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Antidiabetic Activity of the Leaf Extract of *Indigofera conferta* Linn

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ABSTRACT
Diabetes mellitus is a metabolic disorder that remains a major global health concern. In this study, diabetes was induced in Drosophila melanogaster using a high sucrose diet (HSD) for ten days. The flies were divided into six groups: normal control, diabetic control, positive control (0.16 mg/mL of metformin), and three test groups treated with 40 mg/mL, 60 mg/mL, and 80 mg/mL of *Indigofera conferta* leaf extract. Results indicated a dose-dependent reduction in glucose levels, with the highest activity observed at 80 mg/mL, comparable to metformin. The study suggests that *Indigofera conferta* possesses significant antidiabetic potential, reducing blood glucose concentration proportionally with increased extract concentration. Further investigations are recommended to assess the safety profile and elucidate the mechanism of action of the bioactive constituents.

Keywords: Antidiabetic, *Indigofera conferta*, Diabetes mellitus, *Drosophila melanogaster*

I. INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder affecting millions worldwide. It is characterized by the disturbance of carbohydrate, protein, and lipid metabolism resulting from impaired insulin production or utilization (Abubakar et al., 2016). Insulin, a hormone produced by the pancreas, regulates blood glucose levels. Uncontrolled diabetes often leads to hyperglycemia, which, over time, can cause severe damage to various body systems including nerves and blood vessels (World Health Organization [WHO], 2023). Persistent hyperglycemia results in both microvascular (retinopathy, nephropathy, neuropathy) and macrovascular (coronary and peripheral arterial diseases) complications, leading to organ dysfunction and mortality (Pari & Saravanan, 2004).

About 8.5% of persons who were 18 years of age and older had diabetes in 2014. A total of 1.5 million deaths were directly related to diabetes in 2019, and 48% of these deaths occurred in those under the age of 70. Diabetes contributed to an additional 460 000 renal disease deaths, and high blood glucose is responsible for 20% of cardiovascular fatalities (Global Burden of Disease, 2020).

Diabetes is a globally and public health problem particular in the low- and middle-income countries. Nearly 80% of those who have diabetes do so in low- and middle-income nations, where disease affects close to half a billion people. The type of diabetes that affects nine out of ten people is Type 2, and its prevalence is rising quickly in low- and middle-income nations. People with type 2 diabetes are unable to utilize the insulin that their bodies produce to control blood sugar levels. The increase excessive blood sugar over time harms many body functions, including the blood vessels and nerves. Diabetes can cause kidney failure, blindness, and amputation of the lower limbs, heart disease, stroke, and other conditions.Historical reports and centuries-old cultural traditions show that some plants can be an alternative to standard pharmacotherapy or, at least, help with treatment or have a preventative effect. Modern science is very eager to verify these properties by analyzing the so-called medicinal plants for the presence of valuable bioactive compounds, including antioxidants, and the resulting interesting potential health properties (Monica, 2022).

There are different possible ways of introducing such plants into the diet. The first way is to eat them on our own in a basic or modified form or in a slightly changed state of matter. The second way to use raw plant materials with antidiabetic activity is to change the matrix of the given substance, i.e., producing dietary supplements or designing foods containing a given raw material and giving them strictly defined

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characteristics, i.e., producing so-called functional food. This type of food is aimed at people with elevated blood glucose levels and used in the manufacture of food for obese patients. Technologists design such food products (Kozlowska et al., 2019), and consumers increasingly seek such food (Przeor et al., 2018).

Shrubs, shrublets, perennial herbs, or rarely annual herbs or small tree; trichomes typically medifixed (T-shaped), equally to very unequally 2-branched and sometimes crisped or rarely simple multicellular hairs present with glandular tips. Stipules persistent or caduceus. Leaves usually imparipinnate but for some species simle or reduced to 1 leaflet; stipels present or absent; leaflet blades usually opposite but sometimes subopposite or alternate rarely with glands, margin entire. Racemes axillary; bracts usually caduceus, calyx campanulate or cup-shape; teeth 5 subequal or abaxial one longer. Corolla usually redish, sometimes white or yellow; standard usually covered outside with appressed trichomes but occasionally glabrous, base shortly clawed, apex usually obtuse to emarginated and mucronate; wings narror, base auricled; keel falcate or spatulate with spur adnate to wing. Stamens 10, diadelpous, only vexillary one free; anthers uniform, basifixed or subbasifixed sometimes both ends hairy, apex apiculate

Age-standardized diabetes mortality rates increased by 3% between 2000 and 2019. Diabetes-related death rates rose 13% in lower-middle income nations.This study evaluates the potential antidiabetic effect of the locally available and cost-effective Indigofera conferta leaf extract using Drosophila melanogaster as an experimental model.

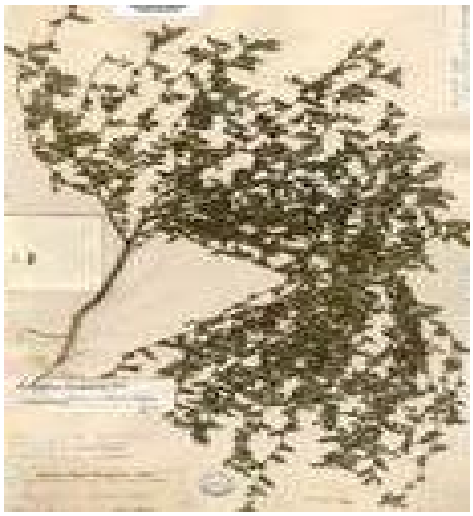
II. MATERIALS AND METHODS

Sample Collection

Fresh leaves of *Indigofera conferta* were collected from Zaria Local Government Area, Kaduna State, Nigeria, and authenticated at the Herbarium, Botany Unit, Usmanu Danfodiyo University, Sokoto. The leaves were air-dried, powdered, and stored in airtight containers before extraction.

Experimental Design

Flies Grouping	Treatment with Leaves Extract	Status
Group I	No diabetic was induced and no treatment were given	Normal control
Group II	Flies were induced with diabetes and no treatment were given	Diabetic control



Acute Toxicity

Acute toxicity tests followed Bonilla-Ramirez et al. (2011). Four concentrations (40 mg, 60 mg, 80 mg, and 100 mg per 10 mL of diet) were prepared. A total of 140 flies (35 per group in triplicate) were starved for 14–16 hours before exposure to the extracts for 30 minutes. Mortality was monitored daily for 15 days to determine the LD50 using the Karber-Behrens (1931) method.

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Group III	Flies were induced with diabetes and treated with standard drug metformin (0.16mg/ml)	Positive control
Group IV	Flies were induced with diabetes and treated with plant extract	An (40 mg/ml)
Group V	Flies were induced with diabetes and treated with plant extract	An (60 mg/ml)
Group VI	Flies were induced with diabetes and treated with plant extract	An (80 mg/ml)

For the main experiment, 900 flies were distributed into six groups: normal control, diabetic control, positive control (metformin 0.16 mg/mL), and three extract-treated groups (40, 60, and 80 mg/mL). Diabetes was induced using a high sucrose diet (30:70 sugar-to-normal diet ratio) for ten days. Glucose and glycogen levels were determined using standard biochemical assays (Thomas, 1999; Akram et al., 2011).

Data Analysis

Statistical analysis employed one-way ANOVA with Duncan's multiple comparison test at $p < 0.05$ using SPSS version 20.0.

Results

Table 1: Effect of *Indigofera conferta* Methanol Leaf Extract on Percentage Mortality of *Drosophila melanogaster*

Doses	**40mg**	**60mg**	**80mg**	**100mg**
Death	6	8	10	30
N	30	30	30	30
A	20	20	20	
B	$\frac{6+8}{2}$	$\frac{8+10}{2}$	$\frac{10+30}{2}$	
Ab	140	180	400	

(n=30 flies/group).

$\sum(ab) = 720$

$LD_{50} = LD_{100}$-

$= 100 - \frac{720}{30}$

$= 75$ mg

Hence, the LD_{50} value of the extract was 75 mg/g

Table 2: Effect of *Indigofera conferta* Methanol Leaf Extract on the Body Weight of *Drosophila melanogaster* after Treatment

Treatment	**Body Weight (g)**
Normal Control (10ml diet)	0.87 ± 0.00^{d}
Diabetic Control (1.6gHSD/ml)	0.33 ± 0.01^{a}
Metformin (0.16 mg/ml)	0.89 ± 0.01^{d}
Indigofera conferta (40 mg/ml)	0.22 ± 0.01^{b}
Indigofera conferta (60 mg/ml)	0.45 ± 0.02^{c}
Indigofera conferta (80 mg/ml)	0.69 ± 0.01^{e}

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Values are mean ± SEM (n=10 flies/group). Value having similar superscript down columns are not significantly different at (P<0.05) analysed using One-Way ANOVA, followed by Duncan multiple comparison test with SPSS version 20.0. HSD: High Sucrose Diet.

Table 3: Effects of *Indigofera conferta* Leaf Extract on some Parameters of Diabetic Assay in *Drosophila melanogaster*

Treatment	Glucose (mg/dL)	Glycogen (mg/dL)
Normal Control (10ml diet)	10.20 ± 0.148^{b}	8.54 ± 0.195^{b}
Negative Control (1.6g HSD)	25.03 ± 0.099^{e}	12.25 ± 0.259^{e}
Met (0.16 mg/ml)	9.78 ± 0.174^{b}	7.08 ± 0.245^{a}
Indigofera conferta (40 mg/ml)	14.16 ± 0.127^{d}	10.09 ± 0.041^{d}
Indigofera conferta (60 mg/ml)	11.22 ± 0.098^{c}	8.14 ± 0.232^{c}
Indigofera conferta (80 mg/ml)	7.35 ± 0.251^{a}	6.02 ± 0.21^{a}

III. IV. DISCUSSION

The acute toxicity study showed an LD50 value of 75 mg/g, indicating that Indigofera conferta extract is relatively safe at lower concentrations. Body weight analysis revealed significant ($p < 0.05$) improvement in extract-treated and metformin groups compared with the diabetic control. Glucose levels decreased significantly across all extract groups, with the 80 mg/mL treatment producing effects comparable to metformin. Similarly, glycogen levels improved in treated flies, suggesting restored carbohydrate metabolism.

The percentage mortality of Drosophila melanogaster on different concentrations (40 mg/ml, 60 mg/ml, 80 mg/ml and 100 mg/ml of diet) of *Indigofera conferta* leaf extract for 15 days is shown in Table 1 above. The exposure of Drosophila melanogaster on different concentration of the extract displayed 11% mortality at 40 mg/ml of the extract group, 15 % mortality at 60 mg/ml of the extract group, 21% mortality at a 100 mg/ml of the extract group, 100% mortality at a 100 mg/ml of the extract group.

Acute toxicity studies had been an index used in the assessment of adverse effects xenobiotics on a single or multiple dose (Diallo et al., 2010). The exposure of drosophila melanogaster on different concentrations of *Indigofera conferta* leaves extract displayed 11% mortality in flies feed on 40 mg/ml, 15% mortality in flies feed on 60 mg/ml, 21% mortality in flies feed on 80 mg/ml and 100% mortality in flies feed on 100 mg/ml which possess the highest mortality. The *Indigofera conferta* leaves extract demonstrate toxic effects at higher doses in rat (Baba et al., 2022).

The results demonstrate that *Indigofera conferta* exhibits a dose-dependent antidiabetic effect in diabetic *Drosophila melanogaster*. The observed hypoglycemic effect may be attributed to phytochemicals with antioxidant and insulin-mimetic properties, consistent with findings in related Indigofera species (Mani et al., 2011). The significant increase in glycogen storage also suggests enhanced glucose utilization and metabolic regulation. These findings align with previous studies showing that plant-derived compounds can effectively lower blood glucose levels and improve insulin sensitivity (Shyam & Kadalmani, 2014).

V. CONCLUSION AND RECOMMENDATIONS

This study confirms that Indigofera conferta leaf extract possesses notable antidiabetic activity in a *Drosophila melanogaster* model. The effect was dose-dependent, with 80 mg/mL showing optimal results. Further research should isolate and characterize the active compounds, evaluate long-term toxicity, and explore the molecular mechanisms underlying its therapeutic potential.

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VI. AKNOWLEDGEMENT

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