

Original Research Article

EFFECTIVITY BETWEEN LEMONGRASS STEW AND CINNAMON INFUSION IN REDUCING BLOOD GLUCOSE LEVEL IN DIABETES MELLITUS PATIENTSSusanti Susanti^{1)*}, Difran Nobel Bistara²⁾¹⁾STIKES Adi Husada,²⁾Universitas Nahdlatul Ulama Surabaya

*Corresponding Author, E-mail: susanti1303@gmail.com

ABSTRACT

Introduction. Diabetes mellitus is a chronic metabolic disorder brought on by insufficient insulin production by the pancreas or inefficient insulin utilization by the organism. This study determines the effectivity between cinnamon infusion and lemongrass stew in reducing blood glucose levels in diabetes mellitus patients. **Method.** This study uses a design pra-experimental by method two-group pre-post design. The sample of this study was diabetics who were willing to be respondents as many as 20 people. The dependent variable was blood glucose levels, the independent variables were lemongrass stew and cinnamon infusion. The instrument used is the observation sheet. **Result & Analysis.** test results for lemongrass stew with cinnamon infusion were obtained in treatment group 1 ($p = 0.502$) and treatment group 2 ($p = 0.730$) where $\alpha > 0.05$, meaning that statistically there was no difference in blood glucose levels reduction between treatment groups 1 (lemongrass) and treatment group 2 (cinnamon). **Discussion.** There was no difference in reducing blood glucose levels between treatment group 1 (lemongrass) and treatment group 2 (cinnamon).

Keywords: Blood Glucose Levels, Cinnamon, Diabetes Mellitus, Lemongrass.

INTRODUCTION

Glucose is one of the main sources of energy needed by the human body. Glucose is formed from carbohydrates in food and stored as glycogen in the liver and skeletal muscles. Insulin and glucagon, two hormones originating from the pancreas that can affect blood glucose levels (Ojha et al., 2019). Increased blood glucose levels (hyperglycemia) can be a symptom of diabetes mellitus (Bistara et al., 2020). Diabetes mellitus is a chronic metabolic disorder caused by the pancreas not producing enough insulin or the body not using insulin effectively (Suryasa et al., 2021). One of the problems in controlling

blood glucose levels in Indonesia is the low behavior of diabetics in modifying their lifestyle for the better. Non-compliance with a diabetes diet, exercise, and taking diabetes medication (Hartono & Anwar, 2019).

The main obstacle to controlling eating patterns is the saturation of patients following diet therapy. Changing their lifestyle and doing diet therapy is quite difficult because patients are used to their previous lifestyle and must change their living habits which they have been doing for years. Many patients think that the diet they are doing is unpleasant, so they still eat according to what they want (Nguyen et

al., 2022). In addition, limited knowledge of how to live healthy causes people to unknowingly take actions that reduce the quality of life. They also consume various plants and traditional medicinal ingredients without understanding their uses and how to use them correctly.

According to the International Diabetes Federation (IDF) 2021, 537 million adults (age 20-79 years) or 1 in 10 people living with diabetes worldwide. The International Diabetes Federation (IDF) states that the number of diabetics in Indonesia continues to increase, from 10.7 million in 2021 to 19.5 million in 2022. This number brings Indonesia to fifth place, from seventh place in 2019, in the list of countries with the highest number of people with diabetes in the world. The main results of Riskesdas for East Java Province in 2018 stated that the prevalence of DM was based on a doctor's diagnosis in residents aged ≥ 15 years, namely from 2.1% to 2.6% (Sun et al., 2022). The Surabaya Health Office recorded 32,381 DM patients throughout 2018. Previous data obtained by researchers showed 2,195 DM patients from January to March 2018 spread across five puskesmas, with the highest number of DM sufferers in Surabaya. This number is spread across East Surabaya (Klampis Ngasem Health Center with 353 people), West Surabaya (Asemrowo Health Center with 367 people), Central Surabaya (Kedungdoro Health Center with 135 people), North Surabaya (Kalikedinding Tanah Health Center with 615 people), and South Surabaya (Jagir Health Center as many as 725 people) and from the results of an initial survey conducted by researchers on November 13, 2022, around Kampung Kejawan RW 001, Kamal District, Bangkalan Regency in 9 people with

Diabetes Mellitus, eight people said that they had never taken herbal medicines and did not regularly take medicine from doctors and one person who Have ever taken herbal medicine but did not regularly take medicine from a doctor.

Diabetes Mellitus (DM) is a metabolic disease characterized by high blood glucose levels (hyperglycemia) because of a deficiency in insulin secretion, impaired insulin activity or both (Bistara, Susanti, et al., 2022). Blood glucose levels can increase, one of which is because the body cannot release or use insulin normally. Everyone has varying glucose levels; this glucose level will increase after eating and then return to normal within 2 hours. In general, blood glucose levels will increase mildly at a young age, but this glucose level will experience a progressive increase at the age of more than 50 years. Insulin is a hormone released by the pancreas and is the main substance responsible for maintaining proper blood glucose levels. Insulin oversees moving glucose into cells so it can produce energy (Bistara et al., 2022).

Diabetes mellitus can occur when the body does not produce enough insulin to maintain normal blood glucose or when cells do not respond appropriately to insulin (Balaji et al., 2019). People who have diabetes mellitus are at a higher risk of experiencing foot problems due to reduced local pain sensation (neuropathy), which makes the sufferer unaware and often ignores the injuries that occur (Win et al., 2019). The reduced immune system that occurs in people with diabetes mellitus is also more susceptible to infection. Someone who has diabetes will experience various long-term complications of diabetes that are not managed properly. DM complications include heart attacks

and strokes, damage to the blood vessels of the eyes, abnormal kidney function so that to avoid these complications, sufferers must maintain blood glucose levels within the normal range, one of which is by undergoing treatment (Bistara & Rusdianingseh, 2019).

Diabetes management is known as the five pillars of managing diabetes mellitus, which include participating in health education/counseling activities about self-care, making proper diet arrangements, exercising regularly, complying with drug consumption and monitoring blood glucose regulation, cholesterol levels, blood pressure, leg disorders and so on (Arifin, 2021). Management of diabetes mellitus Patients with diabetes mellitus require treatment throughout the life of the sufferer, so a therapy that is easy to obtain and economical is needed. Indonesia is a country that has biodiversity which of course is also rich in traditional medicinal plants (Dal Canto et al., 2019).

There are various types of plants in Indonesia that have been used as traditional medicines for diabetics, some of which are lemon grass and cinnamon. From the results of Astuti et al., (2021) regarding the effectiveness of cinnamon, said that there is effectiveness in giving a warm infusion of cinnamon for reducing blood glucose levels in people with diabetes mellitus. According to the results of Widaryanti et al., (2021) regarding the effects of boiling lemongrass, saying that giving stew lemongrass can significantly reduce glucose levels 44%.

Therefore, researchers are interested in conducting research with the title "Effectivity Between Cinnamon Infusion and Lemongrass Stew in Reducing Blood

Glucose Levels in Diabetes Mellitus Patients."

METHOD AND ANALYSIS

This study uses a design pre-experimental design by method two-group pre-post design to determine the effectivity between cinnamon infusion and lemongrass stew in reducing blood glucose levels in diabetes mellitus patients. Researchers collected research data from January until February 2023. The sample of this study were diabetics who were willing to be respondents as many as 20 people with inclusion criteria is diabetes patients without complication.

Research subjects have obligations in terms of their professional, legal, and ethical conduct. STIKES Adi Husada conducted an ethical test for this study and assigned it an ethics number 213A/PPM/Etik/STIKES-AH/XII/2022. Prior to conducting the research, the researcher informed the respondents of additional ethical guidelines. To explain the research, the researcher got in touch with the responder. The explanations cover the following topics: study goals, research methods, advantages of the research, dangers, and potential annoyances, protecting data confidentiality, compensation for unforeseen events, and the researcher's accountability. After then, the researcher requested consent to participate in the study. Researchers gathered primary data and requested informed consent from participants.

The independent variables are lemongrass stew and cinnamon infusion. The rules for drinking lemongrass stew are given for 7 days, consumed in the morning and evening 100 ml. The rules for drinking cinnamon infusion are given for 7 days,

consumed in the morning and evening 200 ml. The dependent variable is blood glucose level. Instrument used for data collection uses a data collection sheet filled in by the researcher. This data collection sheet contains information regarding the characteristics of age, sex, and blood glucose levels. The instrument is used in measuring random blood glucose (RBG) levels with a tool glucometer. Measuring RBG levels was carried out during the pretest before being given the intervention and the post test was carried out after 7 days of being given the intervention. Data were analyzed by conducting test paired t-tests to find out whether there is a difference in RBG levels before and after pre-test and post-test drink infusion of cinnamon and lemongrass stew. On test independent t-test with the level of significant 0.05. This is used to measure the significance of the comparison of two groups of data that are correlated with data in the form of ratios that require observation (pre-test and post-test) which was used to compare the effectiveness of cinnamon infusion and lemongrass stew on reducing RBG levels in diabetes mellitus patients before and after the intervention.

RESULTS

Table 1 Characteristics of Respondents in Kampung Kejawan RW 001

No	Characteristics of Respondents	Treatment Group 1 (Lemongrass)		Treatment Group 2 (Cinnamon)	
		Frequency	Percentage	Frequency	Percentage
1.	Gender				
	Man	4	40%	3	30%
	Woman	6	60%	7	70%
	Total	10	100%	10	100%
2.	Age				
	36-45	4	40%	1	10%
	46-55	2	20%	2	20%
	56-65	3	30%	3	30%
	>66	1	10%	4	40%
	Total	10	100%	10	100%

3. Long Suffering DM				
< 1	2	33%	1	10%
1-2	7	50%	5	50%
3-4	1	17%	3	30%
>5	0	0	1	10%
Total	10	100%	10	100%
4. Use of Anti-Hyperglycemic Drugs				
Take oral hyperglycemia drugs (metformin)	6	60%	6	60%
Do not consume oral hyperglycemia drugs	4	40%	4	40%
Total	10	100%	10	100%

Table 1 shows that in the treatment group 1 with a total of 10 respondents, the majority were female (60%), aged 36-45 years and had suffered from DM for 1-2 years. Most respondents consumed the OHO drug metformin as much as 60%. Whereas in the treatment group 2 with 10 respondents, the majority were female (70%), aged > 66 years and had suffered from DM for 1-2 years. Most respondents consumed the OHO drug metformin as much as 60%. So, it can be concluded that between the two groups most of the characteristics are the same.

Table 2 Observation Values of Random Blood Glucose (RBG) Levels 2Hours Post Prandial Pre-post and the Difference in the Treatment Group

No	RBG 2 Hours After Meal/Intervention (Mg/Dl)					
	Treatment Group 1 (Lemongrass)			Treatment Group 2 (Cinnamon)		
	Pre	Post	Difference	Pre	Post	Difference
1.	530	353	-177	110	100	-10
2.	138	105	-33	426	397	-29
3.	345	302	-43	275	260	-15
4.	413	389	-24	250	112	-18
5.	350	325	-25	205	188	-17
6.	188	165	-23	137	119	-18
7.	160	145	-15	413	395	-18
8.	159	145	-14	145	117	-28
9.	130	113	-17	150	130	-20
10.	161	145	-16	139	128	-11

Mean	257.4	218.7	38.7	213	194.6	18.4
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Table 2 shows that in the treatment group 1 the average pre- and post-intervention values were 257.4 mg/dl and 218.7 mg/dl and the highest pre-post difference was 177 mg/dl. Meanwhile, in the treatment group 2, the average pre- and post-intervention values were 213 mg/dl and 194.6 mg/dl, and the highest pre-post difference was 29 mg/dl.

Researchers use test paired t-tests to see the difference in the decrease in blood glucose levels of the two groups, but before continuing the test the researcher will conduct a normality test to find out whether the data is normally distributed or not. Therefore, the researchers conducted a test Kolmogorov-Smirnov obtained a value ($p = 0.425$) > 0.05 , it can be concluded that the data is normally distributed and based on the homogeneity test results obtained a value ($p = 0.818$) > 0.05 , it can be concluded that the variance of the intervention post-test data is the same or homogeneous.

Table 3 Results of the Paired T-Test Blood Glucose Levels in the Lemongrass and Cinnamon Groups Before and After the Intervention

		N	Mean	P
Treatment group 1 (lemongrass)	RBG Before Intervention	10	257.40	0.035
	RBG After Intervention	10	218.70	
Treatment group 2 (cinnamon)	RBG Before Intervention	10	213.00	0.000
	RBG After Intervention	10	194.60	

Table 3 shows that of the 10 respondents in treatment group 1 (lemongrass) the average blood glucose level before giving lemongrass stew was 257.40 and the average yield value after

giving lemongrass stew was 218.70. Whereas in treatment group 2 (cinnamon) the average blood glucose level before giving cinnamon infusion was 213.00 and the average yield value after giving cinnamon infusion was 194.60.

The results of the processing of test data paired sample t-test in the treatment group 1 (lemongrass) a value of ($p = 0.035$) < 0.05 was obtained, meaning that there was an average difference in the yield of lemongrass stew. So, it can be concluded that lemongrass stew is effective in lowering blood glucose levels. Results of processing test data paired sample t-test in the treatment group 2 (cinnamon) a value ($p = 0.000$) < 0.05 was obtained, meaning that there was an average difference in the results of steeping cinnamon. So, it can be concluded that cinnamon infusion is effective in lowering blood glucose levels.

Table 4 Independent t-Test Results comparing the effectivity between lemongrass stew and cinnamon infusion in reducing blood glucose levels.

Difference value	Group 1	Group 2	Mean Difference	p*
Random Blood Grocose (RBG) levels	216.7±18.98	189.4±16.97	35.95	0.02

Table 4 shows the results of the independent t-test between treatment group 1 (lemongrass) with 10 respondents and treatment group 2 (cinnamon) with 10 respondents. The results of the processing of independent t-test test data obtained results mean difference 35.95 and p-value 0.02 where $\alpha < 0.05$, meaning that statistically there is no difference in blood glucose level reduction between treatment group 1 (lemongrass stew) and treatment group 2 (cinnamon infusion).

DISCUSSION

1. The Effect of Lemongrass Stew on Reducing Blood Glucose Levels

Table 2 shows that in the treatment group 1 the average pre- and post-intervention values were 257.4 mg/dl and 218.7 mg/dl and the highest pre-post difference was 177 mg/dl. The results of this study are in line with previous research which showed that lemongrass stew lowered blood glucose levels by 44% (Widaryanti et al., 2021). According to Garba et al., (2020) stew lemongrass which contains flavonoids and phenolic compounds has an antidiabetic effect, increases glucose tolerance, beta cell function and dyslipidemia. The compounds contained in lemongrass include tannins, flavonoids, steroids (Gazwi, 2020). Flavonoids act as antioxidants that can stimulate the recovery of damaged pancreatic β cells. With this regeneration, insulin secretion will increase so that a lot of glucose in the blood will enter the cells. This compound can also restore insulin receptor sensitivity in cells. In addition, flavonoids also increase hepatic glucokinase activity which has insulin-like activity, namely inhibiting phosphodiesterase so that cAMP levels in pancreatic beta cells become high. This increase in cAMP levels results in stimulation of protein kinase A (PKA) release and closing of K^+ ATP channels in the plasma membrane of beta cells. This situation results in membrane depolarization and the opening of voltage-dependent Ca channels thereby accelerating the influx of Ca ions into the cell. This increase in Ca ions in the beta cell cytoplasm will cause insulin secretion by pancreatic beta cells.

Tannins play a role in increasing glycogenesis activity, where this activity is a metabolic pathway that converts glucose into glycogen to be stored in the liver. This causes a decrease in the amount of glucose in the blood. This compound can also shrink the epithelial membrane of the small intestine so that it can reduce the absorption of food, which in turn causes the rate of increase in blood glucose to be not too high. The role of steroids can be associated as antidiabetic and antihyperglycemic agents because they can stimulate the release of insulin from the pancreas so that they can reduce blood glucose levels (Abdelrahman & Omar, 2023).

In the cross-tabulation results, it was found that the treatment group 1 (lemongrass stew) out of 10 respondents was mostly 36-45 years old with 4 respondents (40%), according to Nur Aini (2016) increasing age is an important risk factor for DM because aging is related with insulin resistance. The researchers argue that with increasing age, the body's intolerance to glucose increases, making it difficult to control glucose levels.

Based on table 3 shows that 10 respondents in treatment group 1 (lemongrass) before and after being given lemongrass stew. The results of the paired sample t-test obtained a value ($p = 0.035$) < 0.05 , meaning that statistically this indicates that lemongrass stew is effective in reducing blood glucose levels in people with diabetes mellitus.

2. The Effect of Cinnamon Infusion on Reducing Blood Glucose Levels

Table 2 shows that in treatment group 2 the average pre- and post-intervention values were 213 mg/dl and 194.6 mg/dl and the highest pre-post

difference was 18.4 mg/dl. The results of this study are in line with previous research which showed that steeping cinnamon reduced blood glucose levels with an average value of 202.48 mg/dl (Astuti et al., 2021). Cinnamon is a plant that contains flavonoids. Flavonoids are natural organic compounds found in roots, leaves, bark, stamens, flowers, fruit, and fruit seeds of plants (Obute & Adubor, 2007). The workings of flavonoid compounds have been shown to have beneficial effects in fighting diabetes mellitus, both through their ability to control blood glucose levels and optimizing the work of the pancreas by increasing the sensitivity of pancreatic beta cells to produce the insulin hormone needed to regulate blood glucose levels in the body (Saxena, 2021).

In the cross-tabulation results, it was found that in the treatment group 2 (infusion of cinnamon) out of 10 respondents, most of them were > 66 years old, with 4 respondents (40%), according to Nur Aini (2016) increasing age is an important risk factor for DM because aging is related with insulin resistance. The researchers argue that with increasing age, the body's intolerance to glucose increases, making it difficult to control glucose levels.

Table 3 shows that 10 respondents in treatment group 2 (cinnamon) before and after being given lemongrass stew. The results of the paired sample t-test obtained a value ($p = 0.000$) < 0.05 , meaning that statistically this indicates that cinnamon infusion is effective in reducing blood glucose levels in people with diabetes mellitus.

3. Analyzing the Comparison of the Effect of Lemongrass Stew and Cinnamon Infusion on Reducing Blood Glucose Levels

Table 4 shows the results of the independent t-test between the lemongrass stew group of 10 respondents and the cinnamon steeping group of 10 respondents, the average decrease in blood glucose levels in the lemongrass stew and cinnamon infusion group was decrease in blood glucose levels with mean difference 35.95. The results of independent t-test data processing showed the results of lemongrass stew and cinnamon ($p = 0.02$) where $\alpha < 0.05$, meaning that statistically there is no difference in decreasing blood glucose levels between lemongrass stew and steeping cinnamon. According to Kasole et al., (2019) herbal medicines in general have a relatively slower healing reaction but have a more fundamental recovery performance. This is because herbal medicine heals damaged cells so they can function again.

Healing Diabetes Mellitus is a type of disease whose treatment uses herbal substances. In addition to using natural ingredients for the treatment of Diabetes Mellitus, the treatment of this disease also requires lifestyle adjustments, including by changing eating habits or adjusting eating patterns. Widaryanti et al., (2021) said that boiling lemongrass influenced reducing blood glucose levels in people with diabetes mellitus with the results of a statistical test $p = 0.000$ ($p < 0.05$), which means it can reduce blood glucose levels in people with diabetes mellitus. Researchers are of the opinion that boiling lemongrass which is drunk regularly 1 time per day for 7 days is sufficient to reduce blood glucose levels in DM sufferers. Evaluation of blood glucose levels after giving intervention is

carried out after 7 days of administration which has decreased blood glucose levels blood. Like consuming lemongrass stew, cinnamon infusion can lower blood glucose levels for people with diabetes mellitus (Dewanti, 2023).

According to Astuti et al., (2021) said that infusion of cinnamon influences reducing blood glucose levels in DM sufferers with the results of a statistical test $p = 0.02$ ($p < 0.05$), which means infusion of cinnamon can reduce blood glucose levels in DM sufferers. People with diabetes mellitus must try to control their disease and avoid risk factors for complications by fostering a healthy lifestyle. DM sufferers cannot produce enough insulin, or the body is unable to use insulin effectively resulting in excess glucose in the body (Susanti, 2019). Researchers argue that consuming cinnamon infusion once per day for 7 days is sufficient to lower blood glucose levels in DM patients, this is in accordance with Dewanti (2023) who says that consuming cinnamon infusion for 7 days influences reducing blood glucose levels. Researchers argue that cinnamon and lemon grass have the same effectiveness in lowering blood glucose levels when consumed regularly. Because cinnamon and lemongrass both contain flavonoids and tannins which act as anti-diabetics. However, the difference between lemongrass stew and cinnamon infusion is the dose of use with lemongrass, 100 ml is enough, while cinnamon, the patient must drink 200 ml. Both treatments reduce blood glucose levels.

CONCLUSION

There is no significant difference in effectiveness between lemongrass stew and cinnamon infusion on reducing blood

glucose levels in diabetes mellitus patients. The results of the study can be used as a reference source for researchers, and it is hoped that future researchers can determine which doses of cinnamon infusion and lemongrass stew are more effective in lowering blood glucose levels.

REFERENCES

- Abdelrahman, W. M., & Omar, S. M. M. (2023). Effect of lemongrass powder on hyperlipidemia compared to Orlistat using experimental animals. *Egyptian Journal of Nutrition and Health*, 18(1), 45–62.
- Arifin, N. A. W. (2021). The Relations Between Knowledge and The 5 Pillars of Management of Type II Diabetes Mellitus in Posbindu Sehati. *Proceeding International Conference Syedza Saintika*, 1(1).
- Astuti, Y., Fandizal, M., Riani, N., Ramadhan, A. R., & Ariastika, W. A. (2021). Effect of Aloe Vera Drink with Cinnamon on Blood Sugar Reduction in Families with Type II Diabetes Mellitus in East Jakarta. *Jurnal Ilmiah Ilmu Keperawatan Indonesia*, 11(04), 214–218.
- Balaji, R., Duraisamy, R., & Kumar, M. P. (2019). Complications of diabetes mellitus: A review. *Drug Invention Today*, 12(1).
- Bistara, D. N., & Rusdianingseh. (2019). The Effect of Acceptance and Commitment Therapy (ACT) on Controlling Blood Sugar Levels of Client Type 2 DM. *Jurnal Ilmiah Keperawatan (Scientific Journal of Nursing)*, 5(2), 143–151.
- Bistara, D. N., Rusdianingseh, Susanti, Wardani, E. M., Septianingrum, Y., Ainiyah, N., Fitriasisari, A., Noventi, I., & Hasina, S. N. (2020). Acceptance and commitment therapy (Act) on increasing the

- compliance of management diabetes mellitus type 2. *International Journal of Psychosocial Rehabilitation*, 24(9). <https://doi.org/10.37200/IJPR/V24I9/PR290115>
- Bistara, D. N., Susanti, S., Setianto, B., Wardani, E. M., Krisnawati, D. I., & Satiti, N. P. (2022). Cycling to Regulate Random Blood Glucose Levels in Individuals with Diabetes. *Open Access Macedonian Journal of Medical Sciences*, 10, 157–161. <https://doi.org/10.5937/OAMJMS2203157B>
- Bistara, D. N., Wardani, E. M., Susanti, S., Putro, A., Santoso, R., Hakim, A., Fasya, Z., & Andini, A. (2022). *The effect of discharge planning on the stability of blood sugar levels in type 2 diabetes mellitus patients*. 11(3), 1180–1184. <https://doi.org/10.15562/bmj.v11i3.3537>
- Dal Canto, E., Ceriello, A., Rydén, L., Ferrini, M., Hansen, T. B., Schnell, O., Standl, E., & Beulens, J. W. J. (2019). Diabetes as a cardiovascular risk factor: An overview of global trends of macro and micro vascular complications. *European Journal of Preventive Cardiology*, 26(2_suppl), 25–32.
- Dewanti, N. P. N. (2023). *Antidiabetic Effect Test of Combination of Ginger (Zingiber officinale), Lemongrass (Cymbopogon citratus), and Cinnamon (Cinnamomum verum) on Male Mice (Mus musculus)*.
- Garba, H. A., Mohammed, A., Ibrahim, M. A., & Shuaibu, M. N. (2020). Effect of lemongrass (Cymbopogon citratus Stapf) tea in a type 2 diabetes rat model. *Clinical Phytoscience*, 6, 1–10.
- Gazwi, H. S. S. (2020). Preventive effect of lemongrass (Cymbopogon citratus) against oxidation in soybean oil. *Proceedings of the National Academy of Sciences, India Section B: Biological Sciences*, 90, 151–159.
- Hartono, M., & Anwar, C. (2019). Effectiveness of Soursop Leaf Extracts on Decreasing Blood Sugar for Type-2 Diabetes Mellitus Patients. *Indian Journal of Public Health Research & Development*, 10(9).
- Kasole, R., Martin, H. D., & Kimiywe, J. (2019). Traditional medicine and its role in the management of diabetes mellitus: “patients’ and herbalists’ perspectives”. *Evidence-Based Complementary and Alternative Medicine*, 2019.
- Nguyen, V. B., Thi, K. H. P., Nguyen, T. X., Pham, N. T. L., Nguyen, V. V. H., & Van Le, C. (2022). Diabetes self-management and its associated factors among patients with diabetes in central Vietnam: A cross-sectional study. *Plos One*, 17(7), e0270901.
- Obute, G. C., & Adubor, G. O. (2007). Chemicals detected in plants used for folk medicine in South Eastern Nigeria. *Ethnobotanical Leaflets*, 2007(1), 17.
- Ojha, A., Ojha, U., Mohammed, R., Chandrashekar, A., & Ojha, H. (2019). Current perspective on the role of insulin and glucagon in the pathogenesis and treatment of type 2 diabetes mellitus. *Clinical Pharmacology: Advances and Applications*, 57–65.
- Saxena, R. (2021). Role of K-nearest neighbour in detection of Diabetes Mellitus. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 12(10), 373–376.
- Sun, H., Saedi, P., Karuranga, S., Pinkepank, M., Ogurtsova, K., Duncan, B. B., Stein, C., Basit, A., Chan, J. C. N., & Mbanya, J. C.

- (2022). IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Research and Clinical Practice*, *183*, 109119.
- Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). Health and treatment of diabetes mellitus. *International Journal of Health Sciences*, *5*(1).
- Susanti, S. (2019). Effect of Diabetic Foot Exercise on Leg Sensitivity Monofilament Test in Diabetic Mellitus Patients in the Endrosono Elderly Posyandu Area, Surabaya. *Adi Husada Nursing Journal*, *4*(2), 29–33.
- Widaryanti, B., Khikmah, N., & Sulistyani, N. (2021). Effects of Lemongrass (*Cymbopogon citratus*) Stew on Oxidative Stress Response in Diabetic Male Wistar Rats (*Rattus norvegicus*). *Life Science*, *10*(2), 173–181.
<https://doi.org/https://doi.org/10.15294/lifesci.v10i2.54457>
- Win, M. M. T. M., Fukai, K., Nyunt, H. H., Hyodo, Y., & Linn, K. Z. (2019). Prevalence of peripheral neuropathy and its impact on activities of daily living in people with type 2 diabetes mellitus. *Nursing & Health Sciences*, *21*(4), 445–453.