



## Effect Jamblang Stem Barks, Mangosteen Peel, and Cinnamon to Blood Sugar Levels

Thabed Tholib Baladraf<sup>1</sup>

<sup>1</sup>Department of Agroindustrial Technology, Faculty of Agricultural Technology, University of Jember, Indonesia



\*Corresponding Author: Thabed Tholib Baladraf

### Article Info

#### Article history:

Received 6 March 2021

Received in revised form 3

April 2021

Accepted 9 April 2021

#### Keywords:

Blood Sugar

Cinnamon

Diabetes Mellitus

Jamblang Stem Barks

Mangosteen Peel

### Abstract

Diabetes mellitus ranks seventh as the most deadly disease with a prevalence of 1.9% and is dominated by type 2 diabetes mellitus with 95%. This research purposed to determine the effect and potential biodiversity of extracts of jamblang stem barks, cinnamon and mangosteen peel as an antidiabetic drug in the form of infusion in rats induced by alloxan. This research used one-factor completely randomized design (CRD) with a linear model. Data were analyzed by One Way ANOVA and Post-hoc Tukey. The sample used was male mice aged 2-3 months with a body weight of  $\pm 20$  grams. The sample consisted of 25 individuals and divided into 5 groups. group I (control), group II (alloxan induction + jamblang stem barks extract, cinnamon, and mangosteen peel 1.35 grams / 200gBB), group III (alloxan induction + mangosteen peel 1.35 grams / 200gBB), group IV (alloxan induction + wood sweet 1.35 gram / 200gBB), group V (alloxan induction + jamblang stem barks 1.35 gram / 200gBB). Day 21, the amount of increase in blood sugar levels was observed and assessed based on the results of the tools used. The results showed that the infusion of jamblang stem barks, cinnamon and mangosteen peel had a significant effect on reducing blood sugar so that it could prevent type 2 diabetes mellitus.

## Introduction

Diabetes Mellitus (DM) is a metabolic disease with characteristics including hyperglycemia that occurs due to insulin disorders, insulin action, or a combination of insulin disorders and insulin action (Soelistijo et al., 2015). According to Fatimah (2015) diabetes mellitus is ranked seventh as the most deadly disease with a prevalence of 1.9% and is dominated by type 2 diabetes mellitus (T2DM) with 95% of all diabetes cases in the world. The International Diabetes Federation (2017) predicts an increase in the number of people with type 2 diabetes mellitus in the world from 425 million in 2017 to 629 million in 2045.

Indonesia is ranked seventh in the world with the highest number of diabetics. Artha *et al.* (2019) predict that type 2 diabetes mellitus sufferers in Indonesia in 2045 will reach 5.4 and have low blood sugar control rates. Diabetes mellitus type 2 is referred to as the silent killer because this disease can affect all organs of the body and cause various kinds of complaints. Diseases that will be caused include eye vision problems, cataracts, heart disease, kidney disease, sexual impotence, wounds that are difficult to heal and rot/gangrene, lung infections, blood vessel disorders, strokes and so on. Even people with diabetes mellitus who are already severe undergo limb amputation due to decay.

The solution to this problem is utilizing natural commodities that are rarely used but have potential, among others jamblang stem barks, mangosteen peel, and cinnamon which is packaged into a popular and easy to consume product. The basic material in this research is jamblang stem barks, mangosteen peel, and cinnamon. These three commodities were chosen

because they have complementary ingredients to prevent type 2 diabetes mellitus. Jamblang stem bark extract has a low glycemic index so that the blood sugar levels that will arise are not too high and contains alkaloid, phenolic, flavonoid, and tannin class compounds which act as an antihyperglycemic (Sariga *et al.*, 2015). Cinnamon contains bioactive cinnamaldehyde which is an antioxidant that can fight free radicals and can lower blood sugar (Kusumaningtyas *et al.*, 2014). Mangosteen peel which has xanthon compounds that act as anti-hyperglycemic and lower blood sugar (Maligan *et al.*, 2018).

Based on the description above, a study was conducted on the analysis of lowering blood sugar and making brew made from jamblang stem barks, mangosteen peel, and cinnamon as an effort to prevent and treat the disease type 2 diabetes mellitus. The combination of these three ingredients can potentially be used simultaneously and result in a significant reduction in blood sugar. The objectives of this research are (1) to determine the potential biodiversity of extracts of jamblang stem barks, cinnamon and mangosteen peel as an antidiabetic drug in the form of infusion in rats induced by alloxan (2) to determine the effect of jamblang stem barks, cinnamon and mangosteen peel to blood sugar.

## Methodology

This research is an experimental study using one factors completely randomized design (CRD). The research data were processed using Microsoft Excel 2007 and SPSS 16 version using the ANOVA method to determine the differences in treatment at the level of  $\alpha = 0.05$ . If the treatment shows a difference, a further test is carried out using Least Significant Difference test (LSD) at a significant level of 5%. Furthermore, the best treatment is obtained by using the effectiveness index test. Data is presented in tabular form and then described.

## Research Design

This research is an experimental study with 1 factor completely randomized design (CRD). The study used a sample of 30 individuals aged 8 weeks with details of 6 normal and 24 individuals infected with diabetes mellitus with extract treatment. Of the 24 animals that were given the extract, they were further divided for 4 special treatments, namely 6 for mangosteen peel extract, 6 for cinnamon extract, 6 for Jamblang stem bark extract and 6 for the three extracts. After calculating using the Federer's formula, the ideal number of samples used in this study was 5 samples in each group. The federer's formula is expressed as:

$$(t - 1) (r - 1) \geq 15 \dots \dots \dots (1)$$

## Tools and Materials

The needs for tools used in this research is cages for experimental animals, scale, blood sugar meter, surgical instruments for experimental animals (scalpel, tweezers, needles, paraffin tub), lup, measuring cup, mortar, beaker glass, hot plate, measuring pipette, filer, syringe is blunt, vaporizer cup, erlenmeyer, test tube, test tube rack, plates, spirtus light and water bath. The needs for materials used in this research is food for experimental animals, mangosteen peel extract, cinnamon extract, jamblang stem bark extract, aquades, alloxan.

## Research Stages

### *Treatment of Diabetes with Induced Glucose 40%*

The toxic dose of 40% glucose in humans is 600 mg/kg body weight in mice. The toxic dose of 40% glucose for mice is based on a human conversion table with a body weight of 200 g with a conversion factor of 0.14. Dosage calculation expressed as:

$$\text{Dosage} = \text{Toxic dose human} \times \text{conversion factor} \dots \dots \dots (2)$$

Based on the dosage calculation, the results are 1.68 mg/20 gBB mice. Alloxan suspension is made by dissolving alloxan in distilled water. For the addition of 0.1 ml of 40% glucose solution, 500 mg alloxan tablet is dissolved in distilled water as much as:

$$\frac{\text{Weight alloxan tablet}}{z} = \frac{\text{Dosage}}{\text{Orally}} \dots\dots\dots(3)$$

Based on the z calculation, the z results are 29.4 ml of solvent. Alloxan dose of 1.7 mg/20 g body weight of mice orally (0.1 ml) was given to the treatment group 1,2,3,4 on days 7-13, once a day.

### ***Preparation Extract Jamblang Stem Barks, Mangosteen Peel, and Cinnamon***

Extract was made by jamblang stem barks (*Syzygium cumini*), mangosteen peel (*Garcinia mangosta*), and cinnamon (*Cinnamomum burmanii*). Material which have been dried in the sun are weighed the same for each type of material, then washed, drained and dried. The next step to get a mixed extract is just to brew the three mixtures of these ingredients.

### ***Therapy with Brew of Jamblang Stem Barks, Mangosteen Peel, and Cinnamon***

The research used a sample of 25 mice, then the mice were divided into 5 groups, so that the number of samples for each group was 5 mice. The explanation regarding the treatment of each group is as follows:

- Group I: Given standard food, as a control group.
- Group II: Given standard food + glucose 40% 1,7 mg/20 gBB + extract of jamblang stem barks, mangosteen peel, and cinnamon as much as 1.35 grams/200Gbb.
- Group III: Given standard food + glucose 40% 1,7 mg/20 gBB + extract of mangosteen peel as much as 1.35 grams/200gBB.
- Group IV: Given standard food + glucose 40% 1,7 mg/20 gBB + extract of cinnamon as much as 1.35 grams/200gBB.
- Group V: Given standard food + glucose 40% 1,7 mg/20 gBB + extract of jamblang stem barks as much as 1.35 grams / 200gBB.

The extract dosage of jamblang stem bark, mangosteen peel, and cinnamon used was the result of the conversion from human to mouse dosage was 1.35 grams/200 gBB. To adjust the maximum capacity of the rat's stomach (5 ml), the dosage of 1.35 gram/200 gBW was dissolved in water until the volume reached 2 ml. Given by injection using a blunt injection. Giving alloxan treatment to the treatment group 1,2,3,4 on days 7-13, once a day, while the treatment of jamblang stem bark extract, mangosteen peel and cinnamon in the treatment group 1,2,3,4 on day 14-20th, once a day.

### ***Measurement Results***

After being treated for 20 days, all experimental animals were sacrificed by anesthetizing using ether, then checking their blood sugar levels. Testing the effect of giving the three extracts was carried out by observing blood sugar levels. The cure rate is based on reducing the level of blood sugar levels measured by calculating the amount of sugar levels.

### ***Data Analysis***

Data obtained blood sugar levels in control group rat, groups of sick rat with induction alloxan, and group of rat therapy that given extract jamblang stem bark, mangosteen peel, and cinnamon. Data were analyzed by Analysis of Variance (ANOVA) and Post-hoc Tukey. The

hypotheses in this study are H0: The three extracts had no effect on reducing blood sugar levels in mice. H1: The three extracts have an effect on reducing blood sugar levels in mice.

## Results and Discussion

Based on the research that has been done, the results and research process images are presented in Figure 1.

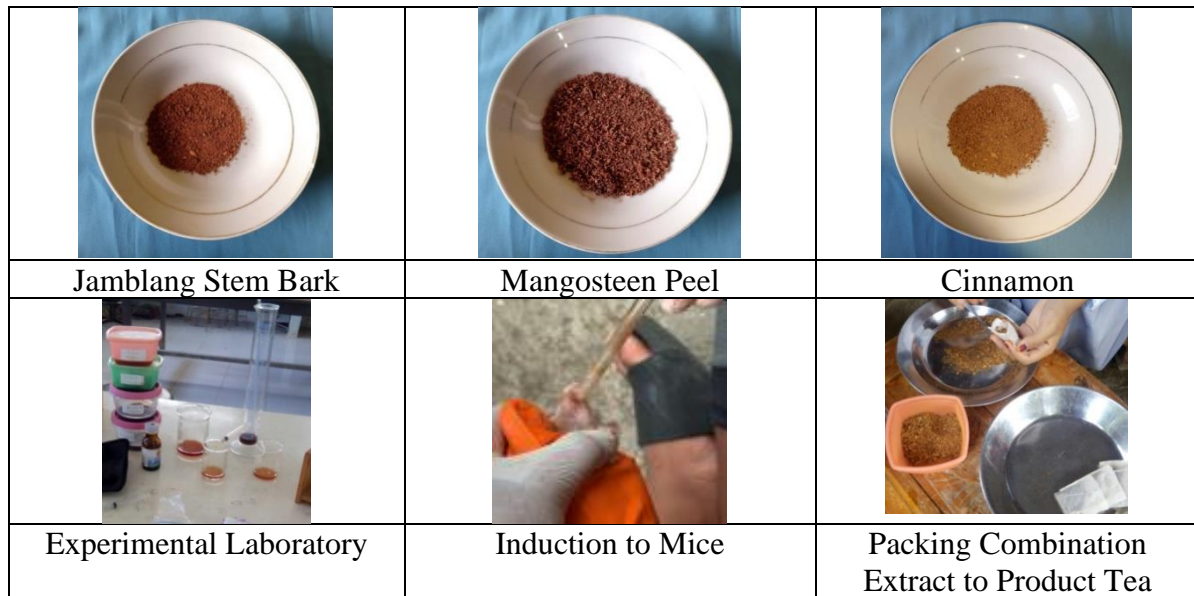


Figure 1. Results and Research Documentation

A study was conducted on reducing blood sugar levels of mice that were given jamblang stem bark extract, mangosteen peel and cinnamon to reduce blood sugar levels induced by alloxan. The data obtained from observations in each group were conducted. Result from the observation of the comparison test for sugar levels are presented in Table 1.

Table 1. Results of Testing Sugar Levels in Each Group

Group	Before Induction	After Induction	Sugar Levels After Being Given the Extract			
			Jamblang Stem Bark	Cinnamon	Mangosteen Peel	Mix
I	76mg/dl					
II	105 mg/dl	295mg/dl	295mg/dl	132 mg/dl	150 mg/dl	70 mg/dl
III	112 mg/dl	235mg/dl	235mg/dl	117 mg/dl	124 mg/dl	65 mg/dl
IV	95mg/dl	335mg/dl	335mg/dl	123 mg/dl	160 mg/dl	100 mg/dl
V	126mg/dl	178mg/dl	178mg/dl	74 mg/dl	152 mg/dl	45 mg/dl

Testing the blood sugar analysis using a blood sugar meter. Blood sugar analysis is done to see the decrease that occurs after being treated. The graph of the results of blood sugar analysis is presented in Figure 2.

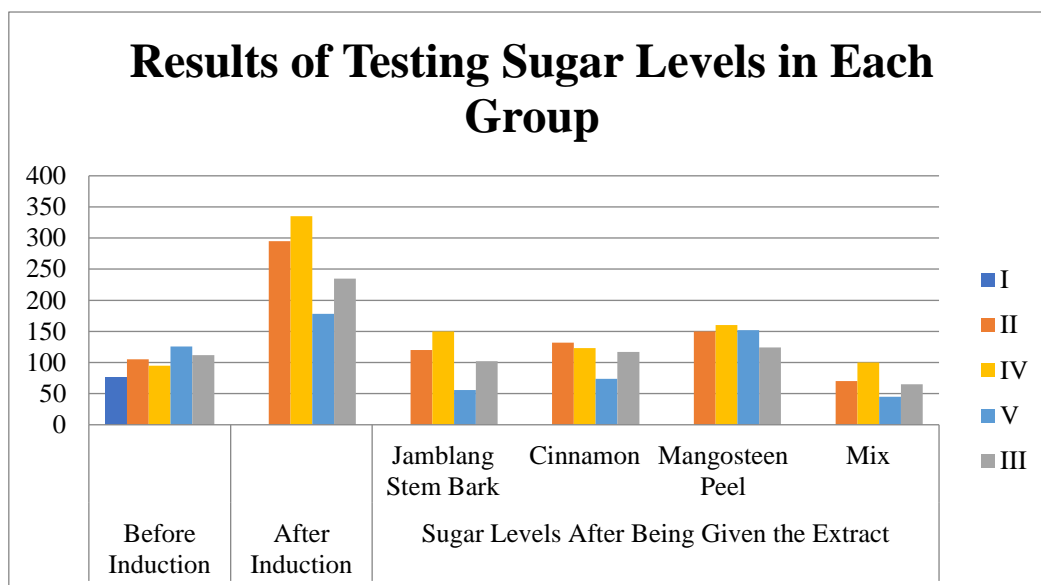


Figure 2. Graphic Result of Testing Sugar Levels in Each Group

Group I became a negative control who was only given standard feed. In this group of mice, normal blood glucose levels were obtained. Group II was the group that was given alloxan + extract of jamblang stem bark, cinnamon, and mangosteen peel as much as 1.35 gr/200gBB. In this group, there was a change in blood sugar levels. Lowered blood sugar levels are more effective than other group. Group III was the group that was given Alloxan + extract of 25% jamblang bark as much as 1.35 grams/200gBB. In this group, there was a change in blood sugar levels. Decreased blood sugar levels are not as effective as the extract at group II. Group IV was the group given alloxan + cinnamon extract as much as 1.35 grams/200gBB. In this group there were also changes in blood sugar levels. Sugar content decreased by a smaller percentage than group III. Group V was the group given alloxan + mangosteen peel extract as much as 1.35 grams/200gBB. In this group, there was a change in blood sugar levels. Blood sugar levels decreased less than in the group IV. To find out if there is the difference in the mean reduction in grade significant mice blood glucose between the two glucose test groups blood of mice, namely the group before treatment and after treatment, then ANOVA one way test was conducted.

Results one way ANOVA test is shows that  $F_{count} > F_{table}$ , which means that  $H_0$  is rejected with a value of  $p = 0.000 < \alpha = 0.05$ , which means that there is a significant effect of jamblang stem bark, mangosteen peel, and cinnamon which is significant between the two blood glucose test groups, namely before treatment and after treatment. A follow-up test is using the Tukey test for find out which group is have a difference. Based on the results of Tukey's post-hoc test above, it was found that the infusion of a mixture of jamblang stem bark, mangosteen peel and cinnamon all had a significant difference because  $p < 0.05$ .

The next test, namely Tukey HSD. It was used to determine the differences in each group. Based on the results of the Tukey HSD\* test, it can be explained that the differences in each group can be seen from the harmonic mean values produced by each group in the subset column. The test results showed that the shooting mixture variation group was in a different subset column, while the other three groups, namely the normal group, the stem bark jamblang group, the mangosteen peel group and the cinnamon group were in the same subset. Based on this it can be concluded that the mixture group was better than the stem bark jamblang group, the mangosteen peel group and the cinnamon group with a mean of 80.4.

The results showed that the mixture of jamblang skin, cinnamon, and mangosteen peel showed the best reduction results and had a significant effect on reducing blood sugar. This is due to the complementary content of each commodity. This is reinforced by the statement of (Katiyar *et al.*, 2016) jamblang stem bark has anti-diabetes mellitus activity because it can lower blood sugar and increase insulin. According to Alam *et al.* (2012) were able to extract the Lupeol compound, 12-oleanen-3-ol-3 $\beta$ -acetate, stigmasterol which has anti-diabetic activity. The flavonoids in jamblang stem bark also have anti-diabetic properties because they have an  $\alpha$ -amylase inhibitory effect of up to 95.4% (Prabakaran & Shanmugave, 2018).

Cinnamon is a complementary commodity because it also acts as an anti-diabetic. Cinnamaldehyde is a group of polyphenolic compounds that act as antioxidants. Cinnamaldehyde is able to ward off free radicals by giving hydrogen atoms to free radicals and converting them to a more stable form. (Kusumaningtyas *et al.*, 2014). Cinnamon has also been shown to improve pancreatic cell function because in the pancreas there is an increase in beta cell proliferation and the formation of new pancreatic lobes for 8 weeks (Bonner-Weir *et al.*, 2010).

Mangosteen peel plays a big role because it contains Xanthon which is contained in mangosteen peel which has antioxidant activity, so it can provide a protective and repair effect on pancreatic beta cells that are damaged by free radicals. Improvement in the condition of pancreatic beta cells can increase insulin secretion (Babu *et al.*, 2013). Insulin is linked to insulin receptors on cell membranes and activates metabolic signals. These signals encourage the translocation of GLUT-4 (glucose transporter-4) to the cell membrane and enter glucose into cells for metabolism. The absence of insulin causes GLUT-4 to be inactive, causing the failure of glucose to enter the cells and then accumulate in the blood so that blood glucose levels increase. Lack of the hormone insulin can reduce the performance of the hexokinase enzyme so that the use of blood glucose as an energy source is reduced and the body tends to obtain energy from other pathways in the form of fat breakdown (Negi *et al.*, 2013).

Previous research related to jamblang bark was still small, but it was found that one of the studies conducted by Ambarsari (2013) examined the effect of jamblang bark on reducing blood sugar in white rats and found good results in lowering blood sugar at a dose of 0.73 mg/g bb but the test animal had diarrhea, this is thought to be caused by a side effect of the jamblang bark which is consumed orally, so it is necessary to add an ingredient in the form of cinnamon to overcome this problem so that it is suitable for consumption. Mursyida and Wati (2021) states that steeping cinnamon can act as an anti-diarrheal because the content of cinnamon can inhibit the growth of *Escherichia coli*. On the other hand, cinnamon is also very good at lowering blood sugar, this is evidenced by the research of Kusumaningtyas *et al.* (2014) which states that test animals of mice experienced an improvement in the structure of the pancreas due to infusion of cinnamon with doses of 0.73 mg/g bb and 1.09. mg/g bw, this is thought to be due to the presence of antioxidant cinnamaldehyde in the brewing of cinnamon powder which is able to ward off free radicals due to alloxan exposure. In order to maximize the reduction in blood sugar, mangosteen peel was added, research on mangosteen peel content was previously conducted by Maligan *et al.* (2018) which shows that the compounds contained in the mangosteen rind extract, besides working as an antioxidant by donating electrons to free radicals, can also work as an inducer which will trigger the expression of the antioxidant coding gene through activation of Nrf2.



## Conclusion

Based on the effect of jamblang stem bark, mangosteen peel, and cinnamon extracts on blood sugar to treat type 2 diabetes mellitus, the following conclusions are obtained. (1) The results of blood sugar analysis showed that Jamblang stem bark, mangosteen peel, and cinnamon extracts were the best treatment compared to the others. Steeping jamblang stem bark, mangosteen peel, and cinnamon extracts can reduce blood sugar levels. Group II has decreased from 295 mg/dl to 70 mg/dl, Group III has decreased from 235 mg/dl to 65 mg/dl, Group IV has decreased from 335 mg/dl to 100 mg/dl, Group V has decreased from 178 mg/dl to 45 mg/dl. (2) Based on the result data analyze, it was found that the steeping of jamblang stem bark, mangosteen peel, and cinnamon extracts had a significant effect on blood sugar so that it was effectively used as a diabetes prevention drink. Further research is needed with more various doses. In addition, it is also necessary to test jamblang stem bark, mangosteen peel, and cinnamon in the form of products that are ready to be commercialized.

## Acknowledgment

The author would like to thank profusely to the Agricultural Industrial Technology Study Program, Faculty of Agricultural Technology, University of Jember as a place of study for author. Thank you to Mr. Andrew Setiawan Rusdianto, S.TP., M.Si who has helped in guiding the author so that the paper can be completed properly.

## References

- Alam, M.R., Rahman, A., Moniruzzaman, M., Kadir, F., Haque, M., Alvi, M., & Ratan, M. (2012). Evaluation of Antidiabetic Phytochemicals in *Syzygium cumini*(L.) Skeels. *Journal of Applied Pharmaceutical Science*, 2(10), 94-98.
- Ambarsari, W. 2013. Test of the Effect of Ethanol Extract 70% of Jamblang Stem Bark (*Syzygium cumini*) on Aloxan-Induced Reduction in Blood Glucose Levels of White Rats (*Rattus norvegicus*). *Skripsi*. Faculty of Medicine, University of Muhammadiyah Surakarta.
- Artha, I., Bhargah, A., Dharmawan, N., Pande, U., Triyana, K., & Mahariski, P. (2019). High Level of Individual Lipid Profile and Lipid Ratio as a Predictive Marker of Poor Glycemic Control in Type-2 Diabetes Mellitus. *Journal Vascular Health Risk Manage*, 15(1), 149-157.
- Babu, P., Liu, & Gilbertc. (2013). Recent Avances in Understanding The Anti-Diabetic Actions of Dietary Flavonoids. *Journal of Nutritional Biochemistry*. 24(11): 1777-1789.
- Bonner-Weir, S., Li, W., Yahalom, L., Guo, L., Weir, G., & Sharma. A. (2010).  $\beta$ -Cell Growth and Regeneration: Replication is Only Part of the Story. *Journal Diabetes*. 59(4): 2340-2348.
- Fatimah, R. N. (2015). Diabetes Melitus Tipe 2. *Journal Majority*, 4(5), 93-101.
- International Diabetes Federation. (2017). *IDF Diabetes Atlas Eight Edition*. Brussel: International Diabetes Federation.
- Katiyar, D., Singh, V., & Ali, M. (2016). Recent Advances in Pharmacological Potential of *Syzygium cumini*: A Review. *Advances in Applied Science Research*, 7(3), 1-12.
- Kusumaningtyas, I., Fajariyah, S., & Utami, E. (2014). The Effect of Cinnamon (*Cinnamomum burmannii*) Steeping on the Structure of the Pancreas of Mice (*Mus musculus*) Diabetic Balb-C Strain. *Jurnal Ilmu Dasar*, 15(2), 69-73.

- Maligan, J., Chairunnisa, F., & Wulan, S. (2018). Role of Xanthon Mangosteen Rind (*Garcinia mangostana* L.) as an Antihyperglycemic Agent. *Jurnal Ilmu Pangan dan Hasil Pertanian*, 2(2), 99-106.
- Mursyida, E., & Wati, H. M. (2021). Aktivitas Antibakteri Ekstrak Kayu Manis (*Cinnamomum burmannii*) Terhadap Pertumbuhan *Escherichia coli*. *Jurnal Farmakologi*, 8(2), 87-91.
- Negi, J. S., Bisht, V., Singh, P., Rawat, M., & Joshi, G. (2013). Naturally Occurring Xanthones: Chemistry and Biology. *Journal of Applied Chemistry*, 13(1), 1-9.
- Prabakaran, K., & Shanmugavel, G. (2018). Antidiabetic Activity and Phytochemical Constituents of *Syzygium cumini* Seeds in Puducherry Region, South India. *International Journal of Pharmacognosy and Phytochemical Research*, 9(7), 985-989.
- Sariga, C.D., Shakila, R., & Khotai, S. (2015). Isolation, Characterization and Quantification of Bergenin from *Syzygium cumini* stem bark. *International Research Journal of Pharmacy*, 6(2), 108-110.
- Soelistijo, S., Novida, H., Rudijanto, A., Soewondo, P., Suastika, K., & Manaf, A. (2015). *Consensus on the Management and Prevention of Type 2 Diabetes Mellitus in Indonesia 2015*. Jakarta: Perkumpulan Endokrinologi Indonesia.