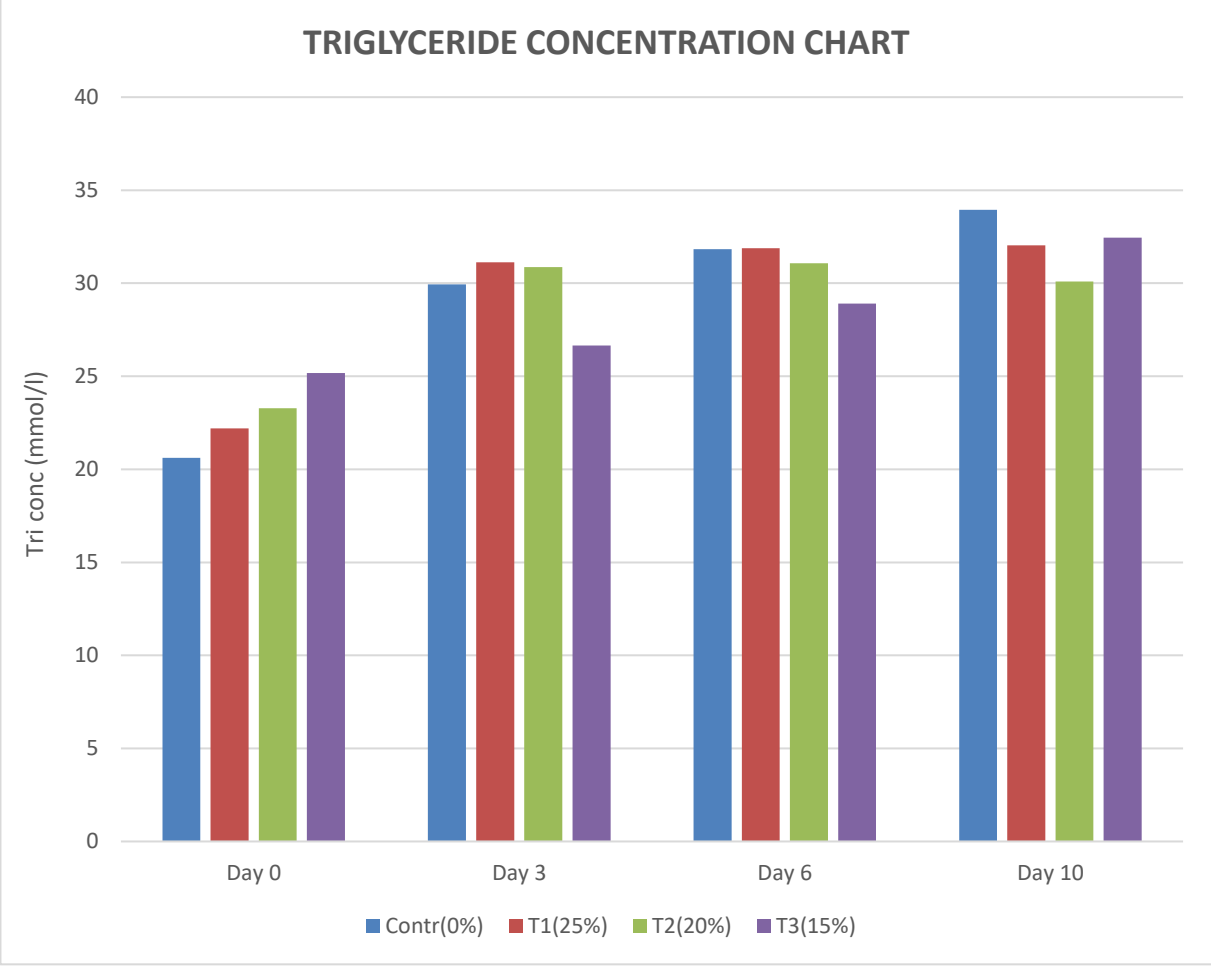


Figure 4. Triglyceride concentration chart.

The triglyceride concentration chart illustrates the effect of 15%, 20%, and 25% concentrations of *Raphia vinifera* mesocarp extract on triglyceride levels over the 10-day treatment period (Figure 4). The 25% concentration group consistently showed the highest triglyceride levels (22.19 ± 4.86, 31.11 ± 1.11, 31.88 ± 0.92, and 32.04 ± 3.56 mg/dL on Days 0, 3, 6, and 10, respectively), while the 15% concentration group recorded the lowest values (25.17 ± 2.08, 26.65 ± 3.56, 28.19 ± 2.18, and 32.45 ± 1.34 mg/dL). Although the changes appeared concentration-dependent, statistical analysis showed no significant difference between groups ($P \geq 0.05$).

4. DISCUSSION

Many indigenous medicinal plants have been widely documented to influence blood glucose and lipid metabolism, exhibiting either hypoglycemic or hyperglycemic effects. Recent studies have investigated the glucose-modulating potential of various plant extracts in both normoglycemic and diabetic animal models (Adedayo & Balogun, 2023; Zhang et al., 2021).

Although ethnomedicinal plants are traditionally employed in the management of diabetes and associated metabolic disorders, some may elicit paradoxical responses depending on factors such as their phytochemical profile, administered dose, or the physiological state of the subject (Ahmed et al., 2021; Sharma & Gescher, 2022).

The findings of this study suggest that the aqueous extract of *Raphia vinifera* mesocarp may exert a hyperglycemic effect in Wistar albino rats. A previous report on the leaf extract of *Raphia vinifera* revealed the presence of several biologically active constituents including 3.6% moisture, 4.4% crude protein, 29.1% fat, 53.4% carbohydrates, 5.6% crude fibre, and 4.1% ash.

These values indicate that the mesocarp is a rich source of organic matter, particularly carbohydrates, which could serve as an energy-dense food supplement (Olatunji et al., 2021). The high carbohydrate content may partly explain the observed increase in plasma glucose levels, as excessive carbohydrate intake can lead to elevated blood sugar levels, especially in individuals or animal models with compromised insulin regulation.

The significant increase in plasma glucose and the marked elevation in plasma triglyceride levels observed in the extract-treated groups suggest that the constituents of *Raphia vinifera* mesocarp may promote hyperglycemia and possess a strong capacity to elevate plasma triglyceride concentrations, rather than mitigate them. This finding stands in contrast to most studies on antidiabetic medicinal plants, which typically report hypoglycemic and lipid-lowering effects. However, it aligns with the emerging hypothesis that certain plant extracts may function as metabolic stimulants rather than inhibitors, depending on their phytochemical composition (Adebayo et al., 2023).

It is widely accepted that a strong physiological link exists between glucose and lipid metabolism. Glucose serves as a precursor for de novo lipogenesis, and disturbances in glucose homeostasis often led to secondary lipid abnormalities such as elevated triglycerides. Recent studies suggest that the interplay between glucose and lipid metabolism may significantly influence insulin secretion and sensitivity, especially under conditions of metabolic stress (Feng et al., 2021).

Therefore, the simultaneous increase in glucose and triglyceride levels observed following *Raphia vinifera* treatment could be indicative of disrupted metabolic signalling, potentially contributing to the development of insulin resistance.

Hyperlipidemia is a well documented risk factor in the pathogenesis of cardiovascular diseases, particularly in diabetic individuals. It not only impairs glycemic control but also exacerbates renal complications and contributes to increased mortality (Zhao et al., 2022). In this study, the extract caused a notable rise in serum triglyceride levels even in normoglycemic rats, suggesting a potential risk factor if consumed chronically or without clinical oversight. This finding underscores the importance of cautious interpretation of traditional plant usage, especially when bioactive compounds capable of modulating lipid metabolism are present.

The literature also identifies several plant extracts that stimulate triglyceride elevation. For instance, extracts from *Trigonella foenum-graecum* (fenugreek), *Murraya koenigii* (curry leaf), and other phytochemical-rich botanicals have been shown to influence lipid metabolism by modulating enzyme activity and intestinal lipid absorption (Sivanesan et al., 2021; Acharjee et al., 2023).

These mechanisms are often linked to the fibre content and specific fatty acid components present in the plant material. Additionally, recent studies have demonstrated the potential toxicity of *Raphia vinifera* fruit extracts on aquatic organisms. For example, Aladesanmi et al. (2022) reported significant reductions in hepatic total protein and disruptions in antioxidant enzyme activity in Nile tilapia following exposure to the plant's mesocarp extract, likely due to phytochemicals such as palmitic, oleic, and linoleic acids present in its oil yield.

5. CONCLUSION

In conclusion, oral administration of different concentration (25%, 20% and 15%) of *Raphia vinifera* mesocarp extract showed significant changes in blood glucose level, while oral administration of different concentration (25%, 20% and 15%) of *Raphia vinifera* mesocarp extract revealed that that there was no significant change on triglyceride level as compared to the control. In this study, we investigated the effect of Raphia vinifera mesocarp on glucose and triglyceride levels of Wistar albino rats. We therefore, recommend that *Raphia vinifera* mesocarp may be used in the treatment of hypoglycemia.

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