



Effectiveness of Using Duwet Seed Flour as Processed Noodles to Lower Blood Sugar in Type 2 Diabetes Mellitus

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Abstract. Diabetes Mellitus (DM) is a chronic disease characterized by metabolic disorders with a prevalence that continues to rise globally. Effective DM management involves four pillars: education, meal planning, physical exercise, and pharmacological interventions. This study aims to evaluate the effectiveness of noodles made from *Syzygium cumini* seeds (Cumini Noodles) in reducing blood glucose levels in patients with type 2 Diabetes Mellitus. The research employs a quasi-experimental method with a pretest-posttest control group design, where the intervention group was given Cumini Noodles, and the control group was given regular wet noodles. The results showed that the consumption of Cumini Noodles significantly lowered blood glucose levels in type 2 DM patients compared to regular wet noodles. Cumini Noodles have several nutritional advantages, including lower energy content, lower fat, and higher levels of protein, calcium, phosphorus, potassium, and magnesium. These advantages contribute to better blood glucose control and reduced risk of insulin resistance. Cumini Noodles have the potential to become an effective functional food alternative for people with type 2 Diabetes Mellitus. However, further research with a stronger design and larger sample size is needed to confirm these findings and to understand its mechanism of action more deeply.

Keywords: Blood Glucose Levels; Cumini Noodles; Diabetes Mellitus; Functional Food; *Syzygium cumini*.

1. INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by elevated blood glucose levels due to reduced insulin secretion by pancreatic beta cells and/or insulin resistance. The risks associated with DM include hypoglycemia, hyperglycemia, ketoacidosis, dehydration, and thrombosis. Hypoglycemia can be experienced by all DM patients, occurring acutely and suddenly, posing life-threatening risks (Rusdi, 2020). DM is a chronic disease that occurs when the pancreas cannot produce enough insulin or when the body cannot effectively use the insulin it produces. Insulin is a hormone that regulates blood sugar. Hyperglycemia, or elevated blood sugar, is a common effect of uncontrolled diabetes, leading to serious damage to many body systems, particularly the nerves and blood vessels.

Diabetes mellitus can affect people of all ages and socioeconomic backgrounds. In Indonesia, DM has not yet become a top priority in healthcare services, despite its clear negative impact on human resource quality, primarily due to the chronic complications it causes. The management of DM can be categorized into four pillars: education, meal planning, physical exercise, and pharmacological intervention (Julianti & Pramono, 2011). Diabetes mellitus ranks 7th among the top 10 causes of death worldwide; 90% to 95% of cases are type 2 DM (DMT2). The International Diabetes Federation (IDF) estimates that Indonesia ranks 6th globally, with around 10.2 million people aged 20-79 living with diabetes in 2017, projected to increase to 16.7 million by 2045.

People with diabetes mellitus have high blood sugar levels accompanied by metabolic disturbances in carbohydrates, lipids, and proteins due to impaired insulin function. This condition is caused by either a defect or deficiency in insulin production by the beta cells of the pancreas or by low cellular response to insulin (Aminuddin, Sima, Izza, & Lalla, 2023).

At the end of 2021, the International Diabetes Federation (IDF) in its 10th edition of the Atlas confirmed that diabetes is one of the fastest-growing global health emergencies of the 21st century. In 2021, more than half a billion people worldwide, specifically 537 million, were living with diabetes, with this number projected to reach 643 million by 2030 and 783 million by 2045. Besides the large number of people with diabetes, it is estimated that in 2021, there were around 541 million people with elevated blood glucose levels or in the prediabetic phase, characterized by impaired glucose tolerance. Diabetes in this population also leads to high mortality rates related to diabetes, estimated at over 6.7 million in adults aged 20-79 years.

Syzygium cumini is a species within the Myrtaceae family, native to Asia, East Africa, South America, and Madagascar, and has been naturalized in Florida, Hawaii, and the United States (Warrier et al., 1996). *Syzygium cumini* is synonymous with *Eugenia jambolana* Lam. and *Eugenia cumini*. *Syzygium cumini* bears dark purple to blackish fruits when ripe and is believed to be rich in antioxidants (Swami et al., 2012). Besides being used as a fruit source, various studies have indicated that *Syzygium cumini* is utilized in traditional medicine for the treatment of diabetes mellitus, anti-inflammation, ulcers, and diarrhea (Swami et al., 2012). The use of plants as medicine is related to their bioactive compounds. The fruit of *Syzygium cumini* is rich in anthocyanins, glucosides, ellagic acid, isoquercitrin, kaempferol, and myricetin. Its seeds contain alkaloids, jambosine, and glycoside jambolin or antimellin (Silalahi, 2018). The fruit of *Syzygium cumini* has various benefits, one of which is as a glucose-lowering agent. The seeds and fruits of *Syzygium cumini* can significantly reduce blood glucose levels in diabetic rats that experience necrosis, fat infiltration, hemorrhage, sinusoidal congestion, and liver damage. The results show that the administration of *Syzygium cumini* seed water extract to diabetic rats can reduce inflammation-induced damage, prevent beta-cell damage, and increase the secretion of insulin granules by preventing beta-cell damage and dysfunction caused by glucose toxicity, lipotoxicity, and oxidative stress (Swami et al., 2012). Another study found that administering *Syzygium cumini* seed powder petroleum ether extract can lower blood glucose levels, reduce total cholesterol by 23%, triglycerides by 28%, and LDL by 35%, and increase HDL levels by 22% (Swami et al., 2012).

In Indonesia, the fruit and bark of *Syzygium cumini* have been traditionally used as an antidiabetic, but the seeds are still rarely utilized (Swami et al., 2012). *Syzygium cumini* seed

extract has the potential to be developed into pharmaceutical or nutraceutical products, thereby increasing its market value. *Syzygium cumini* seeds contain compounds such as jambosine and jamboline that can help lower blood glucose levels. *Syzygium cumini* seed extract can have a hypoglycemic effect, helping control blood sugar levels. Additionally, *Syzygium cumini* seeds also contain antioxidants such as tannins and flavonoids, which can help protect cells from oxidative damage (Lissa, L., et al., 2018).

In addition to alkaloids, flavonoids, tannins, and jamboline compounds, trace elements such as chromium have been widely recognized for their role in glucose metabolism and may contribute to the antihyperglycemic effects associated with *Syzygium cumini*-based functional food. Chromium is an essential micronutrient involved in enhancing insulin action through the potentiation of insulin receptor signaling and improving cellular glucose uptake (Anderson, 1998; Suksomboon et al., 2014). Several studies have demonstrated that chromium supplementation may improve insulin sensitivity, reduce fasting blood glucose levels, and contribute to better glycemic control in patients with Type 2 Diabetes Mellitus. Chromium may contribute synergistically with other bioactive compounds in exerting hypoglycemic effects associated with *Syzygium cumini*-based functional foods. This mechanism is particularly relevant in Type 2 Diabetes Mellitus, where insulin resistance is a major pathological feature. Through improving insulin efficiency and facilitating glucose utilization by peripheral tissues, chromium may support the blood glucose-lowering potential of *Syzygium cumini*-based functional foods.

The use of *Syzygium cumini* seeds as a natural treatment for type 2 diabetes mellitus has been employed by several researchers. The study by Rusmalina showed that *Syzygium cumini* seeds and fruits can significantly lower blood glucose levels in 15 alloxan-induced mice. The test results indicated that *Syzygium cumini* seeds were effective in accelerating the healing of diabetic wounds. This is due to the natural compounds in *Syzygium cumini* seeds that accelerate the healing process of diabetic wounds. These compounds include tannins, gallic acid, phytomelin glucosides, alpha-phytosterols, saponins, flavonoids, and phenols.

Another study conducted by Lissa et al. used *Syzygium cumini* seed powder and mice as test subjects to determine the effectiveness of *Syzygium cumini* seed powder on the duration of wound healing in DM. The population in this study was mice (*Mus musculus*), and the sample consisted of 15 male mice aged 2-3 months, healthy, and alloxan-induced. The sampling technique used was purposive sampling, as there was a specific criterion for the desired mice for the experiment, namely those with high blood glucose levels (hyperglycemia).

After administering *Syzygium cumini* seed powder, povidone-iodine, and no treatment, the incised wounds on the mice showed healing symptoms.

This study aims to evaluate the effectiveness of consuming noodles made from *Syzygium cumini* seeds on lowering blood glucose levels in type 2 diabetes mellitus patients.

2. RESEARCH METHODS

Type of Research

The research method used is a type of research “Quasi experiment”.

Quasi experiment (quasi experiment). According to Creswell (2018) a quasi-experiment is an experimental design that is conducted without randomization (random), but involves placing participants into groups. At the beginning of the study, measurements were taken of the dependent variables that the participants already had. After being given manipulation, measurements are taken again on the dependent variable with the same measuring instrument. Quasi-experimental research is the only method that is effective and accurate compared to other studies, in determining the effectiveness of experiments that have been carried out before.

Research Design

The research design used is a Pretest and Posttest Control Group Design which has an intervention group and a control group. The participants were assigned into an intervention group and a control group, then given a pretest to determine the initial situation, is there a difference between the experimental group and the control group. Good pretest results are results with intervention group values not significantly different. The intervention group is DM patients who consume Cumini Noodles, while the control group is DM patients who consume processed wet noodles on the market.



Figure 1. Pretest and Posttest Control Group Design.

R1

Group 1 (Experiment): Group of DM patients who consumed Cumini Noodles

R2

Group 2 (Control): Group of patients with DM who consume market wet noodles

O1

Group 1 Pretest

O2

Group 2 Pretest

X

Group 1 Treatment

O3

Group 1 Posttest

With Cumini Noodles. Blood glucose will be checked again 2 hours after breakfast and the results will be compared between the changes in blood glucose in the intervention group that consumed Cumini Noodles and the control group.

Data Analysis

The data analysis used in this study are:

- a. Test the effectiveness of the treatment effect by using T-test with excel.
- b. Analysis of Cumini content with literature review

Conclusions were drawn based on the effectiveness of product use, namely the effect of reducing blood sugar levels in people with Diabetes Mellitus (DM).

3. RESULT AND DISCUSSION

Nutritional analysis of Cumini using a literature review:

Table 1. Ingredient Comparison Regular Wet Noodle and Cumini (per 100g).

Nutrients	Regular Wet Noodle	Cumini Noodle
Energy (cal)	88	60
Protein (g)	0.60	0.72
Fat (g)	3.30	0.23
Carbohydrates (g)	14	16.56
Calcium (mg)	14	19
Phosphorus (mg)	13	17
Sodium (mg)	63	14
Iron (mg)	6.80	0.19
Potassium (mg)	13.50	79
Copper (mcg)	60	-
Zinc(mg)	0.40	-
Water (mg)	80	83.1

Ash (g)	2.10	-
Magnesium (mg)	-	15
Vitamin A (IU)	-	3
Vitamin B (mg)	-	0.26
Vitamin C (mg)	-	14.3

The chromium content of Cumini Noodles was not quantitatively analyzed in the present study. Therefore, its potential contribution is discussed based on the known physiological role of chromium in glucose metabolism and findings from previous literature (Anderson, 1998; Suksomboon et al., 2014).

Table 2. Test the effectiveness of the treatment effect with the T Test.

Sample	Group 1			Group 2		
	Pretest	Posttest	Difference	Pretest	Posttest	Difference
1	315	347	+32	225	344	+119
2	261	289	+28	135	237	+102
3	231	258	+27	240	326	+86
4	228	286	+58	196	293	+97
5	150	195	+45	171	249	+78

The results of the nutritional content analysis obtained in Table 1 show that Cumini Noodles have several nutritional advantages compared to Regular wet noodles. Cumini noodles have a lower energy content, namely 60 kcal per 100 g compared to Regular noodles which have 88 kcal per 100 g. This lower energy content is important for individuals with type 2 diabetes mellitus because it can help with better weight management and blood glucose control.

Cumini Noodles also show superiority because they have a higher protein content (0.72 g compared to 0.60 g) and lower fat content (0.23 g compared to 3.30 g). Its low fat content can be beneficial in reducing insulin resistance which is one of the main mechanisms involved in the pathophysiology of Type 2 Diabetes Mellitus. In addition, increasing protein intake can increase feelings of fullness and reduce blood sugar fluctuations after eating.

Micronutrients in Cumini Noodles such as calcium, phosphorus, potassium and magnesium are also higher than regular noodles. Potassium and magnesium, in particular, play important roles in insulin function and blood sugar regulation. The lower sodium content in Cumini noodles is also beneficial because it can help reduce the risk of hypertension which often occurs along with Type 2 Diabetes Mellitus.

Table 2 presents the results of tests on the effectiveness of Cumini noodles (Group 1) and regular noodles (Group 2) in suppressing blood sugar spikes in individuals suffering from Type 2 Diabetes Mellitus. Based on the data, it can be seen that the group consuming Cumini noodles showed a lower increase in blood sugar levels. compared to the group who consumed regular noodles.

Results of blood sugar tests conducted both before and after eating Cumini Noodles. Two hours after eating Cumini Noodles, patients with Diabetes Mellitus II experienced an average 38 mg/dL rise in blood sugar. A p value of 0.003068360474 and a standard deviation of 13.28533026 were obtained in the t test formula. Blood sugar levels increased in patients with diabetes mellitus II, averaging 96.4 mg/dL. In the meantime, the p value is 0.0001640955175, and the standard deviation is 15.72577502. Since The results indicate that the increase in blood glucose levels was greater in the regular noodle group than in the Cumini Noodles group, the increase for regular noodles is greater, indicating that Cumini noodles are more effective than regular noodles in reducing the rise in blood sugar levels. The effectiveness of Cumini Noodles in suppressing postprandial increases in blood glucose levels may be explained through several complementary mechanisms related to their nutritional composition and bioactive constituents. Although Cumini Noodles contain carbohydrates, these carbohydrates are presumed to consist predominantly of complex carbohydrates that require a longer digestion and absorption process compared with simple carbohydrates.

The lower increase in blood glucose levels observed after the consumption of Cumini Noodles may also be associated with a lower glycemic index compared with conventional noodles. Foods with a lower glycemic index produce a slower and more gradual rise in blood glucose concentrations, which is beneficial for individuals with Type 2 Diabetes Mellitus (Jenkins et al., 1981). Slower glucose absorption reduces postprandial glycemic excursions and may decrease the metabolic burden on pancreatic β -cells. In addition, dietary fiber present in *Syzygium cumini* seed flour may contribute to improved glycemic control. Dietary fiber slows gastric emptying and delays intestinal glucose absorption, thereby reducing rapid increases in blood glucose levels after meals. Increased fiber intake has also been associated with improved insulin sensitivity and enhanced satiety, which may further support blood glucose regulation.

The antihyperglycemic effects of Cumini Noodles may also be influenced by the presence of several bioactive compounds in *Syzygium cumini* seeds, including jamboline, jambosine, flavonoids, tannins, gallic acid, ellagic acid, and other polyphenolic compounds. These compounds have been reported to exhibit antioxidant and glucose-lowering activities. Previous studies have suggested that *Syzygium cumini* seed extracts may contribute to

improved glycemic control through antioxidant and antihyperglycemic mechanisms. Furthermore, *Syzygium cumini* seeds contain minerals that are important for glucose metabolism, including magnesium and potassium. Magnesium is involved in insulin-mediated glucose utilization and glycolytic enzyme activity, whereas potassium supports cellular metabolic processes and electrolyte balance. Adequate intake of these minerals has been associated with improved insulin sensitivity and glucose homeostasis.

In addition to magnesium and potassium, trace elements such as chromium have been widely recognized for their role in insulin action and glucose metabolism. Chromium enhances insulin receptor activity and facilitates glucose transport into peripheral tissues (Anderson, 1998; Suksomboon et al., 2014). Chromium deficiency has been associated with impaired glucose tolerance and increased insulin resistance, which are key pathological characteristics of Type 2 Diabetes Mellitus (Anderson, 1998; Suksomboon et al., 2014). Therefore, chromium may contribute synergistically to the antihyperglycemic effects of *Syzygium cumini*-based functional foods.

Oxidative stress is considered one of the major factors contributing to β -cell dysfunction and insulin resistance in Type 2 Diabetes Mellitus (Robertson, 2004). The antioxidant compounds present in *Syzygium cumini* seeds may help neutralize reactive oxygen species and reduce oxidative damage, thereby supporting pancreatic function and improving metabolic control. Overall, the observed suppression of blood glucose elevation following the consumption of Cumini Noodles is likely the result of multiple interacting mechanisms, including slower carbohydrate digestion, lower glycemic response, delayed glucose absorption by dietary fiber, improved insulin sensitivity through mineral components such as magnesium and chromium, and antioxidant protection provided by polyphenolic compounds.

4. CONCLUSION AND RECOMMENDATIONS

Based on research conducted by researchers, a potential processed form of duwet seeds is wet noodles which can be a healthier food alternative for people with type 2 Diabetes Mellitus. Cumini Noodles are processed wet noodles made with a mixture of duwet seed powder and have the potential to prevent significant increases in blood sugar. The study showed that patients who consumed Cumini Noodles experienced an increase in blood glucose levels after eating; however, the increase was substantially lower than that observed in patients who consumed regular noodles. The average postprandial increase in blood glucose levels was approximately 60.6% lower in the Cumini Noodles group (38 mg/dL) than in the regular noodle

group (96.4 mg/dL), suggesting a potential antihyperglycemic effect of Cumini Noodles in individuals with Type 2 Diabetes Mellitus.

This suggests that Cumini Noodles have some nutritional advantages compared to regular noodles as they have a lower energy content which is suitable for people with Type 2 Diabetes Mellitus in weight control and better management of blood sugar levels. The observed effect may be associated with multiple mechanisms, including a lower glycemic response, delayed glucose absorption by dietary fiber, antioxidant activity of polyphenolic compounds, and improved insulin sensitivity supported by minerals such as magnesium and chromium.

The results of this study support the use of Cumini noodles as an alternative functional food for people with Type 2 Diabetes Mellitus due to its ability to control blood sugar levels more effectively compared to regular noodles in individuals suffering from Type 2 Diabetes Mellitus.

Research on the effectiveness of Cumini Noodles in suppressing the rise in blood sugar levels requires more in-depth attention and a more robust design to confirm these findings and uncover a more detailed mechanism of action. Researchers must face several difficulties, such as a stronger research design with negative and positive controls, larger and diversified samples, more detailed chemical analysis to isolate active compounds, as well as accurately measuring blood sugar levels and controlling other variable factors. In addition, researchers must also face difficulties in interpreting complex data results and require sophisticated statistical analysis. Thus, more robust and representative studies can be conducted to confirm the effectiveness of Cumini Noodles in lowering blood sugar levels. In this regard, further research with a more robust design and involving a larger sample is needed to confirm these findings and reveal a more detailed mechanism of action.

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