ISSN 2063-5346

A STUDY ON ANTIDIABETIC ACTIVITY OF FLOWER OF MUSA *PARADISIACA* ON STREPTOZOTOCIN INDUCED DIABETES MELLITUS

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Article History: Received: 02.07.2023 Revised: 15.07.2023 Accepted: 23.07.2023

Abstract

The objective of this study was to evaluate the potential hypoglycemic activity of alcoholic extracts obtained from the flowers of *Musa paradisiacal* in rats. Additionally, the antidiabetic activity of both alcoholic and aqueous extracts of *Musa paradisiaca* flowers was investigated in streptozotocin-induced diabetic rats. During preliminary phytochemical screening, glycosides, fixed oils, tannins, phytosterols, and phenolic compounds were identified in the alcoholic extracts. However, the significant effects of the alcoholic extract were observed only at higher doses.

In the case of streptozotocin-induced diabetic rats, the alcoholic extract of *Musa paradisiaca* flowers demonstrated significant antidiabetic activity, particularly at higher doses, surpassing the effects of the standard drug Glibenclamide. Morphological studies involving water consumption, food intake, and body weight indicated similar effects of the alcoholic extracts and Glibenclamide in diabetic rats when administered at higher doses. Furthermore, the histopathological study revealed a notable restoration of damaged cells in the islets of Langerhans, as compared to the effects of glibenclamide.

Based on findings, it can be concluded that alcoholic extract of *Musa paradisiaca* flowers exhibits promising antidiabetic properties, supporting its traditional usage in managing diabetes.

Keywords: *Musa paradisiaca,* Hypoglycemic, Antidiabetic, Streptozotocin, Glibenclamide.

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DOI:10.48047/ecb/2023.12.9.199

1.0 Introduction:

The Diabetes mellitus is a silent killer, the prevalence of diabetes increases with age in both sexes and is consistently higher in men than in women of 20-49 year of age. It is a syndrome associated with hyperglycemia, Hyperlipidemia, oxidative stress, polyuria, polyphagia, polydypsia, ketosis, nephropathy, neuropathy and cardiovascular disorders.[2] At present diabetes mellitus is affecting nearly 30 million people across the globe. Diabetes mellitus has tremendous impact on health and is one of the leading causes of death in developed and in developing countries. In USA, it is fourth leading causes of death. In India alone it is affecting 1-2% of population.(1,2)

A recent article revealed the rapid growth of diabetes worldwide. As on date about 1.7% of the world population has been estimated to suffer from diabetes mellitus and is expected to rise to 3.6% by the year 2025 and in some places like United States, the number of cases may double by 2030. Other estimates conclude that, the number of new cases of diabetes may triple. A short term projection estimates that 651,000 people with diabetes will be in treatment for end-stage renal disease by that time.(3,4)

In modern medicine, no satisfactory effective therapy is yet available to cure diabetes mellitus. Though insulin therapy is used for the management of diabetes mellitus but there are several drawbacks like insulin resistance, anorexia, nervosa, brain atrophy and fatty liver. Chronic treatment with sulfonyureas and biguanides are also with side effects. Requirement for refrigeration of the drug, requirement of skilled technicians and high cost also a problem because that is not affordable in poor economic community.(5,6)

Since, we know that in the modern medicine there is no effective remedy by which tight glycemic control is possible without adverse affects. Herbals drugs have been used as major source for treatment of diabetes mellitus and other disease since ancient time in India and rest of the world, because herbal drugs having fewer side effects compare to synthetic drugs.(7,8)

Herbal drugs are mostly out of toxic or of less toxic with fewer side effects compared to the synthetic drugs. Hence, there is persistent interest all over the world to explore other alternative therapies like ayurveda, unani, homeopathy, siddha etc. which are believed to be effective, safer and economical.(9)

In the indigenous system of medicine many plants have been claimed to be useful in the treatment of diabetes mellitus. The discovery of widely used hypoglycemic drug, metformin came from the traditional approach of using plant, *Galega officinalis.* Thus, plants are potential source of anti-diabetic drugs but this fact was not gained enough momentum in the scientific community. The reasons may be many including lack of belief among the practitioners of conventional medicine over alternative medicine, alternative forms of medicine are not very well defined, and possibility of quacks practicing such medicine providing alluring and magical cures and natural drugs may vary tremendously in content, quality and safety.(10)

In this context, upon extreme survey, it was found that the fruit of *Musa paradisiaca* has been used as a folk medicine for treatment of peptic ulcers, pulp of *Musa paradisiaca* has been used as analgesic and leaves of *Musa paradisiaca* has been used as anti-asthmatic.

The flower of *Musa paradisiaca* has been used traditionally in the treatment of diabetes mellitus. Nevertheless, its scientific study has not yet been reported. Hence an effect has been made to evaluate the flowers of *Musa paradisiaca* for its hypoglycemic and antidiabetic activity in animal model.(11-15)

2.0 Materials and Methods

2.1 Collection of plant materials:

Flowers of *Musa paradisiaca* were procured and authenticated by the renowned botanist and voucher specimen was deposited in herbarium for future reference. The collected plant material was shade dried to retain its vital phytoconstituents and then subjected to size reduction for further extraction process.

2.2 Extraction and isolation methods

The flowers were dried in shade at room temperature. The dried flowers were powdered by using grinder, and were packed into Soxhlet's column and extracted by 90% ethanol for 24 hrs. The solvent was removed using rotatory flash evaporator. Further the extract was concentrated by using hot water bath ($70 – 80^0$). The dried extract was stored in airtight container in refrigerator below 10^0C. The stock solution of alcoholic extract was prepared using 2% aqueous gum acacia.(16)

2.3 Experimental animals

Albino rats of either sex weighing between 150-200 g were procured from central animal house for experimental purpose. The animals were acclimatized to laboratory conditions for 7 days. The animals were supplied with commercially available standard diet from. Water was allowed *ad libitum* under hygienic conditions. All animal studies were performed in accordance to guideline of CPCSEA and Institutional Animal Ethical Committee (IAEC) guidelines. (17, 18)

2.4 Acute toxicity study

The acute toxicity of alcoholic extract of flowers of *Musa paradisiaca* was determined by using albino mice of either sex (20-25gm); those maintained under standard conditions. The animals were fasted over night prior to experiment. Animals were administered with different doses of the extract, orally by following up and down methods as per OECD guidelines number 425. From LD_{50} dose, $1/10^{th}$, $1/20^{th}$ and $1/5^{th}$ doses are to be selected and were considered as low, medium and high dose respectively for alcoholic extract. (19,20)

2.5Chemical

Streptozotocin was purchased from Sigma Chemical Company, St. Louis, USA. All other chemicals were of highest purity grade.

3.0 Methodology

3.1 Hypoglycemic activity:

Albino rats either sex weighing between 150-200 gm were categorized into five groups, each group consisting of 6 animals.

Group A: Normal control (Saline solution)

Group B: Standard (Glibenclamide)

Group C: Extract of the flowers of *Musa paradisiaca* (100mg/kg)

Group D: Extract of the flowers of *Musa paradisiaca* (200mg/kg)

Group E: Extract of the flowers of *Musa paradisiaca* (400mg/kg)

3.2 Antidiabetic activity:

Albino rats of either sex weighing between 150-200 gms will be categorized into four groups, each group consisting of 6 animals.

Group A: Normal group

Group B : Diabetic group (STZ treated)

Group C : Standard (STZ + Glibenclamide treated)

GroupD : STZ + Extract of the flowers of *Musa paradisiaca* (high dose 800 mg/kg)

3.3 Pharmacological activities

3.3.1 Hypoglycemic activity (21,22)

For hypoglycemic activity, we used only normal animals. This was conducted for all the extracts proposed in the study.

However, here the common procedure involved in the determination of hypoglycemic activity due to any extract is explained, which will be common for all other extracts.

Animals of all the groups were fasted for 16-18 hours before experimentation and fasting will be continued till the end of experimentation. However, the animals will be allowed to have free access to the water throughout the period of experimentation. A 12 hours light and 12 hours dark cycle is maintained with relative humidity of 45-55% and the animals will be maintained at an ambient temperature throughout period of experiment.

Before administration of vehicle /glibenclamide /extract, blood samples were collected from the overnight fasted animals to determine the basal glucose level. Next the animals of respective groups were administered with vehicle/glibenclamide /extracts and there after blood samples were collected at 0,1, 2, 4, 8, 12, 18 and 24hrs intervals and analyzed blood glucose concentration using GOD/POD method.

3.3.2 Anti-diabetic activity

For antidiabetic activity, we used diabetic animals that exhibit blood glucose concentration more than 250mg/dl (STZ treated). Diabetic animals (glucose level > 250 mg/dl) of all the groups were fasted for 16-18 hours before experimentation and fasting will be continued till the end of experimentation. The treatment was started from the same day except control groups for a period of 7 days. During this period, animals in all groups had free access to standard diet and water. Body weight, Food consumption, Water consumption were estimated on 1st to 7th day of the treatment. At the end of 7th day blood samples were collected from overnight fasted rats by tail vein method for 0, 1, 2, 4, 8, 12, 18 and 24 hrs and analyse the blood glucose level. Finally all the animals are sacrificed using ether and the pancreas from all the animals were removed immediately and kept in 10% formalin solution for histopathological examination. (23,24)

3.4 Estimation of fasting blood glucose level

Pipette out 1 ml of glucose oxidizing reagent into marked test tubes and then mix it with 10µl of serum or plasma into the test tube. Incubate the test tube for 15 mins and then take the absorbance readings.

Calculations:

$$\% \text{ BGL (mg/dl)} = \frac{\text{Initial reading (at '0' time)} - \text{Test reading(at regular intervals of time)}}{\text{Initial reading(at '0'time)}} x100$$

3.5 Morphological studies

A. Body weight

All the procedure involved in body weight was carried out parallel with antidiabetic experimentation. For this we considered mean body weight of each group. The mean body weight of each group was taken from 1st day to 7th day, during all experiment and find out the changes in the mean body weight. All the animals were weighed accurately on 1st day of experiment before any treatment. After 24hrs again weighed all the animals in each group and this procedure was repeated for all 7 days. Find out the changes in mean body weight of each group on each day and that is compared with standard group.(25)

B. Water consumption

All the procedure involved in water consumption was carried out parallel with antidiabetic experimentation. For this we considered mean water intake by each group. So the mean water intake of each group was taken from 1st day to 7th day, during all experiment and find out the changes in the mean water intake by rats. The normal water intake was 10-12ml/day/rat. So we take 200ml of accurately measured water in a marked feeding bottle and given to each group

(consisting 6 animals) and time is noted. After 24hrs, remaining water were removed and measured and was deducted from initial value (200ml). The obtained value was divided by 6 that is nothing but the mean water intake by that group. This procedure was repeated for all 7 days and for all groups.(26)

C. Food consumption

All the procedure involved in food consumption was carried out parallel with antidiabetic experimentation. For this we considered mean food intake by each group. So the mean food intake of each group was taken from 1st day to 7th day, during all experiment and find out the changes in the mean food intake by rats.

As normal food intake is 20-40gm/day/rat, so, 300 gm of accurately measured food and given to each group (consisting 6 animals) and time was noted. After 24 hrs, remaining food were removed and measured and was deducted from initial value (300gm). The obtained value was divided by 6 that is nothing but the mean food intake by that group. This procedure was repeated for all 7days and for all groups.(27)

3.6 Statistical analysis:

The values were expressed as mean ± SEM. The statistical analysis was carried out by one way analysis of variance (ANOVA) followed by Dunnet‟s t‟- test. p values <0.05 were considered significant.

4.0 Results

4.1 Hypoglycemic study

4.1.1 Effect of alcoholic extract of *Musa paradisiaca* flowers on fasting blood glucose levels in normal and diabetic rats

Alcoholic extract of *Musa paradisiaca (AEMP)* exhibited a significant dose dependent hypoglycemic activity on single dose treatment. However the hypoglycemic effect of alcoholic extract at 400 mg/kg was found near to the reference standard glibenclamide. The results are depicted in fig 1.

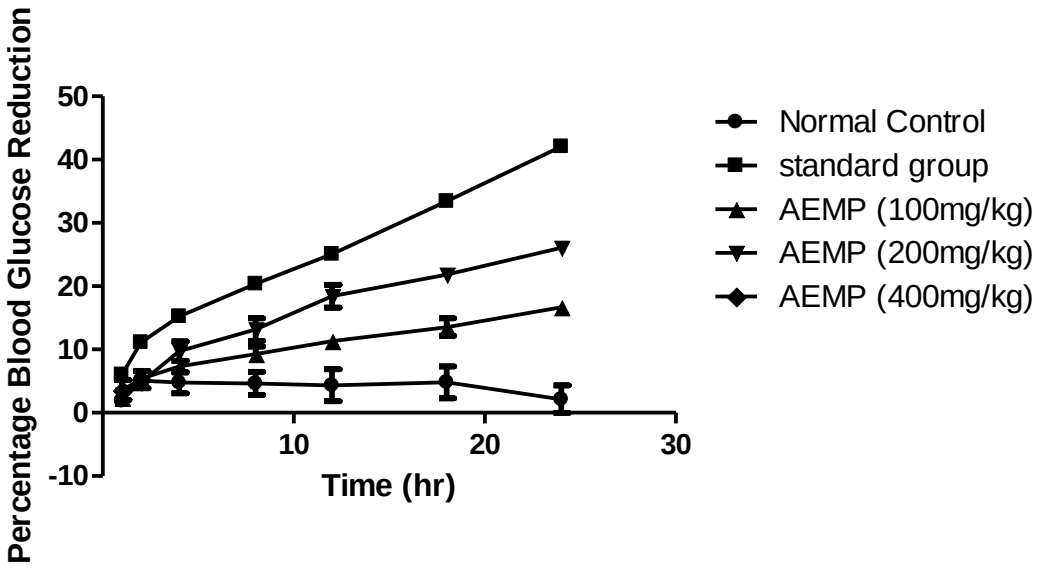

Fig no 01: Effect of alcoholic extract of *Musa paradisiaca* flowers on fasting blood glucose levels in normal rats

4.1.2 Effect of *Musa paradisiaca* flower on fasting blood glucose levels in diabetic rats

Ethanolic extract of *Musa paradisiaca* does not exhibited a significant dose dependent antidiabetic activity on single dose treatment; hence rats were treated with the extracts for 7 days. Since the hypoglycemic effect of alcoholic extract at 400 mg/kg was found nearer to the reference standard glibenclamide. So we selected this dose for its antidiabetic assessment. Ethanolic extract was subjected for anti-diabetic activity in streptozotocin (STZ) used induced diabetic rats. The results are shown graphically represented in Fig. No. 02

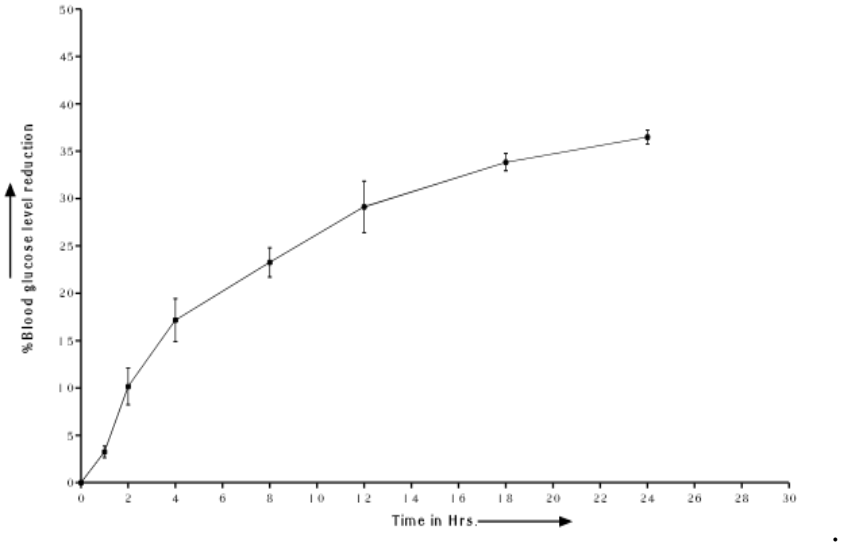

Fig no 2: Effect of *Musa paradisiaca* flower on fasting blood glucose levels in diabetic rats

4.2 Morphological study

4.2.1 Effect of different extracts of *Musa paradisiaca* flower on body weight in diabetic rats

Diabetic rats showed significant reduction in their body weight. STZ caused body weight reduction, which was significantly reversed by the both alcoholic extract at the dose of 400 mg/kg. Results are shown in fig no 03

4.2.2 Effect of different extracts of *Musa paradisiaca* flower on water consumption in diabetic rats

Diabetic rats showed significant increase in their water consumption. Reduction in water consumption was significantly reversed by the alcoholic extract at the dose of 400 mg/kg. Results are shown in Table No. 01

4.2.3 Effect of different extracts of *Musa paradisiaca* flower on food consumption in diabetic rats

Diabetic rats showed significant increase in their food consumption. Increase in food intake was significantly reversed by the both alcoholic and aqueous extract at the dose of 400 mg/kg. Results are shown in table no. 02

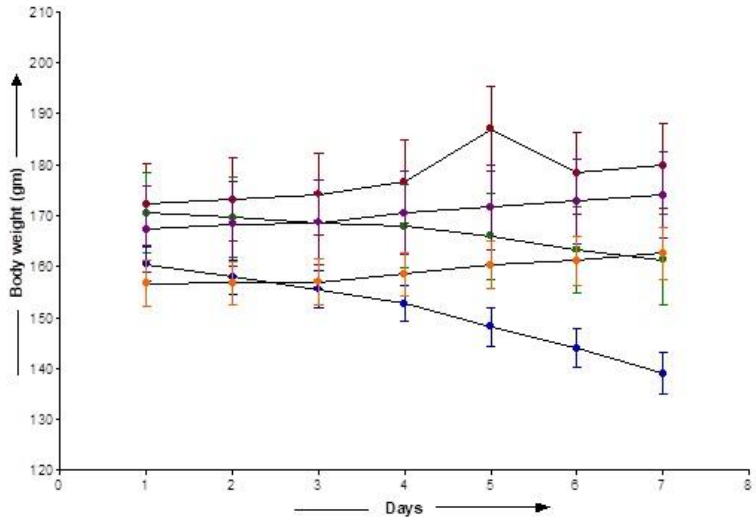

Fig. no. 03: Effect of different extracts of *Musa paradisiaca* flower on body weight in diabetic rats

Table no 01: Effect of different extracts of *Musa paradisiaca* flower on water consumption in diabetic rats

Water intake by rat(ml)							
GROUP	**1st day**	**2nd day**	**3rd day**	**4th day**	**5th day**	**6th day**	**7th day**
Normal	16.67	16.67	15.00	16.67	18.33	17.05	18.33
Diabetic (STZ)	16.67	20.83	25.00	29.17	31.67	35.00	38.33
STZ +Glibenclamide	16.67	16.67	16.67	18.33	18.33	19.67	19.17
STZ+ Alcoholic extract	16.67	18.33	19.17	20.00	22.5	21.67	25.00

Table no . 02: Effect of different extracts of *Musa paradisiaca* flower on food consumption in diabetic rats

Food intake by rat (gm)							
GROUP	**1st day**	**2nd day**	**3rd day**	**4th day**	**5th day**	**6th day**	**7th day**
Normal	30.00	30.83	30.00	29.16	29.16	28.33	28.33
Diabetic (STZ)	33.33	38.33	40.00	41.66	45.83	46.67	48.33
STZ + Glibenclamide	36.67	35.83	35.00	35.00	35.00	33.33	33.33
STZ + Alcoholic extract	31.67	30.83	31.67	31.67	32.05	32.50	33.33

5.0 Discussion

The present study investigated the potential antidiabetic activity of the flower of *Musa Paradisiaca* (banana flower) in streptozotocin-induced diabetes mellitus. Streptozotocin (STZ) is commonly used to induce diabetes in animal models due to its ability to selectively destroy pancreatic beta cells, leading to insulin deficiency and hyperglycemia, which closely mimics type 1 diabetes in humans.(28)

The findings of this study demonstrated that the flower of *Musa Paradisiaca* possesses significant antidiabetic properties. The experimental group treated with the banana flower extract showed a substantial reduction in blood glucose levels compared to the untreated diabetic control group. This reduction in blood glucose suggests that the extract may have a beneficial effect on enhancing glucose utilization or promoting insulin secretion.(29)

Moreover, the improvement in glycemic control was supported by the enhanced levels of insulin observed in the treated group. This indicates that the flower extract of Musa Paradisiaca may have a positive impact on pancreatic beta-cell function or insulin synthesis, which could be beneficial in managing diabetes mellitus.(30)

In addition to its antidiabetic effects, the flower extract reported to possess potential antioxidant properties, with a decrease in malondialdehyde (MDA) levels. Oxidative stress plays a crucial role in the pathogenesis of diabetes, and the ability of the banana flower extract to scavenge free radicals and reduce oxidative damage could contribute to its antidiabetic activity.(31)

Furthermore, the treated group showed a significant improvement in body weight compared to the untreated diabetic group. Diabetes is often associated with weight loss due to increased catabolism of fats and proteins. The improvement in body weight suggests that the banana flower extract may have a protective effect on tissue wasting, possibly by improving nutrient utilization.(32-65)

The safety profile of the banana flower extract was also assessed in the study, and no adverse effects or toxicity were observed at the doses administered. This is crucial information for considering the potential therapeutic application of the extract in diabetic patients.

Overall, the findings of this study support the traditional use of *Musa Paradisiaca* flowers in the management of diabetes mellitus. However, further investigations are warranted to elucidate the exact mechanisms of action responsible for its antidiabetic activity. Additionally, long-term studies on animal models and clinical trials on human subjects are necessary to establish its efficacy and safety in diabetic patients.

6.0 Conclusion

The present study provides promising evidence for the antidiabetic activity of *Musa Paradisiaca* flower extract in streptozotocin-induced diabetes mellitus. Its ability to lower blood glucose levels, enhance insulin secretion, and exhibit antioxidant properties makes it a potential candidate for the development of complementary and alternative medicine for diabetes management. Nonetheless, more comprehensive research is required to validate these findings and explore its potential as a therapeutic agent for diabetic patients.

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