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The Medical Application of Sachet from Butterfly Pea Leaf Extract for People Living with Diabetes

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Abstract

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Abstract:

Patients with Diabetes Mellitus have been expanding every year due to the population growth, urbanization, aging, and increasing prevalence of obesity. Butterfly Pea Leaf also known as Clitoria ternatea L. has been investigated for having antihyperglycaemic activity toward the blood glucose level of alloxan-diabetic mice. The present study was conducted to produce sachets containing powder product from BPL extract through spray-drying method in order to increase convenience of storage and distribution process. Maltodextrin become a parameter in spray-drying method. Based on preliminary research, the most suitable concentration of maltodextrin was 10%. Sachets from BPL extract were distributed to 30 diabetic patients from Puskesmas Pulo Armin, Bogor. All patients were treated by sachets from BPL extract for around four months. The treatment shows the decreasing level of blood glucose from diabetic patients as well as it could keep the blood glucose level remain stable in normal range without leading to hypoglycaemia. Whole blood hematology and kidney function were also tested before and after treatment to maximize the result of this research.

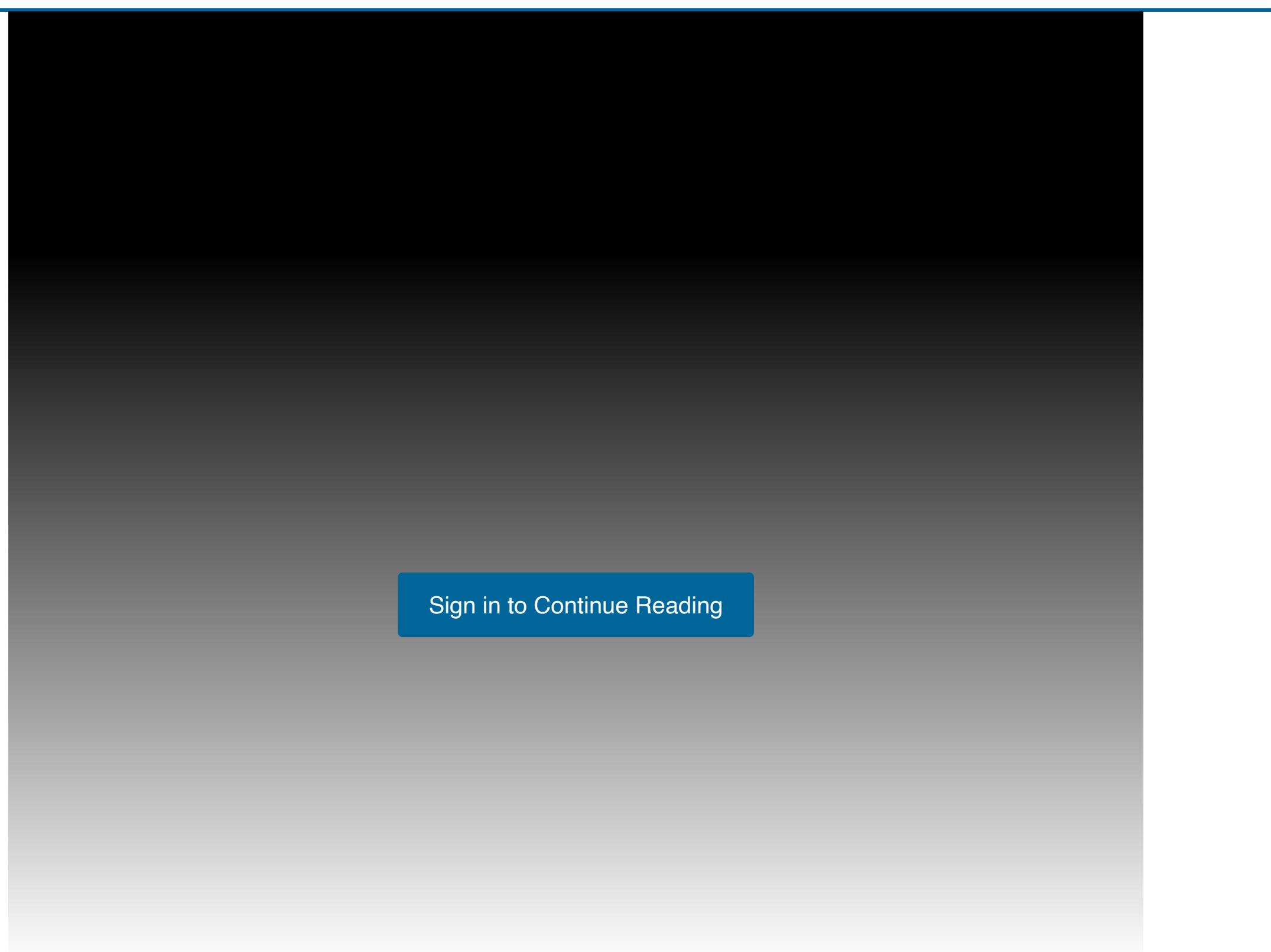
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The Medical Application Of Sachet From Butterfly Pea Leaf Extract For People Living With Diabetes

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Abstract—Patients with Diabetes Mellitus have been expanding every year due to the population growth, urbanization, aging, and increasing prevalence of obesity. Butterfly Pea Leaf also known as *Clitoria ternatea* L. has been investigated for having antihyperglycaemic activity toward the blood glucose level of alloxan-diabetic mice. The present study was conducted to produce sachets containing powder product from BPL extract through spray-drying method in order to increase convenience of storage and distribution process. Maltodextrin become a parameter in spray-drying method. Based on preliminary research, the most suitable concentration of maltodextrin was 10%. Sachets from BPL extract were distributed to 30 diabetic patients from Puskesmas Pulo Armin, Bogor. All patients were treated by sachets from BPL extract for around four months. The treatment shows the decreasing level of blood glucose from diabetic patients as well as it could keep the blood glucose level remain stable in normal range without leading to hypoglycaemia. Whole blood hematology and kidney function were also tested before and after treatment to maximize the result of this research.

Keywords—*Diabetes Mellitus, Butterfly Pea Leaf, Maltodextrin, Blood Glucose Level, Antihyperglycaemic, Hypoglycaemia, Whole Blood Hematology, Kidney Function*

I. INTRODUCTION

Diabetes is one of the most common disease yet is a chronic and serious disease which happened especially to adult around the world. Diabetes divided into two types which are Diabetes Type 1 and Diabetes Type 2. Diabetes type 1 belongs to autoimmune disease. Autoimmune disease is the condition where the body does not have the capability to identify foreign materials, it is incorrectly assume the important cells as a dangerous one which might be endanger to the body. Diabetes type I occurs when pancreas unable to produce insulin or it only able to produce a little amount of insulin. The B cells of pancreas which produced insulin are

wrongly attacked by specific antibodies which produced by immune system. This type of diabetes made patients should inject the insulin everyday to prevent the high blood glucose levels [1]. Different with the type 1, Diabetes Type 2 is lacking of insulin. The condition of insulin produced by pancreas is incompetent to regulate blood glucose level. Diabetes Type 2 is normally happen to middle age to adult people, but it also possibly happen to children or teenagers. [2] The number of adults living with diabetes is growing faster every year due to population growth, urbanization, aging, and the increasing prevalence of obesity and physical inactivity [3]. WHO global report on diabetes reported the dramatic rise of adults living with diabetes, has almost quadrupled since 1980. The number rose up to 422 million where most of them comes from low-middle income countries including Indonesia [4]. Indonesia was reported had 9 million diabetes cases in 2014 which affected people between 20-79 years old. Total mortality reaches up to 175,936 in that year, and 53% of Indonesians were wistfully undiagnosed [5]. If Diabetes is not handled properly, it could develop complications such as blindness, stroke, kidney failure, heart disease, or even death. These facts encourage us all as individuals to address this growing health challenge. As a developing country with uneven economic capability, the best treatment and medicine which is suitable with people's financial capability need to be founded. Herbal medicine could be developed as a promising effort to treat diabetes, especially in Indonesia. Utilizing Indonesian natural plants resources as a raw material could produce inexpensive medicine. In addition, herbal medicine also believed could reduce side effects towards the body and considered to be more environmentally friendly rather than chemical medicine. One plant which can be used as a herbal medicine is *Clitoria*

Ternatea, commonly known as Butterfly Pea. It has been treasured for its importance in curing many kind of diseases and disorders such as diabetes mellitus and chronic bronchitis[4]. BPL has potential in some pharmaceutical traits. It exhibits anti hyperglycaemic effect towards the blood glucose level in alloxan-diabetic mice [5]. Leaf extracts show strong antibacterial activity, antimicrobial activity, and anthelmintic activity. Thus, it can be assumed as a safe material to consume.

II. RESEARCH METHOD

This research consist of two methods which are experimental procedure and medical application. The experimental procedure aims to produce good quality of powder product from BPL extract. It is divided into two phases; extraction and spray drying. The second step which is medical application aims to observe the effect of BPL extract consumption to blood glucose level of diabetic patients.

A. Experimental Procedure

Consideration in selecting raw material is an important thing to produce good quality product. To initiate the experiment, first good quality of fresh BPL were chosen and removed from the stalks. After being removed, BPL were washed thoroughly with water to ensure the hygiene. BPL were cut into smaller pieces and grounded using a blender with water in ratio 1:3. The next step is extraction.

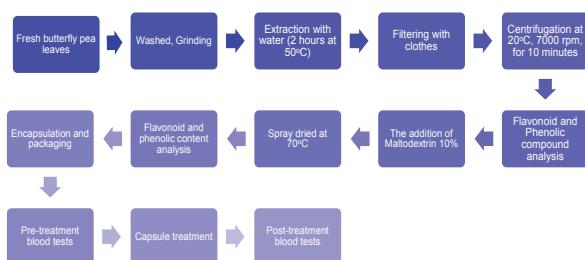


Fig. 1 Flowchart of Experimental Procedure; Powder Product from

The extraction process was conducted for 2 hours at 50°C and homogenized with homogenizer to keep the temperature in the range as well as to produce homogenous solution. If the temperature went to high, it would break down the content of BPL and affect the result of end product. After 2 hours, the solution was filtered with clothes to separate the liquid with supernatant. The extraction process does not finish yet. Centrifugation was conducted in a certain time and speed in order to obtain pure extract from BPL. In this research, centrifugation was done at 20°C, 7000 rpm, for 10 minutes. The extract of BPL was then tested for its phenolic and flavonoid compounds. The second phase of experimental procedure is spray drying. Spray drying was conducted to produce powder product of BPL extract. Before the process has begun, 10% of maltodextrin was added to the extract and

mixed together. Maltodextrin acts as a carrier agent to increase total solid on the extract. The mixing solution was spray dried at 65°C to 70°C resulting powder product from BPL extract. As a part of this experiment, total flavonoid and phenolic content were analysed again after spray drying. Quercetin was determine for total flavonoid content while Gallic Acid was used as standard for total phenolic content. Total flavonoid determined the dose of BPL extract the patients should be consumed. Powder product from BPL extract was packed into several sachets. The amount of sachet given to the diabetic patients were varies depend on the total flavonoid content of extract powder. Once it was already determined, all sachets were ready to distributed.

B. Medical Application

The second method used in this research is medical application. All sachets of BPL extract were distributed to 30 diabetic patients in Puskesmas Pulo Armin, Bogor. Before applied to diabetic patients, whole blood haematology and kidney fuction tests were conducted to indicate the existence of infectious diseases and defficiency of kidney functions. Besides, patients were also given the questionnaire related to the diabetes and other illness which patients have suffered from. The main purpose is to ensure the condition of all patients before being treated by BPL extract and maximize the result of BPL extract medication. All diabetic patients were medicated by BPL extract for 9 weeks through the following medication method:

- Week 1: One sachet of BPL extract with total flavonoid 0.50 mg.
- Week 2: Two sachets of BPL extract with total flavonoid 0.50 mg.
- Week 3: Two sachets of BPL extract with total flavonoid 1.00 mg.
- Week 4: Two sachets of BPL extract with total flavonoid 2.00 mg.
- Week 5: Two sachets of BPL extract with total flavonoid 2.00 mg.
- Week 6: Two sachets of BPL extract with total flavonoid 3.00 mg.
- Week 7: Two sachets of BPL extract with total flavonoid 3.00 mg.
- Week 8: Two sachets of BPL extract with total flavonoid 4.00 mg.
- Week 9: Two sachets of BPL extract with total flavonoid 4.00 mg.

During the first period of the treatment which are week one and two, patients who have personal medicine were medicated by BPL extract while they are also consuming their personal medicine normally. On the third and fourth week, the dosage of BPL extract were increased while the dosage of personal medicine were decreased. On the next following weeks, the dosage of BPL extract were increased more while all patients have no longer consumed the personal medicine. In order to

observe the effect of BPL extract consumption, fasting blood glucose level was checked every once a week with glucometer. After through several steps of medication, the whole blood haematology and kidney function test were conducted as well at the end of the treatment period to analyze the effect which possibly emerge after the consumption of BPL extract to the blood and kidney functions of diabetic patients.

III. RESULTS AND DISCUSSION

The medication of BPL extract resulted some different effects to the blood glucose level of diabetic patients. Besides, the result of whole blood haematology and kidney function tests between before and after treatment were also become topics to discuss in order to maximize the result of this research.

A. Blood Glucose Level

The normal range of fasting blood glucose level is ranging from 70-120 mg/dL. People living with high blood glucose level considered as Diabetes Mellitus. Diabetic patients divided into three groups. First, diabetic patients with normal blood glucose level due to the consumption of personal medicine served as healthy control, second group is diabetic patients with high blood glucose level ranged between 200-400 mg/dL due to the consumption of personal medicine served as Group Two, and the third is diabetic patients which blood glucose level are unstable during the period of the treatment served as Group Three. In this research, those groups were medicated by the same BPL extract medication method. Blood glucose level of diabetic patients were tested every once a week to observe the effect of BPL extract consumption. All diabetic patients were fasting at least 5 hours before blood glucose level test to get optimum result.

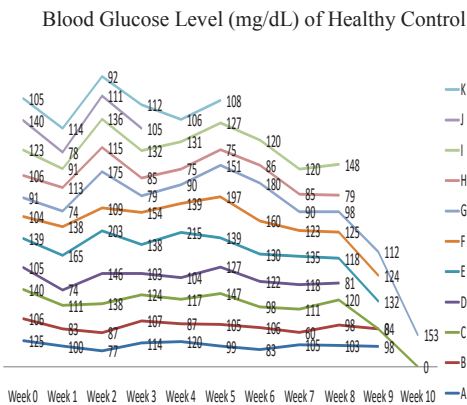


Fig. 2 Blood Glucose Level (mg/dL) Of Healthy Control

Fig. 2 illustrates the blood glucose level of healthy control. From the beginning until the end of treatment period, blood glucose level of healthy control tend to fluctuate. Eventhough there is the increasing and decreasing level of blood glucose but it is still remain stable in the normal range. From this condition, it can be said that the consumption of sachets from

BPL extract sachet could possibly replace personal medicine. Furthermore, Fig. 2 also proves that the consumption of BPL extract sachet affects blood glucose level of diabetic patients thus keep it stable in the normal range without leading to hypoglycemia. Hypoglycemia occurs when blood glucose level is under the normal range.

Blood Glucose Level (mg/dL) of Diabetic Patients Group Two

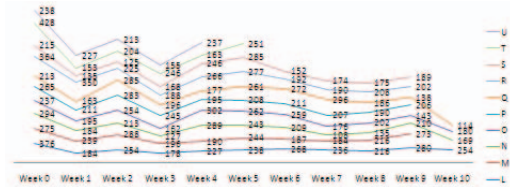


Fig. 3 Blood Glucose Level (mg/dL) Of Diabetic Patients Group Two

Fig. 3 shows the blood glucose level of diabetic patients in Group Two. The total number of patients in Group Two are 10. All patients had high level of blood glucose around 200-400 mg/dL before being treated by sachets from BPL extract. From the first week of the treatment, all patients show the decreasing level of blood glucose. On the second until fourth week, some patients had their blood glucose level increase but on the next following weeks, the blood glucose level of all diabetic patients from Group Two tend to be decrease although still not be in the normal range. It can be assumed that the consumption of sachets from BPL extract could help the blood glucose level to decrease, but it takes more time for the body to adapt with BPL extract until the blood glucose level gradually stands in the normal range.

Blood Glucose Level (mg/dL) of Diabetic Patients Group Three

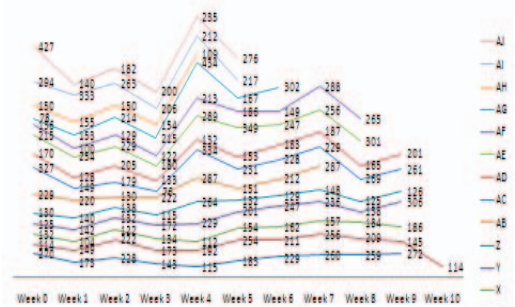


Fig. 4 Blood Glucose Level (mg/dL) Of Diabetic Patients Group Three

From Fig. 4 we can see the blood glucose level of diabetic patients in Group Three. Those patients served as patients who have their blood glucose level ranged between 110-300 mg/dL before being treated by sachets from BPL extract. Those patients had similar changes as a response to the treatment by sachet from BPL extract. After four weeks of treatment, the blood glucose level were remain fluctuate. Some patients had their blood glucose level rise, and some others were decreased

until the end of treatment period. It indicates that every person has different body reaction in order to adapt to foreign material in this case is BPL extract. Health condition of diabetic patients like hypertension and ulcer during the test also affect the result of blood glucose level. Therefore, longer period of time is needed thus all patients could have more time to adapt.

BPL extract contains phytochemical called Flavonoid. The component is believed could avoid the glucose absorption or to improve glucose tolerance. The Flavonoids also act as insulin secretagogue or insulin mimetic. It influences pleiotropic mechanism to decrease diabetic complications. It increases the uptake of glucose in peripheral tissue and regulates the activity rate-limiting enzymes that involved in carbohydrate metabolism pathway. Flavonoids have the ability to preserve β -cell function by reducing oxidative stress-induced tissue damage and against the insulin resistance progression [4]. The medication by sachets from BPL extract can be said could be the method to replace chemical medicine as well as it could treat diabetes and prevent the possibility of side effect arising by the consumption of chemical medicine.

B. Whole Blood Haematology

Whole blood hematology test was conducted to all diabetic patients before and after being treated by sachets from BPL extract. Leukocytes and ESR which is known as Erythrocyte Sedimentation Rate were primary focused on this test. It illustrates the existence of infectious diseases in the body. The normal level of leukocytes ranged between $3.8 - 10.6 \times 10^3/\mu\text{L}$ for adult male and $3.6 - 11 \times 10^3/\mu\text{L}$ for adult female. The normal level of ESR ranged between $0 - 15 \text{ mm/hours}$ for adult male (< 50 years old), $0-20 \text{ mm/hours}$ for adult male (> 50 years old) and adult female (< 50 years old), $0 - 30 \text{ mm/hours}$ for adult female (> 50 years old).

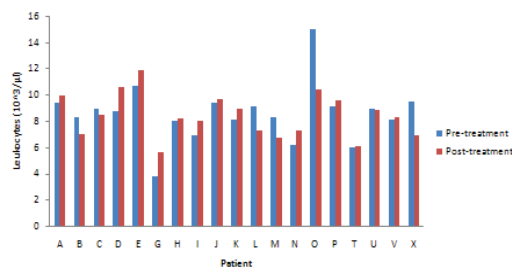


Fig. 5 Leukocytes Level Between Before and After Treatment

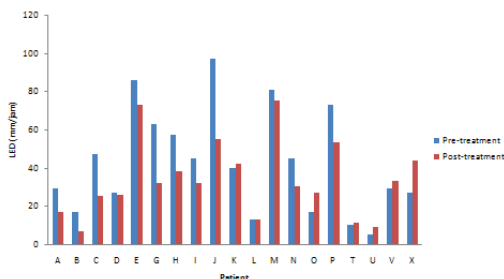


Fig. 6 ESR Level Between Before and After Treatment

Fig. 5 and Fig. 6 demonstrates the result of leukocytes and ESR level of diabetic patients between before and after being treated by sachets from BPL extracts. It can be seen from the graph above that all patients had a normal leukocytes level before and after being treated by sachets from BPL extract except patient O. Before the treatment has begun, the amount of leukocytes patient O was around 15 and after being treated by sachets from BPL extract the level of leukocytes shows the normal level. Associates with the result of ESR, patient C, E, G, H, I, J, K, M, N, and P had high level of ESR before being treated by sachets from BPL extract. It indicates the presence of bacteria inside the body of patients. After the treatment, patient C, G, H, I, K, and N show normal level of ESR. A little bit different cases for patient E, J, M, and P. The level of ESR of those patients were decreased after being treated by sachets from BPL extract but the level is still stand out of the normal range. Patient E, J, M, and P can be assumed have suffered from the infection of immune system but the consumption of sachets from BPL extract did not cause the infection itself. Health condition of diabetic patients could affected the results of whole blood hematology test as well as the results of leukocytes and ESR level can affected blood glucose level of diabetic patients. According to the results, the consumption of sachets from BPL extract had no side effects to diabetic patients.

C. Kidney Function

One of the main factor beside whole blood hematology to prove that the herbal medicine is considered safe to be consumed is kidney function. Urea and creatinine are the primary focused in kidney function test. Creatinine is a metabolic waste product excreted by the body during muscle metabolism. It is derived from the catabolism of creatine which then transported to the kidney via blood stream [6]. Kidney is responsible for filtrating waste products including creatinine and excreting them via urine. Urea is the last metabolic waste of amino acid in the building blocks of proteins. It usually comes from the amino acid which has been removed from the amino group in the liver. It is transported to the kidney and filtered out as waste products. The presence of creatinine and urea in the blood stream indicates potential kidney dysfunction [7]. Herbal medicine is identical with kidney function. It is considered as a harmful medicine, if it increases the level of urea and creatinine three times higher than the previous condition. High level of creatinine and urea indicate the malfunction of kidney. The following graph shows the creatinine level of diabetic patients between before and after treatment. Normal creatinine amount contained in blood is between $0.70 - 1.20 \text{ mg/dL}$ (male, adult) or $0.50-0.90 \text{ mg/dL}$ (female, adult). In the pre-treatment phase, only patient J had creatinine level out of the normal range. The creatinine level of patient J is higher than the normal range but still in a group of high-normal level.

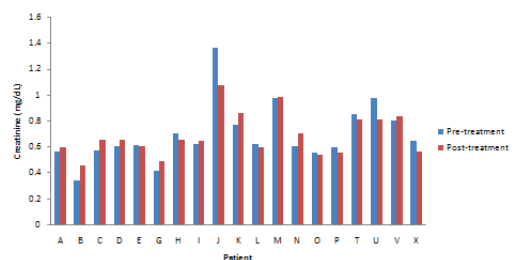


Fig. 7 Creatinine level Between Before and After Treatment

After being treated by sachets from BPL extract, the creatinine level of patient J fall into the normal range while other patients had their creatinine level remain inside the normal range. According to the result, the consumption of sachets from BPL extract is not impair the function of kidney. The normal level of urea in blood ranged between 13-43 mg/dL for people between 18 – 60 years old and 17 – 49 mg/dL for people between 61 – 90 years old.

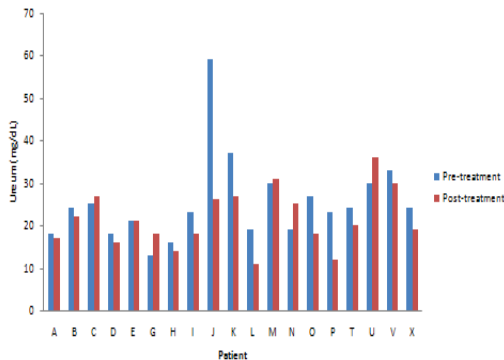


Fig. 8 Urea Level Between Before And After Treatment

Fig. 8 represents urea level of diabetic patients before and after being treated by sachets from BPL extract. All diabetic patients had normal level of urea before and after the treatment besides patient J. Urea level of patient J almost reach 60 mg/dL which is out of the normal range. After several months treated by sachets from BPL extract, the urea level of patient J fall into the normal range. The result of urea level between before and after treatment make it clear that the consumption of sachets from BPL extract is safe for the health of kidney function.

IV. CONCLUSION

The used of sachet as the end product of BPL extract is believed could maximize the convenience of distribution, storage, and consumption. Those products from BPL extract were distributed to 30 diabetic patients in Puskesmas Pulo Armin, Bogor. All patients were treated for 9 weeks and their blood glucose level were tested every once a week in order to observe the blood glucose between before, during, and after the treatment. As a result, the consumption of sachets from BPL extract affect the blood glucose level of diabetic patients. It successfully decreased the majority of diabetic patients. Besides, it also keep the blood glucose level remain stable in normal range without leading to hypoglycemia eventhough

patients consume it continuously. Different with some patients who still have blood glucose level higher than the normal range but during the treatment, the blood glucose level gradually decreased to the normal range. Every person has a different way and a different period of time to react with foreign materials in this case BPL extract. Thus, some people might needed a longer period to adapt to BPL extract until it can successfully fall the blood glucose level into the normal range.

To ensure that sachet product from BPL extract is safe to be consumed, whole blood hematology and kidney function tests were conducted to all diabetic patients. The test resulted good condition of blood hematology and kidney function of diabetic patients after treated by BPL extract. Leukocytes and ESR level were primary focused in the blood hematology test while urea and creatinine became the main indicator to show the kidney function. The consumption of sachet from BPL extract had no effect to blood hematology and kidney function. The test results represent no difference level of blood haematology and function of kidney between before and after treatment.

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