Hypoglycemic Potential of Banana Leaves (*Musa paradisiaca*) in Albino Rats

Maria Patricia Silvestre
San Beda College, Manila, Philippines
Email: mapie_13@yahoo.com

Liwayway H. Acero
Department of Natural Sciences, San Beda College, Manila, Philippines
Email: lilyacero1@yahoo.com

***Abstract*—Banana is one of the staple fruit in the Philippines. It is a part of the major diet among Filipinos. It is grown principally for its fruit. However, the leaves are often used in the Philippines as wrapper for packed food. The medicinal use of the leaves was still unknown to many Filipinos, thus this study focuses on the potential of banana leaves in lowering blood sugar. Banana leaves were dried and turned into powder form in Albino rats. Twelve Albino rats served as experimental animals. They are randomly assigned in two groups. The first group, or treatment 1, (6 animals) as the control wherein they only fed with rat pellets and drinking water. The second group-treatment 2 served as the experimental animals where banana leaves solution was administered orally for the entire duration of the study. Initial fasting blood sugar of both treatments showed no significant result. Fasting blood sugar after three and four days of administration of the solution showed significant result. The result revealed that banana leaves has the potential for lowering blood glucose in Albino Rats. This implies that banana leaves can be used as herbal medicine to lower blood glucose.**

***Index Terms*—*musa, paradisiaca,* hypoglycemic potential, banana**

I. Introduction

Musa paradisiaca is an herbaceous flowering plant to the family Musaceae. It is a hybrid between *Musa acuminata* and *Musa balbisiana* belonging to the genus Musa, mainly grown in the tropical and subtropical countries like the Philippines and is widely used all over the world for folkloric, edibility, clothing and medicinal purposes as well as for its nutritional values. Traditional medicines in India and South-western Nigeria have been using bananas for diabetes [1]. Studies have shown that type 1 diabetics who consume high-fiber diets have lower blood glucose levels and type 2 diabetics may have improved blood sugar, lipids and insulin levels. One medium banana provides about 3 grams of fiber. The Dietary Guidelines for Americans recommends 21-25g/day for women and 30-38g/day for men [2].

Manuscript received November 25, 2015; revised February 18, 2016.

Banana is the common name for herbaceous plants of the genus Musa and for the fruit they produce. It is one of the oldest cultivated plants. All parts of the banana plant have medicinal applications: the flowers in bronchitis and dysentery and on ulcers. Cooked flowers are given to diabetics. The astringent plant sap in cases of hysteria, epilepsy, leprosy, fevers, haemorrhages, acute dysentery and diarrhea and it is applied on hemorrhoids, insect and other stings and bites. Young leaves are placed as poultices on burns and other skin afflictions. The astringent ashes of the unripe peel and of the leaves are taken in dysentery and diarrhea and used for treating malignant ulcers. The roots can be administered in digestive disorders, dysentery and other ailments. Banana seed mucilage is given in cases of diarrhea in India. Antifungal and antibiotic principles are found in the peel and pulp of fully ripe bananas. The antibiotic acts against Mycobacteria [3].

The role of medicinal plants in treatment and cure of disease has been given much attention over the last few decades. With diabetes mellitus, anti-diabetic properties of natural products such as plant extracts have been reported in researches. However, the said research failed to study all parts systematically for their anti-diabetic potential. In the Philippines, banana fruit is a common staple food. The leaves are used as packaging material for packed lunch and food, wrapped sweetened sticky rice due to the aromatic flavor it adds on the food. No study had been conducted in determining the hypoglycemic potential of banana leaves in Albino rats in Philippine setting, thus this study.

A. Objectives of the Study

This study determines the hypoglycemic potential of the leaves of *Musa paradisiaca*, in terms of Fasting Blood Sugar level (FBS) of the control and experimental groups before and after the experimentation period.

II. Materials and Methods

A. Materials

In the preparation of banana leaves the following materials were used; air-tight containers, blender, fresh *Musa paradisiaca* leaves, and sieve.

doi: 10.18178/ijfe.2.1.71-74

The experimental animals includes; twelve (12) young male albino rats weighing between one hundred fifty to two hundred grams (150-200g), confined in rat cages and fed with rat feed.

To monitor the fasting blood sugar of the animals, materials used were; disposable test strips, glucose meter, lancet, surgical masks, surgical gloves, syringe, scalpel blade and thin cloth.

B. Methods

1) Acclimatization of animals

Experimental animals were twelve (12) healthy young male albino male rats, weighing between one hundred fifty to two hundred grams (150-200g). These rats were randomly housed in groups of two animals each, in standard cages for an acclimatization period of seven (7) days or one (1) week before the commencement of experiment. During this period the animals had free access to standard pellet diet and water *ad libitum* in an ambient temperature of (24±2 ℃); a standard laboratory condition.

2) Experimental layout

The experimental groupings were treatments 1 and 2. Treatment 1 was the control group while treatment 2 was subjected to extract administration. Animals were caged according the layout shown in Table I.

TABLE I. EXPERIMENTAL LAYOUT

T1 (Control Group)	T2 (Experimental Group)
T1S1	T2S1
T1S2	T2S2
T1S3	T2S3
T1S4	T2S4
T1S5	T2S5
T1S6	T2S6

3) Preparation of Musa paradisiaca leaf solution

Musa paradisiaca leaves were obtained from the province of Rizal, region of Antipolo district, Metro Manila, Philippines. The leaves were shade dried and torn into smaller pieces before it was crushed through a kitchen blender. After which, leaves were sieved for a finer powder form. The solution was prepared by mixing leaf powder form (120 grams) mixed with 20% Splenda solution (20 grams of Splenda dissolved in 100ml of water through a 250ml beaker). Splenda is an artificial sweetener used to enhance taste of the solution. People rarely consume a sweetener by itself. They use it in their coffee or on breakfast cereal or when they want to sweeten some other food they are eating or drinking [4]. The powder was only mixed with Splenda on days of administration to keep the solution fresh.

4) Administration of leaf extract through syringe-feeding method

The animals were subjected to fasting overnight before blood sugar levels were taken. The diet of the animals was a standard pellet diet of rat feeds and water *ad libitum*. The banana leaves in solution form were administered daily and orally through syringe-feeding method.

5) Collection of blood sample

An incision using a scalpel blade on its tail vein was made for the determination of glucose level. Afterwards, the second drop of blood was placed on the glucose strip and was analyzed using the glucose meter (Fig. 1a and Fig. 1b).

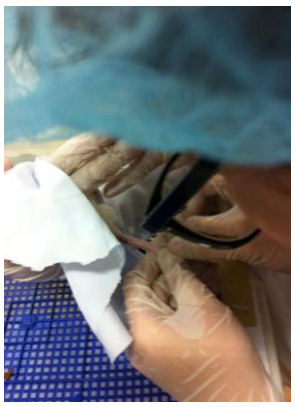

Figure 1a. Incision of the tail vein

Figure 1b. Blood sample was analyzed in glucose meter

The normal blood glucose level of a rat is one hundred milligrams per deciliter (100mg/dL; between 60-130). On the other hand, directly after a meal, blood glucose level may spike up higher, but it should go back to normal range of a rat's blood glucose level, which is between sixty to thirty milligrams per deciliter (60-30mg/dL) [5].

6) Data gathered and statistical analysis

Fasting blood sugar level before and after administration of leaf extract was recorded. The data gathered was statistically evaluated through standard T-test. A statistical analysis was performed using Microsoft Excel, version 2013. A significant difference was achieved when the value of t-statistics is greater than t-critical value.

III. RESULTS AND DISCUSSION

A. Initial Fasting Blood Glucose Levels of the Experimental Animals

Table II shows the initial blood glucose content of the experimental animals. The control group (treatment 1)

had a mean glucose level of 93.8mg/dL. The experimental treatment (treatment 2) had 90.3mg/dL. T-test showed no significant difference on the glucose level of the experimental animals, which further shows that all experimental animals were treated equal on the start of the study.

TABLE II. INITIAL GLUCOSE LEVELS OF THE EXPERIMENTAL ANIMALS (MG/DL)

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Total	Mean	T-test
Treatment 1 - control	92	97	85	94	98	97	563	93.8	N.S. Tstat (1.13) < T.crit (2.57)
Treatment 2 - with leaf extract	92	85	88	97	84	96	542	90.3	

B. Fasting Blood Glucose Levels after Three Days of Administration

Table III shows the glucose content of the experimental animals after three days of administration. Treatment 1 (control group) had a mean glucose level of 92.8 mg/dL. The experimental treatment (treatment 2) had 77.3 mg/dL. T-test showed significant difference on the glucose level of the experimental animals, which further shows that banana leaf extract reduced the glucose content after three days of administration. The result can be supported by the study on Comparative evaluation of the antidiabetic and hyploglycaemic potentials of the parts of *Musa paradisiacal.* The two most important intestinal enzymes that regulate blood sugar level are α-amylase and α-glucosidase. Both are involved in breaking down complex carbohydrates such as starch and glycogen [6].

C. Final Fasting Glucose Content of the Experimental Animals

Table IV shows the final glucose content of the experimental animals. Control group (treatment 1) had a mean glucose level of 92.3mg/dL. The experimental treatment (treatment 2) had 73.7 mg/dL. T-test showed significant difference on the glucose level of the experimental animals, which further shows that the leaf solution reduced the glucose content after four days o f administration. Jain's (1968) study found the following; the flowers and the roots of *Musa sapientum* showed hemoglobin effect on normal fasting rabbits and the chloroform extract of its flowers showed a final reduction in blood glucose, glycosylated haemoglobin and an increase in total haemoglobin [7]. A study on Evaluation of the antidiabetic and hypoglycemic Potentials of the parts of *Musa paradisiaca* plant extracts shows that the plant is antidiabetic by being hypoglycemic. The percentage of α-amylase and α-glucosidase inhibitory activities of the extracts from the plant's different parts such as stem. Phytochemical analysis of *Musa paradisiaca* demonstrated the presence of rutin in crude extract and fractions of *M. x paradisiaca* leaves as the major compound. These beneficial effects on the regulation of glucose homeostasis observed for *M. x paradisiaca* leaves and the presence of rutin as the major compound indicate potential anti-diabetic properties, since previous studies have been reported that rutin can modulate glucose homeostasis [8].

TABLE III. FASTING BLOOD GLUCOSE LEVELS AFTER THREE DAYS (MG/DL)

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Total	Mean	T-test
Treatment Group 1 (control)	93	94	85	91	96	98	557	92.8	Significant. Tstat (19.5) > T.crit (2.57)
Treatment 2- with leaf extract	81	74	76	82	73	78	464	77.3	

TABLE IV. FINAL BLOOD GLUCOSE LEVELS (MG/DL)

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Total	Mean	T-test
Treatment 1 (control)	95	89	87	93	94	98	556	92.3	Significant T-stat (6.1) > T.crit (2.57)
Treatment 2 (with leaf extract)	78	72	68	75	73	73	439	73.7	

IV. CONCLUSION AND RECOMMENDATION

Based on the results and findings on this study *Musa paradisiaca* leaves has hypoglycemic action in normal rats and the effect was found significant four days after the first administration. With its hypoglycemic findings comes a potential antidiabetic effect.

Further studies should be explored on the possibilities of using other means in decreasing blood sugar level through banana leaf extract in different concentrations and different types of administration.

ACKNOWLEDGMENT

The authors acknowledge their invaluable administrators, professors from San Beda College, College of Arts and Sciences. Dr. Tessie R. da Jose-Dean,, Dr. Christian Bryan Bustamante-Vice Dean and Dr. Fedeliz S. Tuy-Associate-Vice Dean, for their constant

encouragement. From the College of Medicine, Dr. Pacifico Calderon for the guidance on the use of Animal House. Other mentor, Dr. Eduardo Lorico, for his expertise, closed supervision and assistance in handling the laboratory animals in monitoring the animals' blood glucose.

REFERENCES

[1] N. Sharma, *et al.*, "Optimization of fermentation parameters for production of ethanol from kinnow waste and banana peels by simultaneous saccharification and fermentation," *Indian Journal of Microbiology*, vol. 47, no. 4, pp. 310-316, December 2007.
[2] M. Ware. (2012). Bananas: Health benefits, risks and nutritional facts. [Online]. 1(1). p. 1. Available: http://www.medicalnewstoday.com/articles/271157.php
[3] K. P. S. Kumar, *et al.*, "Traditional and medicinal uses of banana," *Journal of Pharmacognosy and Phytochemistry*, vol. 1, no. 3, p. 1, 2012.
[4] M. Y. Pepino, *et al.*, "Sucralose affects glycemic and hormonal responses to an oral glucose load," *Diabetes Care*, vol. 36, no. 9, pp. 2530-2535, September 2013.
[5] E. D. Braslasu, *et al*. (2007). Normal blood glucose in white Wistar rats and its changes following anesthesia. [Online]. 15(1). p. 1. Available: http://www.usab-tm.ro/vol7MV/23_vol7.pdf
[6] R. Jayarama and J. Hemachandran, "Comparative evaluation of the antidiabetic and hyploglycaemic potentials of the parts *Musa paradisiaca* plant extracts," *International Journal of Scientific and Research Publication*, vol. 4, no. 4, p. 1, April 2014.
[7] D. L. Jain, *et al.*, "Study of antacid and diuretic activity of ash and extracts of *Musa sapientum*," *International Journal of Research in Pharmaceutical and Biomedical Science*, vol. 3, no. 10, pp. 116-119, 2007.
[8] V. D. Kappel, *et al.*, "Beneficial effects of banana leaves (*Musa x paradisiacal*) on glucose homeostasis: Multiple sites of action," *Revista Brasileira de Farcognosia*, vol. 23, no. 4, p. 1, August 2013.

Maria Patricia Silvestre is an undergraduate BS Human Biology student from San Beda College, Manila, Philippines.

Liwayway H. Acero is a member of Asia Pacific Chemistry, Biology, Environment, Engineering Society, editorial member for Global Science and Technology Forum. Educational background: Doctor of Education major in Educational Management from Palawan State University on March 2003. She conducted her dissertation as a research student at Okayama University Graduate School Education in Japan on March to June 2000. She got her diploma in science teaching -major in biology in 2009 from the University of the Philippines-Open University in Los Banos Laguna. She received her Master of Science degree in agricultural education major in agricultural education minor in Plant Science (Agronomy) from the Western Philippines University in Aborlan, Palawan, Philippines on April 1993. She got her Bachelor of Science degree in Agriculture (*cum laude*), major in Animal science and minor in Plant Science (agronomy) from the Western Philippines University in Aborlan, Palawan Philippines on April 1986.
She is an associate professor and the chairperson of the Department of Natural Sciences, College of Arts & Science in San Beda College, Mendiola, Manila, Philippines. Prior to her employment in San Beda College in Manila, she had served as professor for 20 years in Western Philippines University in Puerto Princesa City, Palawan, Philippines. She handled several administrative works aside from teaching profession. She served as assistant dean of Western Philippines University, Puerto-Princesa Campus, and Director for Instruction, Department Chairperson of the Education Department chairperson of the Agribusiness Department & chairperson for the thesis committee. She had 11 publications. Nine of which are international publications.