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EFFECTIVENESS OF BUTTERFLY PEA ETHANOL EXTRACT ON DECREASING BLOOD GLUCOSE LEVELS OF MALE MICE

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Abstract

Butterfly pea flower (*Clitoria Ternatea L.*) contains flavonoids, tannins, and triterpenoids, which contain flavonoid compounds that have the potential as antioxidants. Antioxidants can suppress beta cell apoptosis without changing the proliferation of pancreatic beta cells. Antioxidants can bind free radicals so that they can reduce insulin resistance. The novelty of this study was that it examined the effectiveness of ethanol extract from butterfly pea flowers on reducing alloxan-induced male mice blood glucose levels. This study aimed to determine the effectiveness of the ethanol extract of butterfly pea flowers in reducing alloxan-induced blood glucose levels. The study used an experimental method with 5 treatments on 25 mice, beginning with purposive collection and processing of sample plants, preparation of Simplicia powder, preparation of ethanol extract of butterfly pea flowers, characteristic testing, determination of total ash content, determination of acid insoluble ash content, determination of extract content. Soluble in water, determination of ethanol soluble extract content, determination of water content, phytochemical screening, testing of antidiabetic activity of butterfly pea flower extract induced by alloxan. The examination results contained a total ash content of 5.20%, an acid-insoluble ash content of 1.16%, a water-soluble essence content of 47.94%, and a water content of 3.29%. The results of the compounds in the ethanol extract of butterfly pea flowers are alkaloids, flavonoids, tannins, saponins, and steroids. The results of testing blood glucose levels of ethanol extract of butterfly pea flower (EEBT) at a dose of 200mg/kg bb were known to be effective in reducing blood glucose after being induced by alloxan 150mg/kg bb with glucose levels of 319mg/dL dropping to 104.93mg/dL. The conclusion of the ethanol extract of the butterfly pea flower shows that the butterfly pea flower is efficacious as a blood glucose lowering agent in alloxan-induced mice *(Mus musculus).*

Keywords: Alloxan; Butterfly pea flower; Blood Glucose; Effectiveness.

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1. INTRODUCTION

The increase in diabetes mellitus in Indonesia based on first-level health research shows from 5.7% in 2007 to 6.9% or around 9.1 million in 2013 (1). Back in 2011, Indonesia had the 10th highest diabetes population in the world with 7.2 million people and rose in 2013 to 7th with 8.5 million people with diabetes. In 2014, Indonesia was ranked fifth for the highest number of diabetes sufferers globally (2).

Diabetes Mellitus (DM) is a metabolic disorder characterized by the occurrence of hyperglycemia (high blood sugar) due to a deficiency of insulin secretion or insulin action (3) (4). This is because the pancreas cannot produce insulin in large enough quantities compared to what is needed by the body, so the burning and use of carbohydrates are not perfect (5) (6). Hyperglycemia sufferers need fast and appropriate treatment because it affects health in the long term (7). Sufferer diabetes has a habit of consuming food that contains carbohydrates and high sugar levels and an unhealthy lifestyle (8).

International diabetes federation (IDF) criteria, American Diabetes Association (ADA) (9). said high blood glucose during fasting above 126mg/d l and 2 hours after eating 200mg/d l, said low glucose levels, namely when blood sugar below 70 mg/d l many plants are used as traditional medicine, traditional medicine has also become a national cultural heritage that needs to be preserved and developed for health, not only is it good to use natural ingredients from traditional medicinal plants it is also an alternative have affordable prices for the community (10).

Many people must be aware of the many benefits of using herbal medicines for health. butterfly pea flower used as a traditional medicine to treat various diseases, so it can be used as a family herbal medicine that can treat red eyes, tired eyes, throat, skin diseases, urinary, stress, and antioxidants (11).

Telang flower (*Clitoria ternatea l.*) Is an identical compound flower with purple petals. Telang flower is usually known by different names in various countries, such as butterfly pea (English), Kordofan pea (Sudan), Cunha (Brazil) or Pokindang (Philippines), Mazerion Hidi (Arabic), Aparajit (Hindi), Aparajita (Bengali), and Kokkattan (Tamil), which belong to the Fabaceae family (12).

Flowers have many health benefits, including antioxidant, antidiabetic, and anti-inflammatory properties in the central nervous system (12). Butterfly pea flowers contain flavonoids, tannins, and triterpenoids. Antioxidants can suppress beta cell apoptosis without pancreatic beta cell proliferation. Antioxidants bind to free radicals, reducing insulin resistance (13). In previous research (14), the butterfly pea flower has a powerful antioxidant content because each phenolic content in it is themed using the depth method, the function of phenolic antioxidant compounds is a base for an oxidation-reduction reaction where phenolic compounds will be formed. As a reducing agent, it can be used as a reducing agent, reducing free radicals in the form of no longer active organisms—the reaction between DPPH radicals and phenolic compounds in

butterfly pea flowers.

Based on previous research (15). a decrease in blood sugar levels occurs because the butterfly pea flower contains phenolic acid compounds, flavonoids, anthocyanins, and other phenolic compounds. These components can reduce or inhibit the activity of gluconeogenic enzymes and glucose-6-phosphate.

Based on the above background, it is necessary to conduct research on "the effectiveness of the ethanol extract of butterfly pea flower *(Clitoria ternatea L.)* on an alloxan-induced decrease in blood glucose levels of male mice *(Mus Musculus)*.

2. METHODS

Research on reducing blood glucose levels included collecting plant materials, identifying plants, preparing powdered butterfly pea Simplicia, and making ethanol extract of butterfly pea flowers by maceration using ethanol solvent. The properties of the analysis included macroscopic tests, microscopic tests, total ash content tests, acid-insoluble ash tests, water-soluble extract tests, ethanol-soluble extract tests, phytochemical tests, and antidiabetic activity tests on various ethanol extracts of butterfly pea flowers.

Research on reducing blood glucose levels used the butterfly pea flower experimental method with 5 treatments, and each treatment consisted of 5 replications, so the total sample was 25 mice (16).

The tools used were laboratory glassware, a blender, a set of glucometers, mice-rearing cages, filter paper, a drying cupboard, mortar, oral sonde, parchment, dropper pipette, *rotary evaporator*, Spatel, 1 cc syringe, and Stamfer. The materials used in this study were Alloxan, Aquades, Butterfly Pea (*Clitoria ternatea* L.*)*, Ethanol pa, Glibenclamide, and Na-CMC. The collection of plant material was carried out purposively, ie without comparing it with similar plants from other areas. The plant used is the butterfly pea taken from Jl. Besar Bukit Lawang Gg Inpres Bahorok District, Langkat Regency, North Sumatra.

This simple powder is made at the Phytochemical Laboratory of the Faculty of Pharmacy, Tjut Nyak Dien University. A total of 4.9 kg of fresh eggplant flowers were cleaned, weighed, then dried by placing them in a drying cupboard at 40+50C, considered dry (simplicia) or broken (crushed), then the dried eggplant flowers were crushed using a blender, and the dry powder was measured (simplicia powder).

The extract was prepared using the maceration method with ethanol solvent as follows, 300 grams of butterfly pea flower Simplicia powder was mixed with ethanol solvent until soaked in a tightly closed container for three days, protected from sunlight, and stirred several times, then sieved to obtain the serum. The macerate obtained was collected, and the extract was evaporated using a rotary evaporator at a temperature of less than 40ºC until a thick layer was obtained. All the masert obtained was removed on a low-heat water bath.

The quality of the simplification and the results obtained include testing for water content, water-soluble ethanol content, total ash

content, and acid-soluble ash content. Phytochemicals screening was carried out to determine the components of the butterfly pea flower. This analysis was carried out on dry simplicia and butterfly pea leaf extract, including chemical analysis of alkaloids, saponins, tannins, flavonoids, steroid glycosides, and essential oils (17).

The experimental animals used were healthy male mice weighing 20-30 g, aged 2-3 months. Because at that age, the metabolic processes in the rat's body are complete, making it easier for research (18). Prior to treatment, the animals were acclimatized for 1 week under standard laboratory conditions, fed, and watered. Furthermore, the experimental animals were randomly divided into 5 groups, namely the positive and negative control groups and the butterfly pea flower extract treatment group (eebt) 50 mg/kg, 100 mg/kg, and 200 mg/kg.

This research has passed the recommendations for an ethical review conducted at the Komite Etik Penelitian Kesehatan (KEPK), Faculty of Sports and Health, the State University of Gorontalo with letter Number: 25/UN47.B7/KE/2023 in an effort to protect human rights and the well-being of research subjects. Health Research Ethics Review is an assessment of the feasibility of a research plan so that the research process that will be carried out by a person or profession can run properly and does not conflict with human values and the research code of ethics.

3. RESULT AND DISCUSSION

3.1. Sample Identification Result

Plant classification was carried out at the Medanense Laboratory (MEDA) Faculty of Mathematics and Natural Sciences, University of North Sumatra. Plant identification aims to determine the identification of plants used so that errors can be avoided in taking plant species. Identification results of plant samples, namely in the butterfly pea flower with the Fabaceae family.

3.2. Result Of Simplicia Powder Manufacturing.

A total of 4.9 kg of fresh butterfly pea flowers have been cleaned and then dried in a drying cupboard at 40 ± 5ºC for ± 3 days until the butterfly pea flowers are brittle (crushed) then put into a blender to obtain 450 grams of ram powder. The simplicia of the butterfly pea flower. The simplicia powder is stored in a well-closed container that is protected from sunlight and heat (19).

3.3. Results of the Extract of Butterfly Pea Flowers (Clitoria ternatea L.)

As much as 300 grams of butterfly pea simplicia powder was macerated using pa ethanol, and the results of the ethanol extraction of butterfly pea flowers were obtained as much as 22 grams of blackish brown color. Yield is the comparison of goods obtained with the first simple. The higher the yield value, the higher the extraction value. Extraction results can be influenced by several factors, one of which is the extraction method used. As much as 300 grams of butterfly pea simplicia powder was macerated using pa ethanol, and the results of the ethanol extraction of butterfly pea flowers were obtained as much as 22 grams of blackish

brown color. Yield is the comparison of goods obtained with the first simple. The higher the yield value, the higher the extraction value. Extraction results can be influenced by several factors, one of which is the extraction method used. In terms of time to get something that is more effective, it takes a long time and production because this image does not use heat assistance, so it produces less. This is due to the absence of other forces that assist in maceration, which is only carried out by immersion so that the osmosis of the solvent in the solid occurs statically even though the solvent has been replaced by recycling (20).

3.4. Result Of Determination of Characteristic

Determination of total ash content

From the test results, it is known that the total ash in this study was 5.20 %. Determination of ash content aims to provide an overview of the internal and external minerals from the initial process to the extracted composition. The principle is that green burns at a temperature where organic compounds and their derivatives disintegrate and explode so that the remaining mineral and inorganic ash content must have a small amount because this parameter indicates the presence of heavy metal contamination on the surface temperature. The report of the Minister of Health of the Republic of Indonesia No. 261/MENKES/SK/IV/2009 that the ash content of drugs should not exceed 10.2% (21).

3.5. Determination of total ash content

From the test results, it is known that the total ash in this study was 5.20 % Determination of ash content aims to provide an overview of the internal and external minerals from the initial process to the extracted composition. The principle is that green burns at a temperature where organic compounds and their derivatives disintegrate and explode so that the remaining mineral and inorganic ash content must have

3.6. Determination of Acid insoluble ash content

From the test results, it was found that acid-insoluble ash in this study was 1.16 %. According to the herbal pharmacopeia, acid-insoluble ash should not exceed 0.7 %. The results obtained indicate that the ethanolic extract of butterfly pea does not meet the requirements of the Indonesian herbal pharmacopeia standard (2008). Insoluble, highly acidic ash can be caused by the presence of sand or other impurities, possibly due to impure washing. Acid-insoluble ash is a requirement to determine the degree of cleanliness in product processing (21).

3.7. Determination of water-soluble essence content

Quality determination in the form of a water solubility test of 47.94% determination of water solubility levels is expected to determine the number of compounds that can be removed by water from simplicia (18), which are considered to play a role in determining other reactions depending on the compounds formed (22).

3.8. Determination of soluble in ethanol

From the test results, it was found that the content of the ethanol-soluble extract in this study was 6.00% ethanol-soluble extract.

According to Indonesian medical materials, the need for ethanol-soluble extracts is <4% (22). Determination of ethanol extract levels to determine the amount of solvent that dissolves in polar solvents, both polar and non-polar compounds (23).

Results of determination of water content. From the test results, it is known that the water content in this study was 3.29%. Too much water content in traditional medicinal preparations accelerated bacterial growth and also facilitated the hydrolysis of chemicals to end the decline in the quality of social medicine. The water contained in simplicia and produced according to health requirements, namely 10% water which is too much 9> 10%) causes the growth of bacteria which can reduce the stability of the object (24).

3.9 Results of Phytochemical Screening

The results of the phytochemical screening of the ethanol extract of butterfly pea flowers were carried out to obtain information on the class of compounds contained therein. Data on the results of the Phytochemical Screening of the Ethanol Extract of Butterfly Pea Flower can be seen in the table below

Table 1 Phytochemical Screening

No	Compound class	Check up result	Information
1	*Alkaloids*	Bouchardart	(-) a brick-red precipitate formed
			(-) brown precipitate formed
		Mayer Dragendrof	(+) brown precipitate formed
2	Flavonoids	Mg+ Hcl	(+) the red color is formed
3	Saponins	Aquadest + alcohol	(+) there is foam
4	Triterpenoids	Salkoswky	(-) no orange/purple ring is formed
5	Steroids	Lieberman-bouchardat	(+) is formed with a bluish-green color
6	tannins	$FeCl_3$ 1%	(+) A blue or green-black color is formed
7.	Glycosides	Lieberman-bouchardat	(-) A brick red color is formed

Source: Primary Data

The results of the phytochemical screening carried out showed that the ethanol extracted from butterfly pea flowers contains alkaloids, flavonoids, tannins, saponins, and steroids. The alkaloid test results showed a positive result for alkaloids when a red brick-red precipitate was formed (25). The mechanism of action in reducing pancreatic blood glucose levels is by increasing the transport of glucose in the blood, inhibiting the absorption of glucose in the milk, increasing glycogen synthesis, and inhibiting glucose synthesis (26).

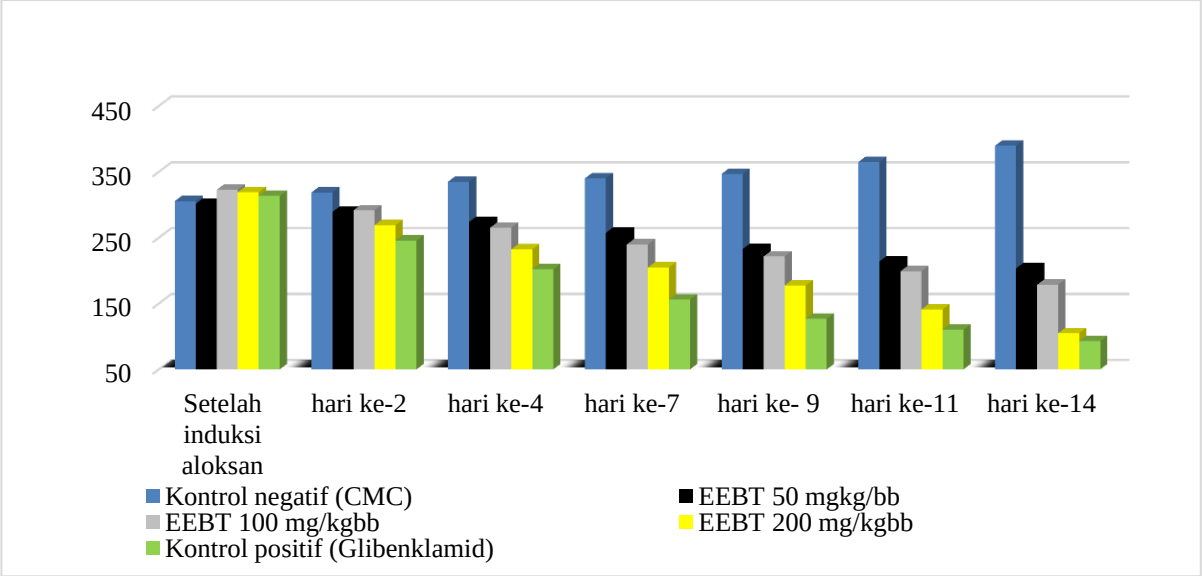
The results of the flavonoid test showed a positive effect of flavonoids, as indicated by the formation of orange, red and yellow colors (25). The mechanism of action of flavonoid oil in lowering blood glucose levels is by increasing the production of insulin produced by pancreatic cells by changing the metabolism of Ca2+ and restoring the pancreatic islets of Langerhans, especially pancreatic cells (26). If

the tannin test results produce a green or blue-black color, the extract is positive for containing tannin (25). The mechanism of action is by increasing glucose uptake through the use of MAPK and PI3K, tannins that can be hydrolyzed are divided into galotannins and ellagitannins.

Galotanin can increase glucose uptake while inhibiting adipogenesis (27). The results of the steroid test showed that the results obtained were negative triterpenoids because a purple-red color was not formed, while steroids were positive because a bluish-green color was formed (25). The glycoside test results are brown. If a green/blue color is formed, it indicates the presence of glycosides (28).

3.10 Results of antidiabetic effects of butterfly pea

In this antidiabetic test, five treatment groups were used, each treatment consisting of 5 replications so that a total sample of 25 mice. Consists of positive control (glibenclamide), negative control (CMC 0.5%), doses 50mg/kgbb, 100mg/kgbb, and 200mg/kgbb are needed to determine the ability of the test material to reduce blood glucose levels in mice. Then n on the positive control (glibenclamide) in lowering blood sugar levels in diabetics. The ability of clamamide gliben will be compared with that of the butterfly peas *(Clitoria ternate L)*.



Graph 1 Blood Glucose Levels in Mice After Administering Glibenclamide CMC Suspension EEBT 50mg/kgbb, EEBT 100mg/kgbb, EEBT 200mg/kgbb.

Blood glucose level after fasting for 8 hours was 100 mg/dL, then induced by alloxan 150 mg/kgbb. On the 14th day after administration of 0.5% CMC suspension, the blood glucose level was 389.6 mg/dL. It can be seen that there was no decrease in glucose levels, meaning that 0.5% CMC was not able to reduce blood glucose levels which increased after alloxan was induced. This means that CMC Na 0.5% is not able to reduce blood glucose levels.

The test results of the ethanol extract of the butterfly pea flower show that the butterfly pea

flower is efficacious in lowering blood glucose in mice *(Mus musculus).* alloxan induced at doses of 50 mg/kg, 100 mg/kg, and 200 mg/kg.

Table 2 Results of Measuring Glucose Levels in Test Animals

Test Group	**Blood Sugar Level (mg/dL)**							
	Fast	**After induction**	**Day 2nd**	**Day to 4**	**Day 7th**	**Day 9th**	**Day 11th**	**Day 14th**
Negative control (CMC)	100	305.4	318.6	335	340	346.8	364.8	389.6
EEBT 50 mg kg/bb	98	301.3	289	273.83	257.3	232.5	213.83	203.3
EEBT 100 mg/kg body weight	102	322.7	291.5	265.2	239.8	221.5	198.83	178.5
EEBT 200 mg/kg body weight	100	319	269	232.2	204.83	177.5	141	104.83
Positive Control (Glibenclamide)	100	313.5	245.7	202.17	156	126.8	110.3	93

Source: Primary Data

Based on Table 2, it is known that the results of blood sugar levels during fasting of the test animals were normal. Normal blood sugar levels in male mice are 71-124 mg/dL (18). Fasting blood glucose levels in the 50 mg/kgbb EEBT group were 98 mg/kgbb. After being induced, the blood glucose level of alloxan was 301.3 mg/ dL. After being given EEBT, the blood glucose level was checked on the 2nd day, which was 289 mg/dL. It was seen that there was a decrease in blood glucose but not normal. Then checked again on day 4, 273.83 mg/dL, and on day 7, 257.3 mg/dL. Day 11 213.83 mg/dL. Day 14 203.3 mg/dL.

Blood glucose levels of fasting mice in the 100 mg/kgbb EEBT group were 102 mg/ dL. After being induced by alloxan, the blood glucose level of the mice was 322.7 mg/dL. Then, given EEBT, blood glucose was checked after day 2, namely 291.5 mg/dL, then checked on day four at 265.2 mg/dL, and on day seven at 239.8 mg/ dL. 9th day 221.5 mg/dL. 11th day, 198.83 mg/dL, checked the blood sugar levels of mice again on day 14, 178.5 mg/dL. There was a decrease in glucose levels, but not to normal limits.

Blood glucose levels of fasting mice in the EEBT 200mg/dL group were 100 mg/dL, after alloxan-induced blood glucose levels in mice, were 319 mg/dL. Then given, EEBT, checking blood glucose levels on day 2, namely 269 mg/dL, then checking on day 4, 232.5 mg/dL. Day 7, 204.83 mg/dL. Day 9, 177.5 mg/dL, on the 11141mg /dL day, it has decreased on the 14th day it is checked, the blood glucose levels of the mice have decreased to normal, namely 104.83mg/dL, meaning that EEBT at a dose of 200mg/dL is more effective in reducing blood glucose than at a dose 50mg/dL and 100mg/dL

The blood glucose levels of mice in the glibenclamide group at a dose of 0.52 mg/dL, after being induced by alloxan, the blood sugar levels of mice were 313.5 mg/dL, then given EEBT. The blood glucose was checked on day 2, which was 245.7 mg/dL. On the 7th day, the

blood glucose level was 1 56 mg/dL. It had decreased but had not reached normal. A check was carried out again on the 14th day the mice's blood glucose level was normal, namely 93 mg/dL

Table 3 *Tukey* Test Results After Alloxan Induction

		Subset for alpha = 0.05
GROUP	**N**	**1**
EEBT 50 mg/Kg Bb	5	304.00
NEGATIVE CONTROL CMC NA 0.5%	5	305.40
POSITIVE CONTROL GLIBENCLAMID 0.52 mg/KgBb	5	314.20
EEBT 200 mg/kg body weight	5	319.20
EEBT 100 mg/kg body weight	5	322.80
Sig.		.428

Source: Primary Data

Based on Table 3 from the Tukey test, it was found that the results of blood sugar levels after being given treatment, namely by being Injected with alloxan, had a sugar level of 300 mg/kgbb – 320 mg/kgbb normal blood sugar levels in male mice.

Table 4 *Tukey* Test Results for Antidiabetic Testing on Day 2

GROUP		**Subset for alpha = 0.05**		
	N	**1**	**2**	**3**
POSITIVE CONTROL GLIBENCLAMID 0.52 mg/KgBb	5	243.60		
EEBT 200 mg/kg body weight	5	271.80	271.80	
EEBT 50 mg/kg body weight	5		291.80	291.80
EEBT 100 mg/kg body weight	5		291.80	291.80
NEGATIVE CONTROL CMC NA 0.5%	5			318.60
Sig.		.070	.301	093

Source: Primary Data

In Table 4 in the Tukey test results above on day two, there were statistical differences in columns 1, 2, and 3. This was due to significant differences in each group due to different administrations at each dose.

Table 5 *Tukey* Test Results for Antidiabetic Testing on Day 4

GROUP	N	Subset for alpha = 0.05			
		1	2	3	4
POSITIVE CONTROL GLIBENCLAMID 0.52 mg/kg body weight	5	203.20			
EEBT 200 mg/kg body weight	5	235.00	235.00		
EEBT 50 mg/kg body weight	5		276.20	276.20	
EEBT 100 mg/kg body weight	5			287.20	287.20
NEGATIVE CONTROL CMC NA 0.5%	5				335.00
Sig.		.362	.148	.965	071

Source: Primary Data

In Table 5 in the *Tukey test results* above on day 4 there are statistical differences in each column, at a dose of 200mg/kgbb with a dose of 50mg/kgbb, 100mg/kgbb, and glibenclamide. The doses of 200mg/kgbb and glibenclamide are in one column, and this states that there is no significant difference. Meanwhile, in column 3, there is a difference at the dose of 200mg/kgbb with doses of 50mg/kgbb and 100mg/kgbb. This can be seen in the doses of 50mg/kgbb and 100 mg/kgbb in one column, so it can be said that there is no significant difference.

Table 6 *Tukey* Test Results for Antidiabetic Testing on Day 7

GROUP	N	Subset for alpha = 0.05			
		1	2	3	4
POSITIVE CONTROL GLIBENCLAMID 0.52 mg/kg body weight	5	155.80			
EEBT 200 mg/Kg Bb	5		207.20		
EEBT 100 mg/Kg Bb	5			238.00	
EEBT 50 mg/Kg Bb	5			259.00	
NEGATIVE CONTROL CMC NA 0.5%	5				340.00
Sig.		1,000	1,000	.100	1,000

Source: Primary Data

In Table 6. in the Tukey test results above, *there* was a statistically significant difference on day 7, which can be seen from the different columns at each dose given. Doses of 100 mg/ kgbb and 50 mg/kgbb are in one column. This states that there is no significant difference. Meanwhile, in column 2, there is a difference in the dose of 200 mg/kgbb separately from columns 3 and 4. This can be said to be a significant difference.

Table 7 *Tukey* Test Results for Antidiabetic Testing on Day 9

		Subset for alpha = 0.05			
GROUP	**N**	**1**	**2**	**3**	**4**
POSITIVE CONTROL GLIBENCLAMID 0.52 mg/KgBb	5	128.20			
EEBT 200 mg/Kg Bb	5		179.40		
EEBT 100 mg/Kg Bb	5			220.00	
EEBT 50 mg/Kg Bb	5			233.20	
NEGATIVE CONTROL CMC NA 0.5%	5				346.80
Sig.		1,000	1,000	.509	1,000

Source: Primary Data

In Table 7, in the results of the Tukey test above, there was a statistically significant difference on day 9. This can be seen from the different columns at each dose given. Doses of 100 mg/ kgbb and 50 mg/kgbb are in one column, and this states that there is no significant difference. Meanwhile, in column 2, there is a difference in the dose of 200 mg/kgbb separately from columns 3 and 4. This can be said to be a significant difference.

Table 8 *Tukey* Test Results for Antidiabetic Testing on Day 11

		Subset for alpha = 0.05			
GROUP	**N**	**1**	**2**	**3**	**4**
POSITIVE CONTROL GLIBENCLAMID 0.52 mg/KgBb	5	110.40			
EEBT 200 mg/Kg Bb	5		142.40		
EEBT 100 mg/Kg Bb	5			198.40	
EEBT 50 mg/Kg Bb	5			214.40	
NEGATIVE CONTROL CMC NA 0.5%	5				364.80
Sig.		1,000	1,000	.158	1,000

Source: Primary Data

In Table 8, the results of the Tukey test above, there is a difference in the number of differences on day 11 which can be seen from the differences in colonies at each of 200 mg/kgBW with a concentration of 50 mg/kgBW given. These drugs are listed in one dose with a dose of 50 mg/kg body weight and 100 mg/kg body weight. This means that there is no significant difference, while at the two points, 1 and 2 degrees of separation 200 mg/kg with good control (glibenclamide), it can be said that there is a significant difference.

Table 9 *Tukey* Test Results for Antidiabetic Testing on Day 14

		Subset for alpha = 0.05		
GROUP	**N**	**1**	**2**	**3**
POSITIVE CONTROL GLIBENCLAMID 0.52 mg/KgBb	5	92.00		
EEBT 200 mg/Kg Bb	5	104.20		
EEBT 100 mg/Kg Bb	5		177.20	
EEBT 50 mg/Kg Bb	5		203.60	
NEGATIVE CONTROL CMC NA 0.5%	5			389.60
Sig.		.672	061	1,000

Source: Primary Data

In Table 9 of the Tukey test results above, there are a number of different variables on day 14. This can be seen from the difference in colons for each of 200 mg/kgBW with a given level of 50 mg/kgBW. The scale in the same column means that there is no significant difference, while in columns 1 and 2, and 3, it is different. It can be said that there is a big difference.

From the first blood glucose table and after the introduction, it can be seen that the decrease in glucose can be seen that all drugs are effective in reducing sugar levels in rats, both in control and without treatment. This is because all treatments were given ethanol extract of tamarind flowers which contain active compounds such as flavonoids and tannins, which play an important role in inhibiting insulin in pancreatic beta cells. Flavonoids are able to overcome insulin deficiency because they can restore pancreatic cells (29). While good control is given with oral antidiabetic drugs, glibenclamide can actually have an effect on reducing sugar levels. This is because glibenclamide works to stimulate insulin secretion from pancreatic Langerhans beta cells through interaction with ATP-sensitive K channels on beta cell membranes, nerves that cause membrane stimulation, and this condition will open Ca channels by opening Ca channels, Ca++ ions will enter beta cells, stimulate insulin-filled granules and insulin secretion will occur (30).

4. CONCLUSION

The test results of the ethanol extract of the butterfly pea flower showed that the butterfly pea flower was efficacious in lowering blood glucose in alloxan-induced mice (*Mus musculus*). It has been proven that the butterfly pea flower is able to lower blood glucose in mice (*Mus musculus*).

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