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Pharmacological Evaluation of Anti-Diabetic Activity of Dioscorea alata Leaves in Animal Model

Mr. Prashant R. Wagh, Dr. Abhijit Shrirao, Dr. Deepak S. Mohale,
Dr. Nitin I. Kochar, Dr. A. V. Chandewar
Department of Pharmacology
Pataldhamal Wadhwani College of Pharmacy, Yavatmal

Abstract: *The current study investigated the anti-diabetic potential of Dioscorea alata extract in streptozotocin-induced diabetic rats. Diabetes was induced in rats by a single intraperitoneal injection of streptozotocin (60mg/kg). The diabetic rats were treated with low (100 mg/kg) and high (200 mg/kg) doses of Dioscorea alata extract. The study assessed the effect of the extract on body weight and blood glucose levels. The results showed that Dioscorea alata extract significantly reduced blood glucose levels and attenuated weight loss in diabetic rats. These findings suggest that Dioscorea alata possesses anti-diabetic activity and may be a potential source of therapeutic agents for managing diabetes mellitus.*

Keywords: Dioscorea alata, Diabetes, Streptozotocin, Blood glucose, Body weight, Phytochemicals

I. INTRODUCTION

Diabetes mellitus is a prevalent endocrine disorder characterized by persistent hyperglycemia. The disease results from the pancreas's inability to produce sufficient insulin or the body's ineffective use of the insulin it produces.1This metabolic dysfunction can lead to a range of acute symptoms, including increased thirst, frequent urination, unexplained weight loss, and blurred vision, and if left unmanaged, can result in severe long-term complications such as cardiovascular, ocular, renal, and neurological damage.2

The global incidence of diabetes is rising, with approximately 537 million adults affected worldwide as of 2021. Type 2 diabetes mellitus accounts for around 90% of these cases, posing a significant health and economic burden, with global health expenditures estimated at $760 billion annually.5

Current management strategies for diabetes include lifestyle modifications, oral antidiabetic drugs, and insulin therapy. However, there's growing interest in exploring alternative therapies, including herbal medicines, for their potential in managing diabetes. This study investigates the anti-diabetic potential of Dioscorea alata, a plant traditionally used in herbal medicine, in an animal model.7

II. MATERIALS AND METHOD

2.1 Materials

2.1.1 Chemicals and reagents used during study

Petroleum Ether, Methanol, Chloroform, Streptozotocin, Molish's Reagent, Mayers Reagent, Sulphuric Acid, Lead Acetate, Ferric Chloride, α – Napthol, Glacial Acetic Acid, Ninhydrin solution, Ammonia solution, Glucose Diagnostic Kit.

2.1.2 Experimental Animals

Healthy Sprague Dawley rats (8 weeks old, weighing 150-250 gm) were housed under standard laboratory conditions (temperature 22 ± 2°C, humidity 55-60%, 12-hour light/dark cycle) with free access to standard pellet diet and water. All experimental procedures were approved by the Institutional Animal Ethical Committee (IAEC) with reference no.

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650/PO/Re/S-2002/2025/CPCSEA/08 and conducted in accordance with the guidelines of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA).

2.1.3 Apparatus and Instruments

Cooling centrifuge, Semiautomatic Biochemistry auto-analyzer, Desiccators, Micropipette, Digital weighing balance and Glasswares, Glucometer.

2.2 Method

2.2.1 Plant Material and Extraction:

Fresh leaves of Dioscorea alata plant were collected from local area of Toranmal, Maharashtra. and authenticated by a botanist (Reference No. (ACDo /Certificate/37/2025). The leaves were shade-dried, coarsely powdered, and subjected to Soxhlet extraction using petroleum ether to remove fatty components, followed by maceration in methanol. The methanolic extract was concentrated by evaporation at 40°C.

2.2.2 Phytochemical Screening:

The methanolic extract of Dioscorea alata leaves (MEDA) was subjected to qualitative phytochemical screening using standard procedures to detect the presence of various secondary metabolites, including alkaloids, carbohydrates, cardiac glycosides, tannins, proteins and amino acids, phenolic compounds, flavonoids, anthraquinones, saponins, and terpenoids.

2.2.3 Induction of Diabetes:

Diabetes was induced in rats (except the normal control group) by a single intraperitoneal injection of streptozotocin (STZ) at a dose of 60 mg/kg body weight, dissolved in freshly prepared ice-cold citrate buffer (0.1 M, pH 4.5). Negative control rats received an equivalent volume of citrate buffer. Blood glucose levels were measured using a glucometer (Ambica Diagnostic) 72 hours post-STZ injection, and rats with fasting blood glucose levels $\geqslant$ 150 mg/dL were considered diabetic.

2.2.4 Experimental Groups:

The rats were divided into five groups (n=6 per group):
Group 1 (Vehicle Control): Non-Diabetic Rats treated with normal saline.
Group 2 (Negative Control): Diabetic Rats treated intraperitoneally with STZ (60mg/kg)
Group 3 (Low Dose MEDA): Diabetic Rats treated orally with MEDA (100 mg/kg).
Group 4 (High Dose MEDA): Diabetic Rats treated orally with MEDA (200 mg/kg).
Group 5 (Standard): Diabetic rats treated orally with glibenclamide (5 mg/kg).

2.2.6 Statistical Analysis:

All data were expressed as the mean ± standard deviation. For statistical Analysis of the rats, group mean were compared by one-way (ANOVA) followed by Dunnett's test, $p<0.01$ was considered as significant value.

III. RESULTS

3.1 Phytochemical Screening:

Phytochemical screening of the methanolic extract of Dioscorea alata leaves revealed the presence of alkaloids, carbohydrates, cardiac glycosides, tannins, proteins and amino acids, phenolic compounds, flavonoids, anthraquinones, saponins, and terpenoids (Table 1).

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Table No. 1: Phytochemicals Screening of MEDA

Sr.No	Phytoconstituents	Test	Hydro Alcoholic extract
1	Alkaloid	Mayer'sTest	+
		Dragendroff'sTest	+
2	Flavonoids	Ferric ChlorideTest	+
		Lead Acetate Test	+
3	Carbohydrates	Molisch Test	+
		Fehling Test	-
		Benedict's Test	+
4	Steroid	Salkowski's Test	+
		Libermann Barchared test	+
5	Tannins	Lead Acetate Test	+
		Gelatin Test	+
6	Proteins	Xantho protein test	+
		Biuret Test	+
		Lead Acetate Test	+
7	Glycoside	Keller Kiliani Test	+

+ Present, - Absent

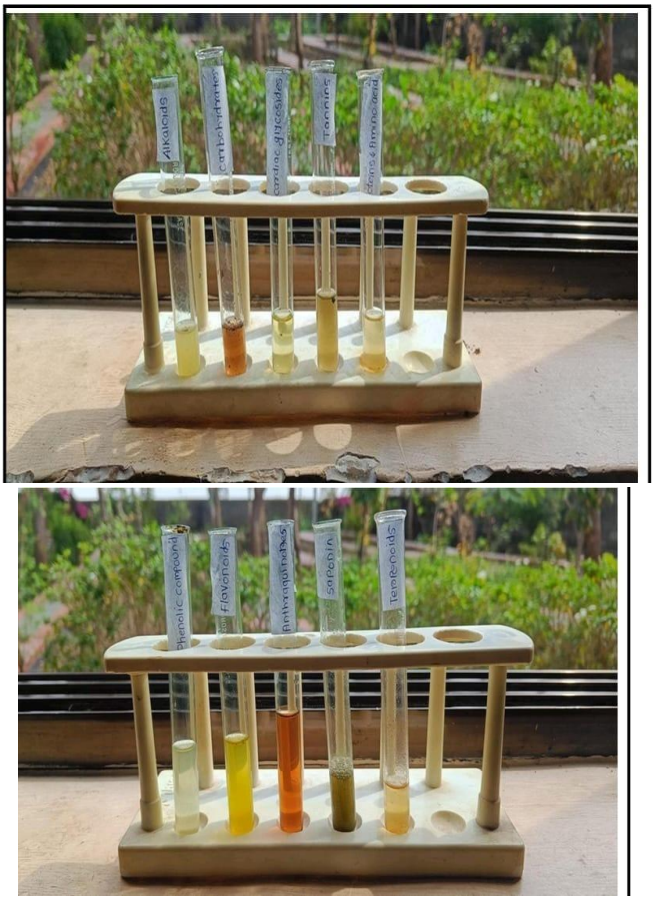

Figure No.1: Phytochemicals screening of MEDA

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3.2 Effect of MEDA on Body Weight:

Table No 2: Evaluation of body weight of rats on day 0, 5, 10, 15 and 20.

Groups	Body weight (gm)				
	Days				
	0 Day	5 days	10 days	15 days	20 days
Normal control	202.75 ± 19.75	237.25 ± 8.26	208.75 ± 11.41	207.50 ± 13.87	218.25 ± 18.52
Negative control	214.5 ± 16.13^{ns}	189.75 ± 7.14$^{@@}$	167.25 ± 8.46$^{@@}$	151.75 ± 4.92$^{@@}$	146 ± 7.83$^{@@}$
MEDA (100mg/kg)	211.75 ± 14.52^{ns}	200.25 ± 6.45^{ns}	178.25 ± 8.96^{ns}	164.50 ± 7.23^{ns}	160.75 ± 7.13^{ns}
MEDA (200mg/kg)	219.75 ± 18.44^{ns}	210 ± 7.07**	189.5 ± 8.35**	174.50 ± 5.80**	176.75 ± 8.77**
Glibenclamide	215.25 ± 13.59^{ns}	220.25 ± 5.12**	200.75 ± 5.56**	194.50 ± 6.81**	193.25 ± 4.86**

The result were expressed as Mean ± SD (n = 4)

ns (not significant) = p>0.05, @@p<0.01 when compared to normal control group of rats

ns (not significant) = p>0.05, **p<0.01 when compared to negative control group of rats

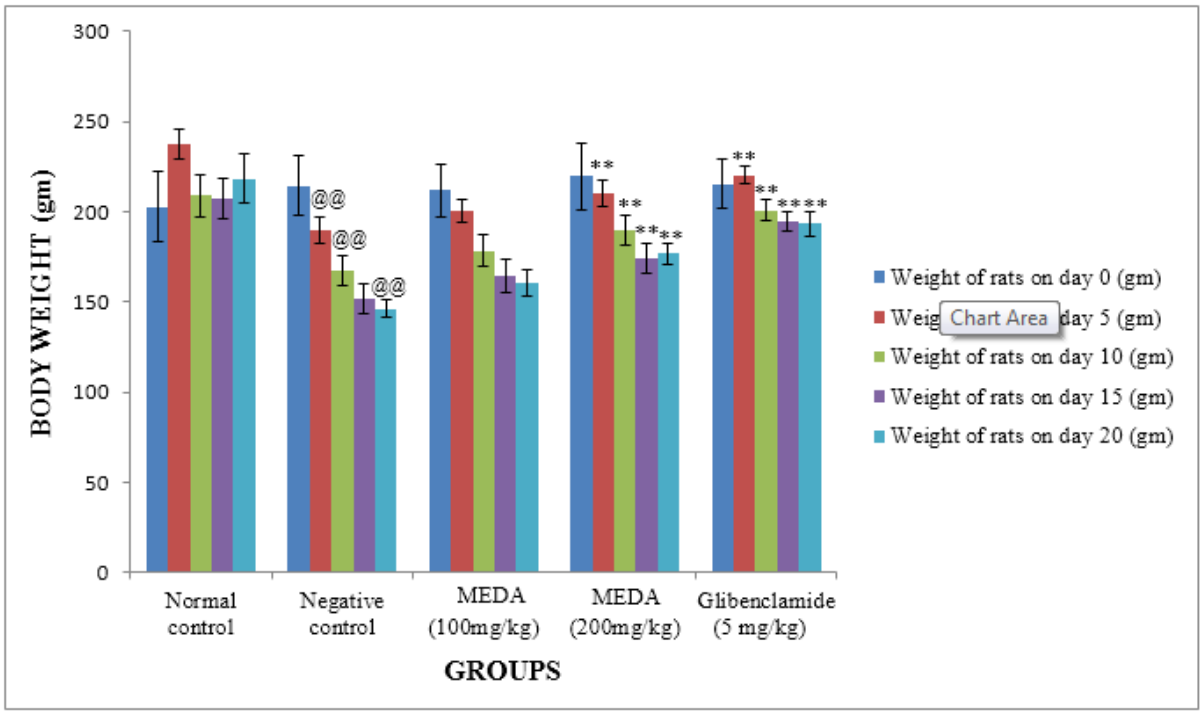

Fig. No. 2: Evaluation of body weight of rats on day 0, 5, 10, 15 and 20.

Table No. 2 and Figure No. 2 Shows the effect of Dioscorea alata on body weight of Streptozotocin induced diabetic rats. There was significant (p<0.01) decrease in body weight in negative control group compared to Normal control group of rats on day 5 to day 20. After the confirmation of diabetes, rats were treated with methanolic extract of Dioscorea alata. After treatment, there was a significant reduction (p<0.01) in body weight in high dose group (200mg/kg) and Standard dose group compared to negative control groups on day 5 to day 20.

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3.3 Effect of MEDA on Blood Glucose level:

Table No 3: Estimation of blood glucose level of rats on day 0, 5, 10, 15 and 20.

Groups	Blood glucose level (mg/dl)				
	Days				
	0 Day	5 days	10 days	15 days	20 days
Normal control	98.75 ± 3.59	103.50 ± 6.81	102.25 ± 4.65	100.50 ± 4.43	101 ± 7.80
Negative control	101 ± 7.07^{ns}	176.25 ± 8.62$^{@@}$	189 ± 6.05$^{@@}$	204.50 ± 8.23$^{@@}$	225 ± 11.34$^{@@}$
MEDA (100mg/kg)	102.25 ± 5.68^{ns}	142 ± 3.37**	158.50 ± 6.66**	169.75 ± 7.72**	180.25 ± 9.53**
MEDA (200mg/kg)	102 ± 6.98^{ns}	121.25 ± 8.02**	140.75 ± 4.50**	140.50 ± 5.20**	154.25 ± 8.58**
Glibenaclamide	103 ± 7.07^{ns}	110.25 ± 6.30**	114 ± 9.20**	114.75 ± 7.63**	120 ± 6.05**

The result were expressed as Mean ± SD (n = 4)
ns (not significant) = p>0.05, @@p<0.01 when compared to normal control group of rats
ns (not significant) = p>0.05, **p<0.01 when compared to negative control group of rats

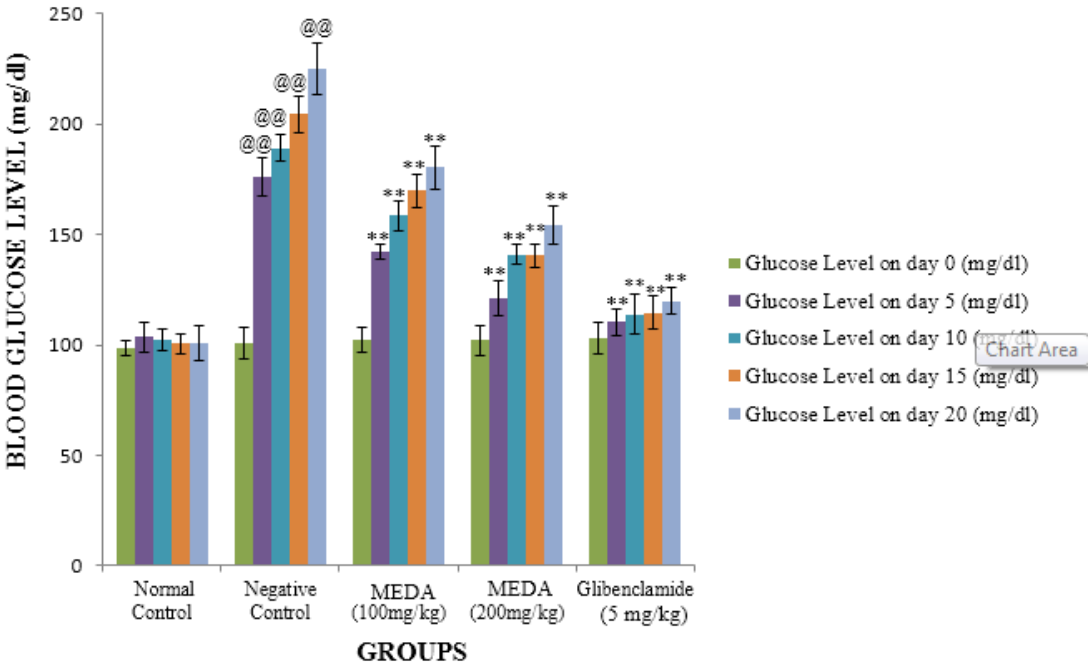

Fig. No. 3: Estimation of blood glucose level of rats on day 0, 5, 10, 15 and 20.

Table no.3 and Figure no 3 Shows the effect of Dioscorea alata on blood glucose level of Streptozotocin induced diabetic rats. There was significant (p<0.01) increase in the blood glucose level in negative control group compared to Normal control group of rats on day 5 to day 20. After the confirmation of diabetes, rats were treated with methanolic extract of Dioscorea alata. After treatment, there was a significant reduction (p<0.01) in the Blood glucose level in MEDA (100mg/kg), MEDA (200mg/kg) and Standard dose group compared to negative control groups on day 5 to day 20.

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IV. DISCUSSION

The findings of this study indicate that Dioscorea alata extract possesses significant anti-diabetic potential. The streptozotocin-induced diabetic rats showed characteristic hyperglycemia and weight loss, which are consistent with the pathophysiology of diabetes mellitus. The administration of Dioscorea alata extract effectively reduced blood glucose levels and attenuated weight loss in the diabetic rats.

These results align with previous research demonstrating the anti-diabetic effects of various plant extracts in animal models. The precise mechanism by which Dioscorea alata exerts its anti-diabetic effect requires further investigation, but it may involve enhanced insulin secretion, improved insulin sensitivity, or reduced glucose absorption.

V. CONCLUSION

This study provides evidence for the anti-diabetic activity of Dioscorea alata extract in streptozotocin-induced diabetic rats. The extract effectively reduced blood glucose levels and attenuated weight loss. These findings suggest that Dioscorea alata may be a potential source of therapeutic agents for managing diabetes mellitus.

VI. ACKNOWLEDGEMENT

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