The Journal of Phytopharmacology 2014; 3(2): 77-81
Online at: www.phytopharmajournal.com

Research Article

ISSN 2230-480X
JPHYTO 2014; 3(2): 77-81
March-April

Vijai Lakshmi
Department of Biochemistry, King George Medical University (KGMC), Lucknow 226003, India

S.K. Agarwal
Department of Biochemistry, King George Medical University (KGMC), Lucknow 226003, India

Jamal Akhtar Ansari
Department of Biochemistry, King George Medical University (KGMC), Lucknow 226003, India

Abbas Ali Mahdi
Department of Biochemistry, King George Medical University (KGMC), Lucknow 226003, India

Arvind Kumar Srivastava
Department of Biochemistry, CSIR-Central Drug Research Institute, Lucknow-226001, India

Correspondence:
Dr. Vijai Lakshmi
Department of Biochemistry, King George Medical University, Lucknow-226003, India
Tel: +91 0522 2254604
E-mail: vijlakshmius@yahoo.com

Antidiabetic potential of *Musa paradisiaca* in Streptozotocin- induced diabetic rats

Vijai Lakshmi, S.K. Agarwal, Jamal Akhtar Ansari, Abbas Ali Mahdi, Arvind Kumar Srivastava*

Abstract

Aim: Over the last few decades the role of medicinal plants as a primary tool in the preservation of health and management of diseases is realized with great concern. This is mainly due to the use of synthetic drug molecules that produce harmful side effects, which are comparatively minimal in drugs of plant origin. The Antidiabetic activity of the flowers has been reported in the literature, but not studied systematically all parts of the *M. paradisiacal* (Linn.). Therefore, we have selected this plant to study all other parts of this in detail for its antidiabetic potential. **Methods:** The ethanolic extracts of leaves, fruit peels, stems and roots were prepared at room temperature and the extracts showing antidiabetic activity were fractionated into 4 fractions by maceration method (hexane, chloroform, n-butanol solubles an n-butanol insoluble fractions). **Results:** The ethanolic extracts and the hexane and chloroform fractions of leaves and fruit peels showed promising antidiabetic activity in STZ-s model. Further the isolated compounds from the active fractions did not show the antidiabetic activity. **Conclusion:** Further work on active molecules from this plant is required to get a lead molecule for the development of a new and potent antidiabetic drug.

Keywords: *Musa paradisiacal*, Antidiabetic activity, STZ-s model..

Introduction

Over the last few decades the role of medicinal plants as a primary tool in the preservation of health and management of diseases is realized with great concern. This is mainly due to the use of synthetic drug molecules that produce harmful side effects, which are comparatively minimal in drugs of plant origin. Medicinal plants are commonly available in abundance, especially in the tropics. Plants are valuable for modern medicine in four basic ways, they are used as a source of direct therapeutic agents, serve as a raw material base for elaboration of more complex semi synthetic chemical compounds; the chemical structures derived from plant sources can be used as models for new synthetic compounds and finally plants can be used as taxonomic markers for the discovery of new compounds. Plants have contributed significantly to allopathic medicinal armory. Some of the drugs used today (e.g., aspirin, codeine, morphine, vinblastine, vincristine, pilocarpine, cocaine, atropine, emetine and ephedrine) have originated from medicinal plants.[1]

Musa paradisiaca (Linn) commonly known as Banana in English and Kela in Hindi languages belongs to the family Musaceae.[2] It is a perennial tree like herb grown indigenously in the tropics and subtropics. It is widely found throughout the Indian

subcontinent. It is cultivated in various parts of India for its consumable fruits (Fig.1). All parts of this plant have been traditionally used in India for several medicinal purposes. The stem juices of *M. paradisiaca* have been reported for dissolving preformed stones and in preventing the formation of stones in the urinary bladder of rats.[3, 4] The traditional use for the treatment of diarrhea, dysentery, intestinal lesions in ulcerative colitis, diabetes, spur, uremia, nephritis, gout, hypertension and cardiac disease has been reported in the literature.[5] Different chemical compounds have been isolated from various parts of the plant which include carbohydrates, Catecholamines such as norepinephrine, serotonin, dopamine, several flavonoids and related compounds (Leucocyanidin, quercetin and its 3-O-galactoside, 3-O-glucoside, and 3-O-rhamnosyl glucoside). Acyl steryl glycosides such as sitoindoside-I, sitoindoside-II, sitoindoside-III, sitoindoside-IV and steryl glycosides such as sitosterol gentiobioside, sitosterol myo-inosityl-β-D-glucoside has been isolated from fruits of M. paradisiacal.[5] Antidiabetic activity of the flowers has been reported in the literature[6] but not studied systematically all parts of the *M. paradisiacal*. Therefore, we have selected this plant to study all other parts of this in detail for its antidiabetic potential.

Musa paradisiaca plant

Leaves

Fruits

Fruit with peels

Figure 1: *Musa paradisiacal*

Materials and Methods

Collection of plant materials

Leaves, ripe fruits, roots and stems were collected from the campus of King George Medical University, Lucknow, India in the month of April. These were authenticated by the Botany Department of the Lucknow University, Lucknow, India.

Extraction and isolation methods

M. paradisiaca stems (1.0 kg. Fresh weight), leaves (1.0 kg. fresh weight) ripe fruit peels (1.0 kg. fresh weight) and roots (1.0 kg. fresh weight) were percolated in 95% ethanol at room temperature in glass percolators each separately. These were percolated four times each of these. The combined ethanolic extract was filtered separately and each were concentrated in a rotavapour below 50ºC in separate flasks to a green viscous mass, each were dried under high vacuum to remove last traces of the solvent. The ethanolic extracts thus obtained were evaluated for their antidiabetic activity in STZ-s model. The ethanolic extract of the leaves and fruit peels showed promising antidiabetic activity in STZ model. The ethanolic extracts of the leaves and fruit peels were fractionated in four different fractions by macerating with hexane, chloroform, n-butanol successively. Thus the four fractions hexane, chloroform, n-butanol soluble and n-butanol soluble were obtained which were evaluated for antidiabetic activity in STZ model. The activity was located in the hexane and chloroform fractions of the leaves and fruit peels. The thin layer chromatography showed identical spots in both the fractions as well as both parts of the plant. Therefore, both hexane and chloroform fractions were mixed and chromatographed over a column of silica gel and by repeated chromatography sitosterol, sitoindoside-I, sitoindoside-II and sitoindoside-III was purified and characterized. All these compounds were found inactive in the antidiabetic STZ model.

Experimental Animals

Male albino rats of Sprague Dawley strain (8 to 10 weeks of age: body weight 120 ± 20 g) was procured from the animal colony of Central Drug Research Institute, Lucknow, India. Breeding colonies of animals were maintained under SPF (specific pathogen free) environment in standard housing conditions. Research on animals was conducted in accordance with the guidelines of the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) formed by the Government of India. The CPCSEA with the registration number 34/99/ CPCSEA approved on 11th March 1999 and renewed up to 2014.

Chemical

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

STZ-s procedure

Omeprazole and other chemicals were obtained from M/s. Sigma Chemicals, St Louis, MO, USA.

Male albino rats of Sprague Dawley strain of the body weight 160±20 g. were selected for this study. Animals, 3/ cage was kept for 7 days under standard experimental conditions before the experiment. Animals were given standard rat-pellet diet and tap water ad libitum. Day 'O'- Day before the experiment, animals were kept for overnight starvation. Day '1': STZ Streptozotocin (Sigma, USA) was dissolved in 100 mM citrate buffer pH 4.5 and the calculated amount of the fresh solution was injected into overnight fasted rats (45 mg/kg.) intraperitonially. Day '2': Rats remained as such in the same conditions. Food pellets were removed on the penultimate day at 5:00 P.M. in the evening and animals were kept on over night starvation. Day '3': Blood-glucose level was estimated between 9:30-10:00 A.M. in all animals. Blood was taken from the tail of the rats by stab techniques and the glucose level was estimated using "Advantage Glucometer" of Boehringer Mannheim Co, USA. Blood was checked 48 hours later by glucostrips and animals showing blood glucose values between 160 to 270 mg./dl. (8 to 15 mM) were included in the experiments and termed diabetic. The diabetic animals were divided into groups consisting of 5 to 6 animals in each group. Rats of the experimental groups were administered suspension of the desired test samples orally (made in 1.0% gum acacia) at 500 mg/kg body weight in the case of the ethanol extract and at 250 mg/kg. in case of the hexane and chloroform fractions. In the case of the pure compound and standard drug Metformin, the dose was taken at 100 mg/kg. The animals of the control group were given an equal amount of 1.0% gum acacia. A sucrose load of the 2.5 g/kg of the body weight was given after 30 minutes of the drug administration. After 30 minutes of the post sucrose load

blood glucose level was again checked by glucostrips at 30, 60, 90, 120, 180, 240,300 minutes and 24 hours respectively. The animals not found diabetic after 24 hours, post treatment of the test samples were not considered and omitted from the calculations and termed as non responders. The animals which did not show any fall in blood glucose profile in a group while the others in that group showed falls in the blood glucose profile were also considered as non responders. The food, but not the water was withheld from the cages during the experimentation. Comparing the AUC of experimental and control groups determined the percent of antidiabetic activity. Statistical comparison between groups was made by the Student's "t" test.

Results and Discussion

Streptozotocin-induced experimental diabetes is a valuable model for induction of type-I diabetes.[7]

Table 1: Antidiabetic effect of *M. paradisiacal* extract and fractions of the fresh leaves standard drug metformin on sucrose challenged streptozotocin-induced diabetic rats

S. No	Compounds	Dose mg/kg.	% Activity in sucrose challenged STZ induced diabetic rats model
1	EtOH ext.	500	20.5**
2	Hexane fr.	100	26.2**
3	Chloroform fr.	100	28.4**
4	n-butanol soluble fr.	100	12.2
5.	n-butanol insoluble fr.	100	6.2
6.	Metformin (Standard drug)	100	26.4 – 35.8**

*Statistically significant at *P<0.05 and **P< 0.01 in comparison to control. n = 6 in each group

Table-1 represents the antidiabetic activity profile ethanol extract, hexane, chloroform, n-butanol soluble and n-butanol insoluble fractions, of the fresh leaves with the standard drug metformin respectively in sucrose challenged Streptozotocin induced diabetic rats.

Table 2: Antidiabetic effect of *M. paradisiacal* extract and fractions of the fresh stems standard drug metformin on sucrose challenged streptozotocin-induced diabetic rats

S. No	Compounds	Dose mg/kg.	% Activity in sucrose challenged STZ induced diabetic rats model
1	EtOH ext.	500	10.5
2	Hexane fr.	100	10.2
3	Chloroform fr.	100	8.6
4	n-butanol soluble fr.	100	5.2
5.	n-butanol insoluble fr.	100	7.2
6.	Metformin (Standard drug)	100	26.4 – 35.8**

*Statistically significant at *P<0.05 and **P< 0.01 in comparison to control. n = 6 in each group

Table-2 represents the antidiabetic activity profile ethanol extract, hexane, chloroform, n-butanol soluble and n-butanol insoluble fractions, of the fresh stems with the standard drug metformin respectively in sucrose challenged Streptozotocin induced diabetic rats.

Table 3: Antidiabetic effect of *M. paradisiacal* extract and fractions of the fresh ripe fruit's peels standard drug metformin on sucrose challenged streptozotocin-induced diabetic rats

S. No	Compounds	Dose mg/kg.	% Activity in sucrose challenged STZ induced diabetic rats model
1	EtOH ext.	500	25.5**
2	Hexane fr.	100	20.2**
3	Chloroform fr.	100	28.6**
4	n-butanol soluble fr.	100	4.2
5.	n-butanol insoluble fr.	100	6.2
6.	Metformin (Standard drug)	100	26.4 – 35.8**

*Statistically significant at *P<0.05 and **P< 0.01 in comparison to control. n = 6 in each group

Table-3 represents the antidiabetic activity profile ethanol extract, hexane, chloroform, n-butanol soluble and n-butanol insoluble fractions, of the fresh ripe fruit peels with the standard drug metformin respectively in sucrose challenged Streptozotocin induced diabetic rats.

Table 4: Antidiabetic effect of *M. paradisiacal* extract and fractions of the fresh roots standard drug metformin on sucrose challenged streptozotocin-induced diabetic rats

S. No	Compounds	Dose mg/kg.	% Activity in sucrose challenged STZ induced diabetic rats model
1	EtOH ext.	500	14.5
2	Hexane fr.	100	11.7
3	Chloroform fr.	100 250	18.6* 16.2
4	n-butanol soluble fr.	100	6.2
5.	n-butanol insoluble fr.	100	9.2
6.	Metformin (Standard drug)	100	26.4 – 35.8**

*Statistically significant at *P<0.05 and **P< 0.01 in comparison to control. n = 6 in each group

Table-4 represents the antidiabetic activity profile ethanol extract, hexane, chloroform, n-butanol soluble and n-butanol insoluble fractions, of the fresh roots with the standard drug metformin respectively in sucrose challenged Streptozotocin induced diabetic rats.

In our study of the antidiabetic potential of the different parts of *M. Paradisaical*, only leaves and ripe fruit peels showed promising antidiabetic effect. The ethanolic extract of the leaves and peels showed % lowering in blood sugar level 20.5 and 25.5 at 500 mg/kg. Body weight, respectively in Streptozotocin induced diabetic rats. On further fraction of the ethanolic extract, the activity was localized only in hexane and chloroform fractions (% lowering in blood sugar level 26.2, 28.4 in the case of leaves at 100 mg/kg. Body weight and % lowering in blood sugar level 20.2, 28.6 at 100 mg/kg. Body weight in case of fruits peels). Few compounds isolated from these fractions did not show the antidiabetic effect at 100 mg/kg. body weight in the same model.

These results are in accordance with the published reports.[8-10] Further work on the isolation and characterization of pure molecules is in progress and will be reported in our next communication.

Conclusion

Our study demonstrated that leaves and fruit peels are responsible for antidiabetic potential of the plant. Further work on active molecules from this plant is required to get a lead molecule for the development of a new and potent antidiabetic drug.

Conflict of Interest

None declared.

Acknowledgement

The authors are grateful to the Head, HRDG, CSIR, Government of India, New Delhi for providing financial support as an emeritus scientistship to Dr. Vijai Lakshmi.

References

1. Natesh S, Mohan Ram HY, An update of green medicine. J Ind.Bo.t Soc, 1999;78: 13-23.

2. Randy C. Ploetz, Angela Kay Kepler, Jeff Daniells, and Scot C. Nelson; Banana and plantain—an overview with emphasis on Pacific island cultivars-Musaceae (banana family); Species Profiles for Pacific Island Agro forestry; Ver. 1, Feb 2007:1-27.

3. Kailash P, Bharathi K, Srinivasan K, Evaluation of *Musa paradisiaca* Linn. Cultivar "Puttubale'' stem juice for antilithiatic activity in albino rats. Ind.J. Physiol.harmacol. 1993; 37: 337-41.

4. Kailash P, Varalakshmi P, Effect of banana stem juice on biochemical change in liver of normal and hyperoxaluric rats. Indian J. Exp. Biol. 1992; 30: 440-442.

5. Mohammad Zafar Imam and Saleha Akter; Musa paradisiaca L. and *Musa sapientum* L.: A Phytochemical and Pharmacological Review; J. Appl. Pharmaceut. Sci, 2011; 01 (05):14-20.

6. Pari L, Umamaheswari J.Antihyperglycaemic activity of *Musa sapientum* flowers: effect on lipid peroxidation in alloxan diabetic rats., Phytother. Res. , 2000; 14(2):136-138.

7. Junod A, Lambert A E, Stauffacher W and Renold AE. Diabetogenic action of streptozotocin. Relationship of dose to metabolic response. J. Clin. Invest. 1969; 48: 2129-2139.

8. Ojewole JA, Adewunmi CO, Hypoglycemic effect of methanolic extract of *Musa paradisiaca* (Musaceae) green fruits in normal and diabetic mice, Methods Find Exp Clin Pharmacol. 2003; 25(6):453-6.

9. Shanmuga Sundaram C, Subramanian S, Biochemical Evaluation of Hypoglycemic Activity of *Musa paradisiaca* (Plantain) Flowers in STZ Induced Experimental Diabetes in Rats,Asian J. Res. in Chem. 2011; 4: 827-833.

10. Virginia DK, Luisa HC, Danielle FP, Bárbara GP, Fernanda AM, Ziliani the SB, Flávio HR, Fátima RMBS, Beneficial effects of banana leaves (Musa x paradisiaca) on glucose homeostasis: multiple sites of action, Rev. bras. Farmacogn. 2013; 23 (4): 706-715.