COMPARATIVE ANTIDIABETIC POTENCIES OF CRUDE EXTRACTS FROM LEAVES OF KANGKONG (*Ipomoea aquatica*), MAKOPA (*Syzigium malaccense*), AND MANGO (*Mangifera indica*) ON WHITE MICE

A Research Paper Presented

To the Faculty of

Philippine Science High School- Western Visayas

In partial fulfillment of the requirements

In Science Research II

Researchers:

Alubog Kristina J.

Montaño, Archi Mae P.

Pedrosa, Kristin Mae E.

Rafols, Czarmagne G.

Abstract

The antidiabetic potencies of different medicinal plants (*Mangifera indica, Syzygium malaccence, Ipomoea aquatica)* were investigated and was compared to the hypoglycemic drugs in this study.

The plants were osteorized at a one gram of plants to 3 milliliter of water proportion. The blood glucose levels of the mice were gathered and then it was starved with constant supply of sugar solution at 50% concentration. The glucose level after sugar intake were then determined The mice were forced to take the treatment and its blood glucose were extracted for 2 consecutive 6 hours interval.

The five by three analysis of variance proved that there is no significant difference on the effects of mango and kangkong leaf extracts with the hypoglycemic drugs. On the other hand,the effect of makopa leaf extract differed significantly.

LIST OF TABLES

LIST OF APPENDICES

Acknowledgements

We would like to extend our heartfelt gratitude to all the people who had been with us all along the way to make this project possible. First, we would like to thank the Almighty Heavenly Father for giving us the wisdom and preseverance that have helped us endure the whole tedious process of this study. To Mrs. Josette T. Biyo, our Science Research II adviser, who through her constant reminders and guidance, have prodded us to finish this project and for continually believing in our capabilities in doing this project. To Mr. Marvin Cadornigara, our Science Research I adviser, for teaching us the basics and giving us an overview of a research study which had really helped us in the study proper. We would also like to thank our panelist, Ms. Lea Salinel, Mrs. Virna Jane Navarro, and Ms. Rowena Magno, who had been there to help us in our project and to Mrs. Rose Espinosa who had been with us during the absence of Mrs. Biyo.

To our dear parents who never fail to support us financially and emotionally.

We would also like to thank the Rafols family for their warm accommodation as we stayed in their house to

make this study last October 27-29, 2000. To Atty. Rafols for giving us some of his hypoglycemic drugs. To the man in the bus (going to Antique) for helping us catch the white mice that had escaped from the cage. To Nong Augusto Granada for gathering the plant leaves for us.

To Ramon Maza Hospital for donating some of the haemoglucotest strips, injections, syringe, gloves... To Mrs. Maribel RAfols for facilitating our request. To the Medicus in Jaro, Iloilo for analyzing the blood samples of mice for us.

To our school, PSHS, for supporting us in this project, specifically, allowing us to put our mice in the Biology laboratory and for providing us with the equipment and apparatus needed in this study. To Mr. Eduardo Ongcol, who agreed to help us in the distillation process of the plant samples.

To the Photon people for helping us take care of the mice- feeding it sometimes, for sharing some of their pellets so us to feed the mice, and helping us catch the mice that have escaped. To Mark Glenn Melivo for accompanying us feed the mice during night and for assisting us ones in a while. To Manong guards for assisting us transfer the mice to the other cage.

And lastly we would like to thank our inspirations (meloy,U.F.O.,mooch,ninoy,pido,dhart,biloy,kuloy,agaton,kaiser,lowell,andre,nikoy,georgepontigon,redguy,gio,yuan,jb..) for inspiring us to move on with this project. And to those we fail to mention...thanks.

We love you guys!!!

TABLE OF CONTENTS

Chapter 1

Introduction to the Study

A. Background of the Study

Lots of people suffer from diabetes. In fact, it is one of the top ten diseases in the Philippines. Diabetes mellitus is a disorder of glucose metabolism that results from the inadequate secretion of insulin from the pancreas (Wegman, 1995). Because of this, the level of glucose in the blood remains high due to the condition that glucose cannot enter the cells (Wegman, 1995). Diabetes is a major risk factor for stroke and is now recognized as a major risk factors for coronary heart diseases, which leads to heart attack. Insulin, tolbutamide, and glyburide are drugs commonly used to control the blood glucose levels (New Standard Encyclopedia, 1989).

Diabetes in animals results when glucose transport channels on cell membrane are insensitive to effects of insulin (or when there is too few channels) or the quantity of insulin produced by the pancreas is inadequate to activate the number of glucose channels needed to maintain normal cellular metabolism (http:/ www.vetmed.auburn. edu/sac/mededu/diabetes/intro.html).

Since the country is under economic crisis, the researcher want to study and compare the different cures for diabetes from extracts of some of the local plants which are of abundant supply in the country. The crude extracts from popular, abundant and relatively cheap sources such as leaves of kangkong(*Ipomoea aquatica*), makopa (*Syzygium malaccence*), and mango(*Mangifera indica*) were tested for their antidiabetic potencies using white mice as test sample.

B. Statement of the Problem and Hypothesis

This study is focused on the antidiabetic potencies of the crude extracts from the leaves of kangkong, makopa, and mango on blood glucose level of white mice. It determined the significant differences in the antidiabetic potencies between crude extracts of some medicinal plants and hypoglycemic drugs.

It is hypothesized that there are no significant differences in the antidiabetic potencies of the (1) crude extracts of local plants and the (2) crude extracts with hypoglycemic drugs on white mice.

C. Objectives of the Study

This study was conducted to:

1. establish the antidiabetic potencies of the different plant extracts and hypoglycemic drugs on white mice.
2. determine the significant differences in the antidiabetic potencies between the given test plants and the hypoglycemic drugs; and
3. perform a fast screening bioassay using haemoglucotest strips on the glucose level of white mice.

D. Significance of the Study

The discovery of the effectiveness of the extracts from medicinal plants in curing diabetes mellitus may provide an alternative to the expensive hypoglycemic drugs.

The medicinal plants to be used in this study are often rejected by the people and are abundant here in the Philippines. Thus, this study would be significant to those people especially the less fortunate ones who are suffering from diabetes mellitus.

This study would be very significant if proven that the extracts from certain Philippine medicinal plants are as effective as the hypoglycemic drugs.

E. Scope and Limitation

This study used white mice as the test organism. It involves three mice for every plant sample treatment, which was purchased at the sidewalk near the Iloilo Supermart at P 20 each.

Leaves of makopa, kangkong and mango are to be tested in this experiment. They were gathered from the vicinity of Sibalom, Antique.

The hypoglycemic drugs (neuglucon) by which the plants' crude extracts be compared were donated by Atty. Felimon Rafols.

In analyzing the blood glucose level of the white mice, the researchers need the haemoglucotest strips which was availed by the donation of Ramon Maza Hospital and some were purchased at EVZ drugstore in Lapaz, Iloilo City.

Ramon Maze Hospital also gave injections, gloves and syringe to us.

With all the materials needed available and the cooperation of the four researchers, they were able to conduct and finish their study. The researchers conducted their study at Sibalom, Antique.

Results were obtained and were analyzed statistically by the SPSS. This allowed the researchers determine the significant differences among the plant samples' effectivity.

F. Definition of Terms

Diabetes mellitus- disease in which the body is unable to use properly the sugar absorbed by the digestive system (The New Complete Medicinal and Health Encyclopedia, 1995)

Medicinal Plants- plants that can be commonly seen in our environment which has curative values (Philippine Medicinal Plants, 1993) Operationally, medicinal plants are those plants which the researchers find to be useful in curing diabetes.

Mango (*Mangifera indica)*- a large tree, the crown dense spreading. Leaves are oblong to oblong-lanceolate and is common through out the Philippines.

Kangkong (*Ipomoea aquatica)*- an annual, glaborous, widely spreading vine; the stem is trailing inward or floating on stagnant pools, often thickened.A teaplant used to determine the effectiveness in curing diabetes.

Makopa (Syzygium malaccence)- cultivated in most parts of the Philippines for its edile fruit.

Antidiabetic potencies- in this study, antidiabetic potencies refer to the capability of the medicinal plants to lowre down the high glucose level of white mice.

Glucose- a sugar found normally in the blood (The New Complete Medical and Health Encyclopedia, 1995). Operationally, too much of it would would indicate that blood from the samples has the greater tendency to acquire diabetes.

Dose-response relationship- in this study, it means that for every particular dose of plant extracts, there is a corresponding response on the blood glucose level.

Insulin- an enzyme secreted by cells in the pancreas that regulates the transfer of glucose from the blood to the fat muscle and liver tissues.

Hypoglycemic drugs- drugs used to lower down the blood glucose level. In this study hypoglycemic drugs are used as one of the treatment and the its potency in lower5ing the blood glucose of white mice were compared to the lowering potencies of the medicinal plants.

Chapter 2

Review of Related Literature

A. Diabetes Mellitus

Diabetes Mellitus is a disease in which the body is unable to use properly the sugar absorbed by the digestive system. It is characterized by an imbalance in the production of insulin, the hormone that regulates the transfer of glucose(sugar) from the blood to the fat, muscle, and liver tissues were it is stored. Insulin is secreted by the cells in special areas of pancreas called the islets of Langerhans (New Standard Encyclopedia, 1994).

Diabetes is marked by a high concentration of sugar in the blood. When such a concentration occurs, the kidneys flush the excess sugar and water in the form of urine causes two of the common symptoms of diabetes, excessive thirst and hunger(New Standard Encyclopedia, 1994).

Diabetes has been for several thousand years. Late in the nineteenth century, when diabetes was well

recognized as an abnormality in carbohydrate metabolism, several scientists discovered the experimental removal of a certain cells, the islets of Langerhans, from the pancreas, produced diabetes in dogs. This observation led to the 1921 discovery of isolation of naturally produced insulin. Injection of insulin into the bodies of people with diabetes proved to be the first and, to this day, the most effective means of treating the disease (The New Complete Medical and Health Encyclopedia, 1995).

Diabetes has a long-term side effects which are caused by the sugar crystals passing to the small tubes of the circulatory system. If the sugar crystals are larger than the tubes, as in the case with the capillaries, then the tubes are scratched, torn or destroyed by the sugar. This damage can cause plague to build up on the inside of the arteries, leading to atherosclerosis and heart disease. It can cause scarring and hemorrhaging in the kidneys, leading to kidney failure and kidney diseases. It can cause reduction of blood flow to the hands and feet because of the tears in the capillaries that provide blood to the extremities. It makes the healing take longer, and infections become more

likely. The diabetic is at risk of losing arms and legs because of the eventual decrease of blood flow to the limbs (The New Complete Medical and Health Encyclopedia, 1995).

Diabetes is a chronic metabolic disorder that causes persistent thirst, excessive urination, weight loss, and surplus of sugar in the blood and urine. Diabetes afflicts about four million people in the United States, with at least one third of them undiagnosed at any given time. Although diabetes can develop at any age, susceptibility rapidly increases after the age of forty when it is more common among women than among men, with the excessive overweight a contributing factor in later life (Medical and Health Encyclopedia, 1977).

Diabetes has been recognized as a disease since ancient times. The Greeks-observing that its victims urinated more often and copiously than was normal- gave the disorder its present name, which means "to run through" in Greek. In the seventeenth Century the word mellitus(meaning sweet) was added as an official

designation to distinguish the disease from a totally different one known as diabetes incipidus- associated with a malfunctioning of the pituitary gland (Medical and Health Encyclopedia, 1977).

An insufficiency of insulin in production by the pancreas from the metabolizing of food sugars and starches produces the diabetic condition. In the normal digestive process these food sugar and starches (carbohydrates) are changed into the sugar glucose. This is stored in the form of glycogen (animal starch) in the liver and muscle for later use as body fuel, at which time it is reconverted into glucose. For both the storage and reconversion of glucose, insulin is the essential hormone. The metabolic failure characteristic of diabetes may occur because of a faulty chemical reaction, or a combination of both. The result of the disturbed metabolism of glucose causes an abnormal accumulation of sugar in the blood stream (Medical and Health Encyclopedia, 1977).

Although it had long been known that diabetics were suffering from a defect in carbohydrate metabolism, the

basic reason for the disorder was discovered only in the nineteenth century. At that time, experiments were conducted in which certain cells known as the islets of Langerhans- which normally produce insulin needed by the body- were removed from the pancreas of dogs. The removal of this cell cause the dogs to become diabetics. By 1921, two Canadian Doctors, Frederick Banting and Charles Best, discovered and isolated the insulin hormone (Medical and Health Encyclopedia, 1977)

Diabetes is a disorder caused by insufficient or absent production of the hormone insulin by the pancreas. Insulin is an important hormone responsible for the absorption of glucose into the cell for their energy needs and into the liver and fat cells for storage. If there is a deficiency in insulin, the level of glucose in the blood becomes abnormally high, causing polyuria (the passing of large quantities of urine) and polydipsia (excessive thirst). The body's inability to store or use glucose causes weight loss, hunger and fatigue. Diabetes mellitus also results in disorder lipids (fat) metabolism and accelerated degeneration of small blood vessels (Smith, 1990).

Apart from the symptoms of thirst and polyuria, the disease has nothing in common with the much rarer disorder diabetes incipidus (Smith, 1990).

Metabolic disturbances other than increase blood sugar and sugar in the urine occur in diabetes mellitus. The body's utilization of fats and proteins. is also affected. All these defects are associated with the deficiency of, or a deficient response to the hormone insulin (Smith, 1990).

The fundamental problem in diabetes is the body's inability to metabolize glucose, a common form of sugar fully and continually. This is a vital process in creating body cell energy. Glucose is a chemical derivative of the carbohydrate in food after they have been digested. Carbohydrates are mostly of plant origin and maybe called starch, saccharide, sucrose, or simply sugar Glucose is stored under normal condition in the form of glycogen, or animal starch, in the liver and muscles for later use, at which time it is reconverted to glucose (The New Complete Medical and Health Encyclopedia, 1995).

The diagnosis of diabetes is not ordinarily a difficult one. Especially in children, the symptoms of rapid weight loss, extreme hunger, generalized weakness, frequent and copious urination, and insatiable thirst make it easy to recognize. Finding glucose in the urine along with the increased levels of glucose in the blood generally confirms the diagnosis. However, glucose in the urine does not always indicate the presence of diabetes. A few people with unusual kidney function have glucose in their urine with normal blood levels, a common condition known as renal glycosuria (The New Complete Medical and Health Encyclopedia, 1995).

Moreover, an adult with diabetes may not have such a definite set of symptoms for months or years after he has actually developed the disease. Instead he may have vague fatigue or persistent skin infections. A woman may have a persistent genital itch that a physician might suspect is due to diabetes. Proof is provide by urine and blood test. Glucose in the urine at the time of a routine physical examination might provide the first clue. Once diagnosed, treatment should begin (The New Complete Medical and Health Encyclopedia,1995).

Metabolic disturbances other than increased blood sugar and sugar in the urine occur in diabetes mellitus. The body's utilization of fats and protein is also affected. All these defects are associated with a deficiency of, or a deficient response to, the hormone insulin. Insulin is manufactured in the pancreas by the special cells known as beta cells which are located in clumps of cells called the islet of Langerhans. Insulin combines with and acts on special molecular structures, termed receptor located on the surfaces of cells through out the body. The insulin signals a receptor to activate the cell's surface to permit glucose to enter and also to stimulate mechanism inside the cell to utilize the sugar (Colliers Encyclopedia, 1993).

If the sugar is not thus used, it begins accumulating in the blood. When it reaches a certain level, the sugar begins to pass through the kidneys into the urine (Colliers Encyclopedia, 1993).

If the condition of high blood sugar levels and sugar in the urine is not corrected, it leads to weight loss, excessive urination, marked thirst and hunger. The

initial weight loss is due to dehydration cause by the loss of fluid to excessive urination. Eventually, in the body's effort to compensate for calories being loss in the form of sugar in the urine and actual breakdown of tissue (muscle and stored fat) occurs. Ketones which are waste products resulting from the metabolism of fats begin to accumulate as a consequence of this accelerated tissue destruction. The accumulating ketones make the body more acid resulting in diabetic ketoacidosis. If untreated, ketoacidosis causes fatigue, drowsiness, nausea, vomiting, stupor, and comma. If uncorrected it may lead to death (Colliers Encyclopedia, 1993).

When the importance of insulin was revealed and hormone first became available, it was hailed as a cure. However, as diabetics live longer it became apparent that insulin was not he cure for the long-term degenerative complications, especially the premature aging of blood vessels. Hardening of large arteries occurs earlier and accounts for the increased incidence of gangrene and amputations. The smaller arteries are also susceptible to damage, particularly those in the eyes and kidneys. The former complications can cause blindness, and the later

often results in kidney failure. The nervous system is also affected, manifested as various problems ranging from painful inflammation to impaired nerve function (Colliers Encyclopedia, 1993).

Diabetes mellitus may be detected by routine urine or blood testing or by the appearance of various symptoms as the disease progresses. Medical diagnosis is establish by substantiating abnormally high blood sugar levels before and after meals (Colliers Encyclopedia, 1993).

The aims of treatment are to prolong life, to relieve symptoms and to prevent long term complications. Success depends on keeping the level of blood glucose as near normal as possible though maintenance of normal weight, regular physical activity, careful dietary management, and if necessary, injections of insulin (Smith, 1990).

Treatment is based on diet and exercise an on the administration of insulin are agents to enhance the effectiveness of the body's insulin (Colliers Encyclopedia, 1993).

The diet of the diabetic, although a major part of his treatment is similar to what normal person of the same age should eat. However, some radical dietary changes maybe ordered if the previous diet has not been a proper one. This is particularly true in regard to reducing he calories in food eaten by overweight diabetics (The New Complete Medical and Health Encyclopedia, 1995).

Diet is the only treatment needed by many adult diabetics particularly those who are obese when they develop the disease, provided they can lose and not regain their excess weight. Because obese people are more likely to develop diabetes, they should have urine or blood sugar tests yearly after the age of forty. But it is more important for them to make every effort to lose weight before they become diabetics (The New Complete and Health Encyclopedia, 1995).

Each diabetic's diet has to be individualized to a certain extent. This is done originally by the physician when the diagnosis is made and periodically thereafter. Because eating is so much apart of the patient's

personality and has such great psychological importance, its pattern should be changed radically only when necessary (The New Complete Medical and Health Encyclopedia, 1995).

Various efforts are being made with open-loop pumps to control diabetes by the automatic release of appropriate amounts of insulin, as required. The earliest model required presetting by the diabetic (Colliers Encyclopedia, 1995).

Commercially available insulin, is obtained largely from pork and beef pancreas. By means of genetic engineering, it has also become possible to induce certain bacteria to produce human insulin in the laboratory and such biosynthetic insulin has been approved for clinical use (Colliers Encyclopedia, 1993).

Transplanting beta cells, islets, and even whole pancreas is being attempted. In the few successful total pancreatic transplant, sugar control has been normalized. The problem is one of transplant rejection, but efforts are being made to overcome this difficulty (Colliers Encyclopedia, 1993).

B. Local Plants

Among Filipinos, as with people in other lands, certain plants in their immediate environment have been known for centuries to have some curative values. In case of illness among the members of the family or other relatives, these plants have been applied for immediate treatment and in some cases were found to be effective. A large number of them, after years of scientific research, constitute the basis of the modern pharmacopoeia. Researchers in different areas are still under way for the discovery of the medicinal properties of plants; but inspite of their great advances in medicine, Much still remains to be learned in the curative properties of plants (Quisumbing, 1993).

Mango (*Mangifera indica*)

Mango is cultiveted throughout the Philippines. This is a large tree, with the dense in spreading crown. The leaves are oblong to oblong- lanceolate, ten to thirty centimeters long. The flowers are yellow, small, three to four millimeters long, and borne on erect, hairy panicles which are often as long as the leaves or longer. The fruit (drupe) is yellow, freshly, oblong-ovoid, ten to fifteen centimeters long, and somewhat

compressed. The seeds are large, flattened, and fibrous (Quisumbing, 1993).

The mango is the most widely grown and most highly pized of all Philippine fruits. There are several varieties in cultivation, but the most popular are the "kalabao" and "piko" varieties. Mangoes are of varying shades of yellow, large elliptical in outline, but somewhat flattened. The skin is thin, and in the center of the fruit is a very large flattened seed which is surrounded by the edible yellow pulp. The mango has the very decided, perfume like taste. The "kalabao" mango is highly prized buy practically everyone who eats it. The "piko" variety is a smaller and more fibrous mango and is less highly regarded than the "kalabao" variety, but is sweeter (Quisumbing, 1993).

The juice of the leaf is useful in bleeding dysentery. A decoction of th eleaves with a little honey added is given for loss of voice. The tender leaves dried and made into a powder are useful in diabetes. The ashes of the leaves are a popular remedy for burns and scalds. An infusion of the young leaves is prescribed for chronic diseases of the lungs, and for asthma and coughs. The young leaves are used as a pectoral in Sind (Quisumbing, 1993).

Kangkong (*Ipomoea aquatica*)

Kangkong is found throughout the Philippines in stagnant streams, fresh water swamps, and pools. It was perhaps introduced. It is also found throughout the tropics of the old world and is extensively cultivated in Southern China (Quisumbing, 1993).

This is a smooth, widely spreding vine with a stem trailing on mud or floating on stagnant pools. The leaves are oblong-ovate and seven to fourteen centimeters long, with a pointes tip and heart-shaped or arrow-shaped base, on long petioles, the margins bein entire or angular and sublobed,.The peduncles are erect, 2.5 to five centimeters long, usually having one or two flowers, and born in the axils of the leaves. The sepals are green, oblong, and eight millimeters long. The corolla is narrowly bell shaped about five centimeters long, and purplish; the limb is nearly white or pale pink purple and about five centimeters in diameter; the tube is deeper purple inside. The capsules are smooth and ovoid, and about one centimeter long (Quisumbing, 1993).

The young leaves and stem are boiled and eaten as a leafy vegetable. The young stems are also used as an ingredient in native pickles. Kangkong according to

Marañon is an excellent source of iron and a good source of calcium. Guerrero states that the tops are mildly laxative in the Philippines. Dr. F. Garcia declares that kangkong particularly the purplish kind contains an insulin like principle and can be used as a cure for diabetes mellitus (Quisumbing, 1993).

Makopa (*Syzygium malaccence*)

Makopa is found in and about towns in cultivation throughout the country where it is ocassionally naturalized. It is of prehistoric introduction, occuring also in Indo-Malaya generally and being cultivated in other tropical countries (Quisumbing, 1993).

This plant is a tree reaching a height of about ten meters. The young leaves are pinkish. The older leaves are large, drooping, elliptic-oblong to broadly oblong lanceolate, fifteen to thirty centimeters long, 7.5 to fifteen centimeters wide, and narrowed and pointed at both ends. It was stated that the pulverized leaves are employed as a remedy for diabetes (Quisumbing, 1993).

C. Mice (*Mus musculus*)

Mus musculus may originally from Mediterranean region to china, but has now been distributed throughout the world by humans and lives as a human commensal. The length of the head is 150 to 190 millimeter and the tail is 70 to 95 millimeter long. Fur coloration is generally light brown with white or buffy bellow. The long tapered tail has obviously circular rows of scales and is sparcely furred. (askjevs.com, 2000).

Mus musculus eat many kinds of vegetable matter such as seeds, fleshy roots, leaves and stems. Insects (beetle larvae, caterpillars, and cockroaches) and meet may be taken when available. Mus musculus consumes any human food that is acessible as well as glue, soap, and other house hold material (askjevs.com, 2000).

Mus musculus is characterized by tremendous reproductive potential. Breeding occurs throughout the year. The estrous cycle is four to six days long, with estrous lasting less than a day. Females experience a postpartum estrus 12 to18 hours after giving birth. Females generally have five to ten litters per year if conditions are suitable, but as many as 14 have been reported. Gestation is 19 to 21 days but may be extended by several

days if the female is lactating. Litters consist of three to twelve offspring, which are vorn naked and blind. They are fully furred after ten days, open their eyes at 14 days and reach sexually maturity at five to seven weeks. Average life span is about two years in captivity, but individuals have lived for as long as six years (askjevs.com, 2000).

Mus musculus generally lives in close association with human—in houses, barns, granaries, etc. They also occupy cultivated fields, fencerows, and even wooden areas, but they seldom stray far from buildings (askjevs.com, 2000). Domesticated forms and albinos have been developed which are commonly used as laboratory animals (especially in medicine and genetics), and as pets. Mus musculus also has a small role as an insect destroyer, but this is minimal (askjevs.com, 2000).

Chapter 3

Research Design and Methodology

A. Research Design

This study compared the antidiabetic activities of different local plants.

It specifically aimed to determine the significant differences on the antidiabetic activities of the different local plants.

It is hypothesized that there is no significant difference on the antidiabetic activities of the local plants and the hypoglycemic drugs in lowering the blood glucose levels of white mice.

The research design employed was the Pre-test Post-test Control Group Design. This kind of design consisted of the (a) control group and the (b) experimental group and both involved the Pre-test Post-test.

The study utilized three mice each for the control group and the experimental groups for each plant to be tested. The independent variables were the plant extracts and the hypoglycemic drugs that were used as the treatment, while the dependent variables were the glucose levels of the mice.

A. Methodology

B.1 Gathering of Plant Samples

Fresh local plants were gathered from the vicinity of Sibalom, Antique.

The steps done in preparing the plant samples were as follows:

For *Ipomoea aquatica* (Kangkong)

- Intermediate kangkong leaves with no sign of disease were the ones used. They were sliced into longitudinal sections.

For *Mangifera indica* (Mango) and *Syzyguim malaccence* (Makopa)

- Fresh leaves of mango and makopa with no signs of diseases were the ones gathered. Their stems then cut and the remaining parts were chopped into chunks.

The local plants were then washed thoroughly with running water.

B.2 Crude Extraction of Plant Samples

One gram plant sample: 3 ml water was the proportion used in this study. Each of the plant was processed in the osteorizer until thoroughly macerated, occasionally adding a small amount of prepared volume of water. The processing of the

plant samples was continued until a thorough and uniform mixture was obtained.

The mixture was placed in a sterilized bottle and was allowed to stand with occasional shaking. The extracts of the plant samples were then separated from the liquid portion using a fine strainer.

B.3 Extraction of Blood Samples and Measurement of Blood Glucose Level

Three albino white mice were used per test sample. The mice were fasted for twelve hours with constant supply of water. After the said hours, blood was extracted by the tail-venipuncture method. The drop of blood was placed in the reactive site of the haemoglucotest strips. The researchers then measured the normal glucose levels of white mice.

B.4 Sugar Solution Intake

A concentration of one gram of sugar : two mL of water was prepared. The mixture was administered to the white mice to increase their blood glucose level. After six hours of constant supply of sugar solution, the blood was extracted to determine the

blood glucose level. The results were then recorded.

B.5 Application of Treatment

After two hours, the crude extracts from plant samples were administered to the white mice through force feeding. The mice were given enough time to digest and let the extracts accumulate in their body which is important for the next measurement of glucose level. A complete digestion of extracts in the mice's bodies after a certain period of time was a go signal for the researchers to proceed to the next procedure.

B.6 Measurement of Blood Glucose Level

After applying the treatment, blood glucose level was then measured every after six hours. The blood glucose level was recorded and was compared to the mice's glucose level before the application of extracts or what the researchers call the initial glucose level. A decrease on the initial glucose levels signifies the effectiveness of the plant samples as a glucose level lowering factor thus, have the potential for curing diabetes.

B.7 Statistical Analysis of Results

Three by Five ANOVA (p 0.05) was used to determine if the different treatments and their duration has significant effects in lowering the blood glucose levels of white mice. Tukey Test (p 0.05) was used to determine if the duration of treatment has significant effect in lowering the blood glucose level of white mice for each plant extract.

Chapter 1V

Results and Discussions

The study entitled Comparative Antidiabetic Potencies of *Ipomoea Aquatica* (kangkong), *Mangifera indica* (mango) and *Syzygium malaccence* (makopa) on the Blood Glucose Level of white mice primarily aimed to determine the antidiabetic potencies of crude extracts from each plant sample and compare these potencies with each other. Three determinations were made for added accuracy and reliability of the data on antidiabetic potencies of the four plant samples.

Table 1 shows the amount of the glucose levels decreased by the mice in 6-hour intervals after they have been treated with the different plant samples. It also shows whether the amount it decreased is significant or not.

The data were obtained by extracting blood samples from the mice and the blood glucose levels of these mice were measured using the haemoglucotest strips. The mice were subjected to any of the four treatment (Table 1).

72.5> 15.0> 8= 3>-5.3

makopa > mango > drugs = kangkong > control

It was observed that the blood glucose levels of mice treated with makopa had the greatest decrease on the first

six hours. From its initial level, it decreased by the amount of 72.5 mg/dl (Table 1).

It was followed by the crude extracts from the mango leaves having a 15.0 mg/dl decrease (Table 1).

However the mice which received the treatment of hypoglycemic drugs and kangkong leaf extract had a comparable significant decrease on their glucose levels, it decreased by the amount of 8.0 mg/dl and 3.0 mg/dl respectively (Table 1).

The control group shows a negative decrease or an increase on its blood glucose levels, this signifies that mice don't have the potential to lower the blood glucose level on the first six hours (Table 1).

All the decrease on the blood glucose levels of the mice show a significant decrease except for the control group (Table 1).

Table 1 also shows the amount of the blood glucose levels decreased by the mice from the sixth hour to the twelfth hour and it also shows whether it is a significant decrease or not.

$$10.3 > 3.6 = 3.0 > 0.0 = -2.3$$

drugs > control = mango > makopa = kangkong

On the twelfth hour, the mice treated with hypoglycemic drugs decreased its blood glucose level enormously, amounting to 10.7 mg/dl (Table 1).

The control group and those treated with mango leaf extract had comparable significant decrease. While the mice who received the makopa and kangkong leaf extract decreased the list. Mice under the makopa leaf extract retained its blood glucose level and those treated with kangkong leaf extract even increased the blood glucose level after 12 hours (Table 1).

The last column of the table shows the total decrease of blood glucose levels of the mice from its initial level until the final twelfth hour (Table 1).

It was the mice treated with extract from leaves of mango and makopa and those treated with hypoglycemic drugs had he significant decreased until the twelfth hour. The makopa group received the biggest total decrease (72.5 mg/dl) which was obtained in the first six hours after the treatment has been administered (Table 1).

Next is the hypoglycemic drugs having an 8.7 mg/dl decreased and the mango leaf extract treatment, amounting to 18.0 mg/dl (Table 1).

The control group and those treated with kangkong leaf extract has the insignificant decrease. On the twelfth hour, the control group has the negative decrease or shows an increase on the blood glucose level of the mice (Table 1).

Table 1. The amount of blood glucose levels decreased by the mice after administering the treatment at different time intervals and the significance or the insignificance of that decrease.
Values are means of three determinations.

treatment	Glucose level drop (mg/dl)		
	Initial-6th hour	6th- 12th hour	Initial-12th hour
Kangkong	3.0*	-2.7	0.3
Mango	15.0*	3.0*	18*
Makopa	72.5*	0.0	72.5*
Hypoglycemic drugs	8*	10.7*	18.7*
Control	-5.3	3.6*	-1.7

The mice were force feed of the crude extracts from kangkong, makopa, and mango leaves. There was a 6 - hour lapse after feeding to allow a complete digestion of the treatment.

Table 2 shows the continuous decrease of the blood glucose level after the administration of the treatment at a 6- hour interval.

It was observed that the blood glucose levels of the mice treated with the three plant samples, hypoglycemic drugs and as well as the control group, all dropped on the 6th hour. The average decrease is 15 mg/dl. But it was the mice treated with Makopa leaves extract decreased the most. From its normal glucose level, it decreased by the amount of 72.5mg/dl on the

first six hours only. And mice treated with kangkong leaves extract decreased the least amount. It has only 3mg/dl-decrease(Table 2).

Table 2 showed that on the 12th hour not all of the blood glucose levels of the mice decreased. Only the mice treated with mango leaf extracts, hypoglycemic drugs and the control group have a blood glucose level drop. Mice treated with crude extracts from mango leaves decreased by 3mg/dl while the control group decreased by 3.6 mg/dl. The blood glucose levels of mice treated with hypoglycemic drugs decreased the greatest, amounting to 10.7 mg/dl.

Mice treated with kangkong and makopa leaves extract did not decrease their blood glucose levels on the 12th hour instead, they slowly return to its normal glucose level or retain (Table 2).

Table 2. Blood glucose levels (mg/dl) at different time intervals after administering treatment. Values are means of three determinations.

Treatment	Glucose Levls (mg/dl)		
	Initial level	6th hour	12th hour
Kangkong	84	81	83.7
Mango	99.7	84.7	81.7
Makopa	155	82.5	82.5
Hypoglycemic drugs	83.7	75.7	65
Control	57	62.3	58.7

Table 3 shows which of the treatment differed significantly and those which do not after comparing its effectivity between them. Using the one-way ANOVA (p 0.05) as the statistical tool, the results of the different plant extracts on blood glucose levels of white mice showed that if there is a two-way interaction between the time and the treatment, some of the blood glucose levels of mice do not differ significantly and some differ significantly. Further more the Scheffe Multiple Comparisons implied that there is no significant differences between the makopa and kangkong; mango and makopa; kangkong and mango; control and hypoglycemic drugs. It also shows that all the plant leaves extract differ significantly with the hypoglycemic drugs and the control group (Table 3).

Table 3. Table showing the significant or insignificant results between the treatment.

	Makopa	Kangkong	Mango	Medicine	Control
Makopa	-	NS	NS	S	S
Kangkong	NS	-	NS	S	S
Mango	NS	NS	-	S	S
Medicine	S	S	S	-	NS
Control	S	S	S	NS	-

Table 4 shows the significant differences on the decrease of the blood glucose levels of mice after 12 hours. It determines whether the decrease of blood glucose levels for each plant leaves extract decreased significantly or not. This was determined by Scheffe one-way ANOVA.

There is no significant difference on the decrease of the blood glucose levels of mice treated with makopa, kangkong, mango leaves extract and the control group and only the mice treated with hypoglycemic drugs decreased significantly (Table 4).

Table 4. Table showing the significance or insignificance of the decrease on the blood glucose levels of mice after 12 hours.

Treatment	Decrease on the blood glucose level
Makopa	NS
Kangkong	NS
Mango	NS
Hypoglycemic drugs	S
control	NS

CHAPTER 5

Summary of Results

1. The crude extracts of makopa leaf has the potential to decrease the blood glucose level of white mice on the first six hours but not on the twelfth hour.
2. The mice treated with mango leaves crude extract and hypoglycemic drug has a comparable significant lowering effect on the blood glucose level of mice. Both decreased the blood glucose of mice significantly on the two 6-hour laps.
3. The blood glucose levels of mice treated with kangkong leaves crude extracts decreased insignificantly. The kangkong leaves crude extracts is not as effective as the commercialized hypoglycemic drugs.
4. The control group, which was not given any treatment, has a negative effect in lowering the blood glucose level. Mice don't have the potential to lower their glucose level on their own.

Conclusion

By the given data and information, the researchers therefore conclude that the extracts from mango and makopa leaves had a great effect on decreasing the blood glucose

level of the mice and has the potential to be as effective as the commercial hypoglycemic drugs, since the decrease on the blood glucose level does not differ significantly. The Kangkong extract also affected the glucose level of the mice but not as strong compared to hypoglycemic drugs for during the twelfth hour the blood glucose levels of the mice treated with kangkong increased. All the plant samples can lower the glucose level of mice but it was observed that it decreases enormously only on the first six hours. Through this experiment, researchers can also conclude that mice don't have the potential in decreasing its glucose level back to its normal glucose level.

Recommendations

To reinforce the lowering effect of the various plant extracts on the blood glucose level, one must identify the components or the characteristics found with in the extracts that may affect or that is responsible for such property (glucose level). The extracts may be used as a main ingredient in an economical, but effective hypoglycemic drugs.

There are also many medicinal plants, which are very abundant here in the Philippines that would serve as a breakthrough in curing the disorder called, diabetes mellitus.

Although often overlooked and underutilized, these plants would be as effective as those expensive commercial hypoglycemic drugs that we usually buy. The utilization of these plants as an alternative in curing diabetes mellitus can be a great help especially to those who cannot afford to buy the expensive hypoglycemic drugs.

List of Literature Cited

New Standard Encyclopedia, 1989, Standard Educational Corporation, Chicago, pp. 234-236.

Wegman, R.J., 1995, The New Complete Medicinal and Health Encyclopedia, JG Ferguson Publishing Company.

Smith 1990, Complete Family and Health Encyclopedia, Dorling Kindersley Limited, London.

Edgardo Quisumbing, 1978, Medicinal Plants of the Philippines, Katha Publishing Company, Inc., pp.119-506.

Wegman, R.J., 1997, Medicinal and Health Encyclopedia, Ferguson Publishing Company, Chicago.

Del Mundo F., Estrada F.A., Ocampo D.D., 1982, Pediatrics and Child Health, GMC Press Inc.

Padua L.S., Lugod G.C., Pancho J.V., 1987, Handbook on Philippine Medicinal Plants, UP Los Baños, Laguna, Vol.II p. 5.

Padua L.S., Lugod G.C., Pancho J.V., 1987, Handbook on Philippine Medicinal Plants, UP Los Baños, Laguna, Vol.III p. 18.

Collier P.F., 1995, Collier's Encyclopedia, P.F. Colier and Son Limited, New York.

Http://www.vetmed.auburn.edu/sac/mededu/diabetes/intro.html

Appendix 1. Glucose levels of mice by time, crude extracts treatment.

			UNIQUE METHOD				
			Sum of squares	df	Mean square	F	Sig.
Glucose Levels of White Mice	Main Effects	Combined	10563.80	6	1760.663	4.887	.002
		time	2523.757	2	1261.878	3.503	.044
		Crude extracts treatment	7546.889	4	1886.722	5.237	.003
	2-way interacti on	Time*crude extracts	3404.449	8	425.556	1.181	.345
	Model		14746.63	14	1053.331	2.924	.008
	Residual		10087.00	28	360.250		
	Total		24833.63	42	591.277		

Appendix 2. Multiple comparison of the crude extracts.

	(I) Crude Extracts treatment	(J) Crude Extracts treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	kangkong	Makopa	-21.5397	10.252	.241	-50.8921	7.8128
		Mango	-5.7778	9.590	.974	-33.2345	21.6789
		Medicine	8.1111	9,590	.914	-19.3456	35.5678
		control	23.8889	9.590	.114	-3.5678	51.3456
	makopa	Kangkong	21.5397	10.252	.241	-7.8128	50.8921
		Mango	15.7619	10.252	.545	-13.5906	45.1144
		Medicine	29.6508*	10.252	.047	.2983	59.0033
		control	45.4286	10.252	.001	16.0761	74.7810
	mango	Kangkong	5.7778	9.590	.974	-21.6789	33.2345
		Makopa	-15.7619	10.252	.545	-45.1144	13.5906
		Medicine	13.8889	9.590	.601	-13.5678	41.3456
		control	29.6667*	9.590	.029	2.2100	57.1234
	medicine	Kangkong	-8.111	9.590	.914	-35.5678	19.3456
		Makopa	-29.6508*	10.252	.047	-59.0033	-.2983
		Mango	-13.8889	9.590	.601	-41.3456	13.5678
		Control	15.7778	9.590	.479	-11.6789	43.2345
	control	Kangkong	-23.8889	9.590	.114	-51.3456	3.5678
		Makopa	-45.4286*	10.252	.001	-74.7810	-16.0761
		Mango	-29.6667	9.590	.029	-57.1234	-2.2100
		medicine	-15.7778	9.590	.479	-43.2345	11.6789

Table 5. Blood glucose levels of white mice before and after intake of sugar solution . Values are means of three determinations.

Mice	Glucose level (mg/dl)	
	Before sugar sol'n intake	After sugar sol'n intake
Kankong Group	79.7	84
Mango Group	84.7	99.7
Makopa Group	81.7	155
Hypoglycemic drug	70.7	83.7
Control Group	48	57.3

Table 6. Means of Glucose levels of mice treated with kangkong initially, and after 6 and 12 hours.

12th	Mean	83.667
	N	3
	Std. Deviation	2.082
6th	Mean	81.000
	N	3
	Std. Deviation	1.000
Initial	Mean	84.000
	N	3
	Std. Deviation	1.000
Total	Mean	82.889
	N	9
	Std. Deviation	1.900

Table 7. Oneway for kangkong, initially and after 6 and 12 hours.

		Sum of Squares	df	Mean Square	F	Sig.
GLUCOSE	Between Groups	16.222	2	8.111	3.842	.084
	Within Groups	12.667	6	2.111		
	Total	28.889	8			

Table 8. Post Hoc Test for kangkong, initially and after 6 and 12 hours.

(I) Level	(J) Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Initial	6 hours	3.000	1.186	.113	-.805	6.805
	12 hours	.333	1.186	.962	-3.472	4.138
6 hours	Initial	-3.000	1.186	.113	-6.805	.805
	12 hours	-2.667	1.186	.160	-6.472	1.138
12 hours	Initial	-.333	1.186	.962	-4.138	3.472
	6 hours	2.667	1.186	.160	-1.138	6.472

Table 9. Means of glucose level of mice treated with mango initially, and after 6 and 12 hours.

Initial	Mean	99.667
	N	3
	Std. Deviation	17.616
6 hours	Mean	84.667
	N	3
	Std. Deviation	.577
12 hours	Mean	81.667
	N	3
	Std. Deviation	1.528
Total	Mean	88.667
	N	9
	Std. Deviation	12.166

Table 10. Oneway for mango, initially and after 6 and 12 hours.

		Sum of Squares	df	Mean Square	F	Sig.
GLUCOSE	Between Groups	558.000	2	279.000	2.674	.148
	Within Groups	626.000	6	104.333		
	Total	1184.000	8			

Table 11. Post Hoc Test for mango, initially and after 6 and 12 hours.

(I) Level	(J) Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Initial	6 hours	15.000	8.340	.274	-11.749	41.749
	12 hours	18.000	8.340	.178	-8.749	44.749
6 hours	Initial	-15.000	8.340	.274	-41.749	11.749
	12 hours	3.000	8.340	.938	-23.749	29.749
12 hours	Initial	-18.000	8.340	.178	-44.749	8.749
	6 hours	-3.000	8.340	.938	-29.749	23.749

Table 12. Means of Glucose levels of mice treated with makopa initially, and after 6 and 12 hours.

Initial	Mean	155.000
	N	3
	Std. Deviation	57.663
6 hours	Mean	82.500
	N	3
	Std. Deviation	.500
12 hours	Mean	82.433
	N	3
	Std. Deviation	.513
Total	Mean	106.644
	N	9
	Std. Deviation	46.332

Table 13. Oneway for makopa, initially and after 6 and 12 hours.

		Sum of Squares	df	Mean Square	F	Sig.
GLUCOSE	Between Groups	10522.18	2	5261.088	4.746	.058
	Within Groups	6651.027	6	1108.504		
	Total	17173.20	8			

Table 14. Post Hoc Test for makopa, initially and after 6 and 12 hours.

(I) Level	(J) Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Initial	6 hours	72.500	27.185	.096	-14.688	159.688
	12 hours	72.567	27.185	.096	-14.621	159.755
6 hours	Initial	-72.500	27.185	.096	-159.688	14.688
	12 hours	6.667E-02	27.185	1.000	-87.121	87.255
12 hours	Initial	-72.567	27.185	.096	-159.755	14.621
	6 hours	-6.67E-02	27.185	1.000	-87.255	87.121

Table 15. Means of Glucose levels of mice treated with medicine initially, and after 6 and 12 hours.

T32

Initial	Mean	83.667
	N	3
	Std. Deviation	.577
6 hours	Mean	75.667
	N	3
	Std. Deviation	7.506
12 hours	Mean	65.000
	N	3
	Std. Deviation	8.185
Total	Mean	74.778
	N	9
	Std. Deviation	9.833

Table 16. Oneway for medicine, initially and after 6 and 12 hours.

		Sum of Squares	df	Mean Square	F	Sig.
GLUCOSE	Between Groups	526.222	2	263.111	6.383	.033
	Within Groups	247.333	6	41.222		
	Total	773.556	8			

Table 17. Post Hoc Test for medicine, initially and after 6 and 12 hours.

(I) Level	(J) Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Initial	6 hours	8.000	5.242	.374	-8.813	24.813
	12 hours	18.667*	5.242	.033	1.853	35.480
6 hours	Initial	-8.000	5.242	.374	-24.813	8.813
	12 hours	10.667	5.242	.207	-6.147	27.480
12 hours	Initial	-18.667*	5.242	.033	-35.480	-1.853
	6 hours	-10.667	5.242	.207	-27.480	6.147

Table 18. Means of Glucose levels of mice in the control initially, and after 6 and 12 hours.

Initial	Mean	57.000
	N	3
	Std. Deviation	14.731
6 hours	Mean	62.333
	N	3
	Std. Deviation	2.517
12 hours	Mean	58.667
	N	3
	Std. Deviation	1.155
Total	Mean	59.333
	N	9
	Std. Deviation	7.858

Table 19. Oneway for control, initially and after 6 and 12 hours.

		Sum of Squares	df	Mean Square	F	Sig.
GLUCOSE	Between Groups	44.667	2	22.333	.298	.753
	Within Groups	449.333	6	74.889		
	Total	494.000	8			

Table 20. Post Hoc Test for control, initially and after 6 and 12 hours.

(I) Level	(J) Level	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Initial	6 hours	-5.333	7.066	.762	-27.995	17.329
	12 hours	-1.667	7.066	.973	-24.329	20.995
6 hours	Initial	5.333	7.066	.762	-17.329	27.995
	12 hours	3.667	7.066	.877	-18.995	26.329
12 hours	Initial	1.667	7.066	.973	-20.995	24.329
	6 hours	-3.667	7.066	.877	-26.329	18.995