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Antidiabetic Effectiveness Test of Bitter melon (*Momordica charantia L*) Extract Suspension in Male White Mice (*Mus musculus*)

Arief Rahman Afief[1*], Subagja[1], Dosi Ahmad Yani[1], Ichan Harry Prayoga Sasongko[1]

[1]Department of Pharmacy, Universitas YPIB Majalengka, Indonesia

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***Corresponding author:** Arief Rahman Afief
Department of Pharmacy, Universitas YPIB Majalengka, Indonesia

Abstract

Diabetes mellitus is a metabolic disorder characterised by the inability of the pancreas to produce the hormone insulin in accordance with the body's requirements. Diabetes mellitus is a lifelong disease and, as yet, there is no cure. The costs associated with diabetes mellitus drugs are currently quite expensive. The utilisation of traditional medicinal practices involving the use of medicinal plants represents an alternative treatment option that employs natural ingredients with minimal side effects. One such example is the use of bitter melon (*Momordica charantia L.)*, which has been demonstrated to possess antidiabetic properties. The objective of this study was to ascertain the antidiabetic efficacy of a bitter melon fruit extract suspension formula. This study employed an experimental methodology, whereby a suspension formulation of bitter melon fruit extract was prepared with three distinct doses. A total of 25 male white mice, induced with alloxan, were selected as test animals and divided into five treatment groups. Group X1 received a dose of 150 mg/kg b.w., Group X2 received a dose of 300 mg/kg b.w., Group X3 received a dose of 450 mg/kg b.w., while the negative control and positive control groups were also included. The data were subsequently analysed using the statistical software package SPSS (version 27), which included tests for normality, homogeneity, one-way ANOVA and the T-test. The findings of this study indicate that the treatment group, which received a suspension of bitter melon fruit extract at a dose of 450 mg/kg bw, exhibited a superior efficacy in reducing blood glucose levels, approaching the level observed in the positive control group.

Keywords: Diabetes Mellitus, Bitter Melon, Extract Suspension.

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INTRODUCTION

Diabetes mellitus is a metabolic disorder characterised by hyperglycaemia, which results from a metabolic system disorder in the body. This is caused by an inability of the pancreas to produce the hormone insulin in accordance with the body's requirements, which in turn leads to the development of microvascular and macrovascular chronic complications [1]. The diagnosis of diabetes mellitus can be made by measuring the patient's blood glucose levels. In individuals with diabetes mellitus, blood glucose levels are typically above 200 mg/dL [2]. In individuals with diabetes mellitus, fasting blood glucose levels are typically above 126 mg/dL [3].

The prevalence of diabetes mellitus in Indonesia is 8.5%, representing a significant increase from 1.5% in 2013 [4]. A mere 25% of individuals with diabetes in Indonesia are aware of their condition. In 2009, diabetes was the sixth leading cause of mortality in Indonesia [5]. By 2019, however, it had risen to become the third leading cause of death in the country [4, 5].

Diabetes mellitus is a lifelong disease with no known cure. However, blood glucose levels can be managed effectively to achieve a state of equilibrium with the glucose levels of a healthy individual. There are four principal methods of treating diabetes mellitus: education, dietary modification, physical exercise and pharmacological treatment, which encompasses the administration of oral hypoglycaemic drugs [6, 7]. The financial burden associated with diabetes mellitus medications is currently considerable. Consequently, there is a need to identify alternative therapeutic options that can effectively address this condition [8]. One potential avenue for exploration is the utilisation of medicinal plants that are readily available in our immediate environment [8].

Bitter melon (*Momordica charantia L.*) is a food crop that is frequently employed as a traditional medicinal agent. As both a food ingredient and a traditional medicine, bitter melon is a plant with considerable growth potential due to its high economic value. Bitter melon contains a variety of compounds, including alkaloids, flavonoids, and triterpenoids [9]. One compound, flavonoids, has been identified as a potential antidiabetic agent. This compound has been shown to reduce blood sugar levels by inhibiting the enzyme α-amylase [10][11].

MATERIAL AND METHODS

The methodological approach encompasses the following elements: design, subject, location, ethical considerations, measurement/measuring tools, data collection methods/procedures and data analysis. This type of research employs an experimental approach, specifically the investigation of the antidiabetic efficacy of bitter melon fruit extract suspension in male white mice as experimental subjects. The research was conducted in the pharmacy laboratory of the Imam Bonjol Majalengka Education Foundation University.

The following tools were employed in this study: a Maserator, digital scales, a measuring cup with a capacity of 100 mL, a stirring rod, a flannel cloth, a funnel, a vaporising cup, a bottle, a water bath, a test tube, a drip pipette, filter paper, an oven, a mortar and stamper, a sudip, parchment paper, a beaker glass, a sonde spuit 1 mL, an easy tourch, a strip gluco, and a blood lancet. The materials employed in this study comprise bitter melon, aquadest, hot water, glibenclamide, alloxan, Na-CMC, Nipagin, aquadest pro injection, and male white mice.

Preparation of Bitter Melon Extract Suspension

The dried fruit of the bitter melon has been extracted using the maceration method and is available in three specific concentrations: 150 mg/KgBB, 300 mg/Kg/BB, and 450 mg/KgBB. A suspension was prepared in a volume of 100 mL using the following formulation: Sodium CMC, Aqua pro CMC, Nipagin, and Aquadest [12].

Preparation of 1% Sodium CMC Solution

The sodium CMC was weighed in quantities of up to 1 gram, and the Nipagin solution was prepared with a volume of 100 mL. The sodium CMC was mixed with hot distilled water in quantities of up to 20 mL, and the resulting solution was stirred until a homogeneous and viscous mucilage was formed [12].

Alloxan As Induction Diabetic Mice

The conversion factor of 200 grams of rats to 20 grams of mice is 0.14. Subsequently, the dose for one mouse is calculated to be 3.5 mg/0.2 mL, which equates to 0.2 mL of alloxan administered intraperitoneally (IP) [13, 14].

Preparation of Glibenclamide Suspension

The administered dose is based on the human dose, which has been converted to a dosage appropriate for mice. The known dose of glibenclamide for humans is 5 mg, and the conversion factor from humans to mice is 0.0026. The glibenclamide solution was prepared by dissolving one glibenclamide tablet in 1% Na-CMC (79.92 mL). Subsequently, 0.2 mL, the equivalent of the daily dose administered to mice, was administered [15].

Treatment of Test Animals

A total of 25 male white mice were randomly assigned to one of five groups, with each group comprising five mice. (The mice that will be treated should be weighed). Prior to testing, the mice were adapted to the testing environment by fasting for eight hours (administering water but no food). On the first day of the experiment, the test animals were first measured for blood sugar levels and all groups of test animals were first given alloxan intraperitoneally (IP) at a dose of 0.2 mL. On the third day, the blood sugar levels of the mice were then measured. Subsequently, Groups I, II, and III were administered a sample of bitter melon fruit extract suspension at doses of 150 mg/kgBB, 300 mg/kgBB, and 450 mg/kgBB, respectively, in volumes of 0.25 mL, 0.50 mL, and 0.75 mL. The three doses were administered on a daily basis. Group IV was administered suspended glibenclamide (K+) once a day orally in doses of up to 0.2 mL. Group V was administered the suspending agent (K-) once a day orally in a dosage of up to 0.2 mL. Blood samples were collected via puncture of the tail with a lancet. On days six and ten, blood glucose levels were assessed, and the data were subsequently analysed.

Data Analysis

The data on the reduction in blood sugar levels in mice were subjected to a series of statistical tests, including normality tests, homogeneity tests, ANOVA tests and T-tests, using the IBM SPSS 27 application. The objective of these tests was to ascertain whether there were significant differences between the various groups in terms of their blood glucose levels [16, 17]. A T-test was conducted to ascertain the dose of the papaya fruit extract suspension that exhibits the greatest antidiabetic efficacy in male white mice. This statistical test was performed on data that met the criteria for normality and homogeneity [18, 19].

RESULTS AND DISCUSSION

The results of this study were obtained in the pharmaceutical laboratory of the Imam Bonjol Majalengka Education Foundation University. The efficacy of bitter melon fruit extract in the treatment of diabetes in male white mice can be observed in the following table of data.

Table 1. Recapitulation of the results of the reduction in glucose levels of test animals

Group	Average reduction in blood glucose level (mg/dl)	Standard deviation
1 (X1)	72,4	22,87
2 (X2)	87,6	29,39
3 (X3)	123,8	24,69
4 (K+)	159,8	44,48
5 (K-)	26,4	7,70

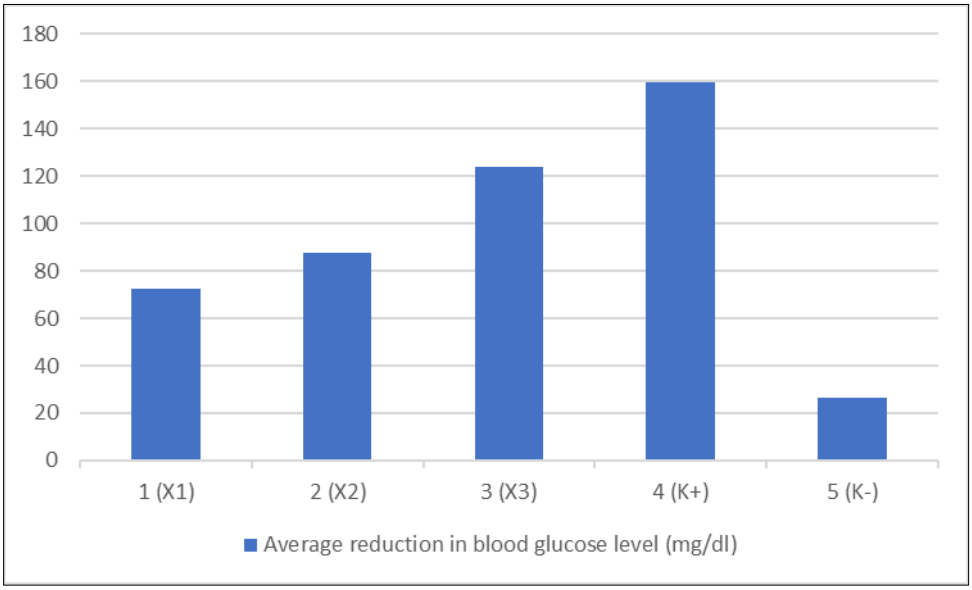

Figure 1. Graph of recapitulation of the average decrease in blood glucose levels in each group

The results of the study, as presented in Table 1, indicate that Group 1 (X1) exhibited an average reduction in blood glucose levels of 72.4. Group two (X2) exhibited an average reduction in blood glucose levels of 87.6. The mean reduction in blood glucose levels for Group 3 (X3) was 123.8. Group four (K+) exhibited an average reduction in blood glucose levels of 159.8. Group five (K-) exhibited an average blood glucose level of 26.4, as illustrated in Figure 1. The administration of a dose of 450 mg/kgBB to group 3 resulted in the most notable reduction in blood glucose levels in comparison to groups 1 and 2.

Normality Test

Table 2. Normality Test Results

Tests of Normality							
	Variaberl	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Variable Results X1,X2,X3,K+,K-	X1	.306	5	.142	.871	5	.272
	X2	.202	5	.200*	.979	5	.929
	X3	.329	5	.081	.862	5	.236
	K+	.217	5	.200*	.948	5	.722
	K-	.222	5	.200*	.864	5	.244
*. This is a lowerr bournd of ther trurer significancer.							
a. Lillierfors Significancer Correrction							

The normality test data in Table 2, revealed that all values (sig) were greater than 0.05. In X1, the bitter melon extract suspension with a dose of 150 mg/KgBB yielded a significant value of 0.272, which was greater than 0.05. Similarly, in X2, the bitter melon extract suspension with a dose of 300 mg/KgBB produced a significant value of 0.929, which was also greater than 0.05. Finally, in X3, the bitter melon extract suspension with a dose of 450 mg/KgBB yielded a significant value of 0.236, which was greater than 0.05. Similarly, the positive control glibenclamide suspension yielded a significant value of 0.722, which is greater than 0.05, while the negative control Suspending Agent also yielded a significant value of 0.244, which is greater than 0.05. This indicates that the data obtained are normally distributed.

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Homogeneity Test

Table 3. Homogeneity Test Results

Tests of Homogeneity of Variances					
		Lerverner Statistic	df1	df2	Sig.
Variable Results X1,X2,X3,K+,K-	Baserd on Meran	1.494	4	20	.242
	Baserd on Merdian	.714	4	20	.592
	Baserd on Merdian and with adjursterd df	.714	4	17.137	.594
	Baserd on trimmerd meran	1.457	4	20	.252

The results of the homogeneity test yielded a significant value of 0.242, which is greater than 0.05. This indicates that the data is uniform and has the same variance, thus meeting the requirements for the one-way ANOVA test.

One-Way ANOVA Test

Table 4. One-way ANOVA Test Results

ANOVA					
Variable Results X1,X2,X3,K+,K-					
	Surm of Squrarers	df	Meran Squrarer	F	Sig.
Bertwerern Grourps	51474.800	4	12868.700	15.943	.000
Within Grourps	16143.200	20	807.160		
Total	67618.000	24			

The results of the ANOVA test indicate that the data value (sig) is less than 0.000, thereby rejecting the null hypothesis (Ho) and accepting the alternative hypothesis (H_1). This signifies that: The fruit extract suspension of bitter melon has been demonstrated to possess antidiabetic efficacy in male white mice.

T-Test

Table 5. T-test Results

Paired Samples Test									
		Pairerd Differrerncers					t	df	Sig. (2-tailerd)
		Meran	Std. Derviation	Std. Errror Meran	95% Confiderncer Interrval of ther Differrerncer				
					Lowerr	Urpperr			
Pair 1	X1 – K+	-87.400	39.991	17.885	-137.056	-37.744	-4.887	4	.008
Pair 2	X2 – K+	-72.200	56.451	25.246	-142.293	-2.107	-2.860	4	.046
Pair 3	X3 – K+	-36.000	36.339	16.251	-81.120	9.120	-2.215	4	.091
Pair 4	K- – K+	-133.400	42.524	19.017	-186.201	-80.599	-7.015	4	.002

The results of the study were analysed using a T-test. The objective of the T-test was to ascertain whether there were any significant differences between the bitter melon fruit extract suspension and the positive control. The results of the T-test, which compared X1 and K+, demonstrated a statistically significant difference with a p-value of 0.008, which is less than 0.05. The T-test results, comparing X2 and K+, yielded a significant value of 0.046, indicating a notable discrepancy. The T-test results for the comparison between X3 and K+ (with a significant value of 0.091 > 0.05) indicate that no significant difference was observed. The T-test results indicate a significant difference between K- and K+ ($p = 0.002$, with a confidence interval of 95%), suggesting that the two groups are not comparable.

The T-test results indicate that X3 has the largest value in comparison to the positive control, with a significance level of 0.091, exceeding the 0.05 threshold, suggesting that no significant differences are observed between the two. The results demonstrate that the bitter melon fruit extract suspension at a dose of 450 mg/kg body weight is the most effective in reducing blood sugar levels.

CONCLUSION

The results of the research demonstrate that the bitter melon fruit extract suspension exhibits antidiabetic efficacy in male white mice. The bitter melon extract suspension at a dose of 450 mg/kg body weight (BW) was observed to be the most effective antidiabetic agent, exhibiting a reduction in blood sugar levels approaching those observed in the positive control group.

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Authors Contribution

Conceptualized, conceived, and designed the study: S., and D.A.Y. Performed the analysis: I.H.P.S. Curated the data: S., D.A.Y and A.R.A. Wrote the original draft: A.R.A. Interpreted the data: I.H.P.S and A.R.A Revised the manuscript: S., D.A.Y and A.R.A. All authors have read and agreed to the published version of the manuscript.

Declaration of Competing Interest: The authors declare no competing interests.

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