Vol 11 No. 1 (2026) 60-68 ISSN (Online) : 2502-0943

Jurnal Katalisator

EFFECT OF WEST SUMATRAN DADIAH ON BODY WEIGHT AND GLYCEMIA IN HYPERGLYCEMIC RATS

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Detail Artikel

Diterima : 20 Juli 2026
Direvisi : 21 Juli 2026
Diterbitkan : 21 Juli 2026

Kata Kunci

dadiah
hyperglycemia
body weight
blood glucose levels
diabetes mellitus

Penulis Korespondensi

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A B S T R A K

This study was a laboratory-based experimental study using a post-test control group design to evaluate the effect of curd administration on body weight and blood glucose levels in hyperglycemic rat model. Male Wistar rats (Rattus norvegicus) aged 8–10 weeks with body weights of 250–300g were used and randomly divided into four groups: a negative control group without diabetes induction or treatment, a positive control group with diabetes induction without therapy, and two treatment groups receiving curd at different doses, P1 (1.8750 g/250 g body weight) and P2 (3.750 g/250 g body weight). The mean body weight was 277.67 g in the negative control group and 227.50 g in the positive control group. Treatment groups showed increased body weights of 246.83 g in P1 and 262.50 g in P2. Blood glucose levels were

http://doi.org/10.22216/jk.v5i2.5717
Published by LLDIKTI Wilayah X

Jurnal Katalisator Vol 11 No. 1 (2026) 60-68

125.56 mg/dL in the negative control group and increased to 487.00 mg/dL in the positive control group, while curd administration reduced levels to 122.17 mg/dL in P1 and 101.83 mg/dL in P2. These results indicate that curd improves body weight and lowers blood glucose in hyperglycemic rats, with greater effects at higher doses, suggesting its potential as a functional food for metabolic and glycemic control.

INTRODUCTION

Diabetes mellitus is a chronic metabolic disease characterized by hyperglycemia resulting from impaired insulin secretion, impaired insulin action, or both. This disease has become a global health issue as its prevalence continues to rise each year. The International Diabetes Federation reports that more than 537 million adults worldwide were living with diabetes in 2021, and this number is projected to continue increasing in the coming decade. Chronic hyperglycemia in people with diabetes can lead to various serious complications such as cardiovascular disease, nephropathy, neuropathy, and retinopathy, making effective prevention and blood glucose control essential

In animal models of alloxan-induced hyperglycemia, weight loss is commonly observed due to impaired glucose metabolism and increased breakdown of proteins and fats as alternative energy sources. This condition occurs because cells are unable to utilize glucose optimally due to insulin deficiency or resistance. Therefore, monitoring changes in body weight in diabetic mouse models is often used as an indicator to evaluate the therapeutic effects of an intervention [2]. One approach that is increasingly being developed for diabetes management is the use of functional foods containing probiotics. Probiotics are known to modulate the gut microbiota, improve glucose metabolism, and reduce inflammation and oxidative stress, which play a role in the pathogenesis of diabetes. Several studies have shown that probiotics can improve insulin sensitivity and lower blood glucose levels in both animal and human models [3].

Dadiah is a traditional fermented dairy product from West Sumatra made by naturally fermenting buffalo milk inside bamboo tubes. This fermentation process produces various lactic acid bacteria, such as Lactobacillus plantarum, Lactobacillus fermentum, and Lactococcus lactis, which possess probiotic properties. The lactic acid bacteria in dadiah are known to offer various health benefits, including antioxidant and antimicrobial activity, as well as the potential to improve digestive health [4]. Several previous studies have shown that the administration of curd or lactic acid bacteria isolates from curd can have a positive effect on metabolic parameters in animal models. Curd has been reported to reduce oxidative stress and improve tissue condition in animal models of diabetes, suggesting the potential for antidiabetic activity in this fermented product. This activity is thought to be related to the ability of probiotics to improve gut microbiota balance and enhance glucose metabolism [5]. Research on the effects of curd on physiological parameters such as body weight and blood glucose levels in diabetic animal models remains limited and requires further investigation.

Based on this background, research on the effects of curd administration on changes in body weight and blood glucose levels in hyperglycemic rat models is important to conduct. This study aims to evaluate the potential of curd as a functional food intervention that can

http://doi.org/10.22216/jk.v5i2.5717
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Jurnal Katalisator Vol 11 No. 1 (2026) 60-68

improve metabolic conditions in diabetes. Additionally, this study is expected to provide a scientific basis for the use of curd as a complementary therapy in the management of hyperglycemia.

MATERIAL AND METHODS

Research Type

Type of Research: This study is a laboratory-scale experimental study. It was conducted in the animal facility and the Pharmacy Laboratory of the Faculty of Pharmacy at Universitas Andalas. his study is a laboratory-based experimental study using a post-test control group design aimed at determining the effect of dadiah administration on changes in body weight and blood glucose levels in a hyperglycemic rat model. The study was conducted using diabetic rats that were then administered curd in two dosage variations: treatment 1 at 1.870 g of curd per 250 g of body weight and treatment 2 at 3.750 g of curd per 250 g of body weight in Rattus norvegicus rats.

The study subjects were male Wistar strain white rats (Rattus norvegicus) weighing approximately 250–300 grams and aged 8–10 weeks. The experimental animals were randomly divided into four groups, each consisting of an equal number of samples. The first group was the negative control group (K−), consisting of normal rats without diabetes induction and without curd administration. The second group was the positive control group (K+), consisting of rats with induced diabetes but without curd treatment. The third group was the dose 1 treatment group (P1), consisting of diabetic rats administered curd at a specific dose, and the fourth group was the dose 2 treatment group (P2), consisting of diabetic rats administered Dadiah at a higher dose.

Induction of diabetes and in vivo experimental

Diabetes was induced in mice using alloxan administered intraperitoneally at a standard dose to induce hyperglycemia. Mice were considered diabetic if their fasting blood glucose levels reached ≥135 mg/dL 72 hours after induction. After the diabetic condition was confirmed, rats in the treatment group were administered curd orally via a gastric tube daily during a specific treatment period, while the control group received no curd intervention. The main materials used in this study were curd obtained from the natural fermentation of buffalo milk, alloxan as the diabetes-inducing agent, standard rat chow, and distilled water. The equipment used included a digital scale to measure the rats' body weight, a glucometer to measure blood glucose levels, injection syringes, an oral feeding tube, rat cages, and other supporting laboratory equipment. Blood samples were collected from the rats' tail veins to measure blood glucose levels.

Instruments of research

The research equipment consisted of a digital scale (ACS) with an accuracy of 0.01 g for weighing the mice. Also included were cages for the experimental animals, food and water containers for the experimental animals, and a tube for Dadiah's probing. The equipment used in this study includes a luminometer, pipettes, a razor blade/scissors, aluminum foil, glucometer. Surgical scalpel and blades, tissue forceps, tissue scissors,

http://doi.org/10.22216/jk.v5i2.5717
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Jurnal Katalisator Vol 11 No. 1 (2026) 60-68

specimen pots, 10% buffered formalin, tissue processor. Beakers or graduated alcohol containers (70%, 80%, 96%, 100%), xylene containers. Embedding center, metal molds, liquid paraffin, cold plate, water bath.

Experimental animals

Prior to treatment, the rats were acclimatized for approximately one week under controlled environmental conditions with appropriate temperature, humidity, and light-dark cycles. During the study, the rats were provided with standard chow and drinking water ad libitum. Data collection was performed by measuring the rats body weight using a digital scale and testing blood glucose levels using a glucometer. Body weight measurements were taken periodically throughout the study period, while blood glucose level measurements were taken after the mice had been fasted for several hours prior to blood sampling. The data obtained were then recorded and analyzed to observe changes occurring in each treatment group.

RESULT AND DISCUSSION

Body Weight

Table 1. Average body weight of the rats in the study before and after being given the curd treatment

Group	Body Weight (gram)
K-	277.67
K+	227.50
P 1 (Dadiah 1,870 gr)	246.83
P 2 (Dadiah 3,750 gr)	262.50

Based on Table 1, the average body weight of rats in the negative control group was 277.67 grams, while that in the positive control group was lower at 227.50 grams. The weight loss in the positive control group indicates the effect of a specific alloxan induction, which can reduce body weight compared to normal conditions in the negative control group. Meanwhile, the treatment groups administered dadiah showed variations in body weight changes. In group P1 (administration of 1.8750 grams of dadiah), the average body weight was 246.83 grams, which was still between the negative control and the positive control. However, in group P2 (administration of 3.750 grams of dadiah), there was a significant increase in body weight to 262.50 grams.

http://doi.org/10.22216/jk.v5i2.5717
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Jurnal Katalisator Vol 11 No. 1 (2026) 60-68

Table 2. Post-hoc Test of Body Weight in Rat from the Study Across Each Treatment Group

Group		Sig.
Negative Control	K+	0,001
	P 1	0,001
	P 2	0,001
Positive Control	K-	0,001
	P 1	0,001
	P 2	0,001
P 1	K-	0,001
	K+	0,001
	P 2	0,001
P 2	K-	0,001
	K+	0,001
	P 1	0,001

Note: All differences are statistically significant (Sig. 0.001) because $p < 0.05$

These results indicate that feeding dadiah has the potential to increase body weight in rat, particularly at higher doses. This pattern suggests a doseresponse relationship, where in higher doses of curd result in a greater increase in body weight. At low doses (P1), the increase was not yet very noticeable, whereas at high doses (P2), the effect became more pronounced. These findings indicate a relationship between the response and the administered dose. The higher the dadiah dose administered, the more significant the increase in body weight. This pattern suggests that dadiah has the potential to act as an agent that can influence body metabolism, particularly in weight management.

Curd is a traditional fermented dairy product rich in probiotic bacteria, such as lactic acid bacteria. Probiotics are known to play an important role in maintaining the balance of the gut microbiota. The gut microbiota itself contributes to the regulation of energy metabolism, fat storage, and inflammatory processes associated with obesity. The literature indicates that modulating the gut microbiota through probiotics may help reduce the risk of obesity and influence body weight [6]. Additionally, probiotics can enhance metabolic efficiency and influence nutrient absorption. A possible mechanism is the increased production of short-chain fatty acids (SCFAs), which can regulate appetite and energy metabolism. This can lead to reduced energy intake and increased energy expenditure.

The results of this study are also consistent with other experimental studies showing that probiotic administration can significantly affect body weight in rats and indicating that

http://doi.org/10.22216/jk.v5i2.5717
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Jurnal Katalisator Vol 11 No. 1 (2026) 60-68

probiotic administration, whether alone or in combination, has a significant effect on changes in body weight in rats [7]. Other research also mentions that an increase in body weight was observed in the group that received the curd intervention [8]. This reinforces the hypothesis that the probiotic content in curd plays a role in the weight control observed in this study. In addition to microbiota factors, the nutritional content in curd, such as protein and organic acids, may also contribute to this effect. Protein is known to increase satiety, thereby reducing food intake.

Overall, the results of this study indicate that the feeding of dadiah has the potential to regulate body weight in rats in a dose dependent manner. This effect is likely related to the probiotic activity in restoring the balance of the gut microbiota and influencing energy metabolism. These findings open up opportunities for the use of dadiah as a functional food in weight management, although further research is still needed to confirm the mechanisms and effectiveness in greater depth.

Blood glucose level

Table 3. Average glucose levels in rats from the study before and after being given the dadiah treatment

Group	Average Glucose Level (mg/dl)
K-	125.56
K+	487.00
P 1 (Dadiah 1,8750 gr)	122.17
P 2 (Dadiah 3,750 gr)	101.83

According to Table 2, the average blood glucose level in the negative control group was 125.56 mg/dl, indicating a normal condition. Meanwhile, in the positive control group, there was a highly significant increase to 487.00 mg/dL, indicating a state of hyperglycemia. This demonstrates that the induction of a hyperglycemic rat model using alloxan is effective, as the positive control group successfully achieved a drastic increase in blood glucose levels [9].

Table 4. Post-hoc test of glucose levels in rats from the study for each treatment group

Group		Sig.
Negative Control	K+	0,001
	P 1	0,001
	P 2	0,001

http://doi.org/10.22216/jk.v5i2.5717
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Jurnal Katalisator Vol 11 No. 1 (2026) 60-68

Positive Control	K-	0,001
	P 1	0,001
	P 2	0,001
P 1	K-	0,001
	K+	0,001
	P 2	0,001
P 2	K-	0,001
	K+	0,001
	P 1	0,001

Note: All differences are statistically significant (Sig. 0.001) because $p < 0.05$.

In the treatment groups given curd, a significant decrease in blood glucose levels was observed compared to the positive control. Group P1 (Dadiah 1.8750 grams) had an average glucose level of 122.17 mg/dl, which was close to the normal range (negative control). Meanwhile, group P2 (Dadiah 3.750 grams) showed a greater decrease to 101.83 mg/dL, bringing blood glucose levels within the normal range. These results indicate that curd administration has a strong antihyperglycemic effect, capable of lowering blood glucose levels from a hyperglycemic state to near or even within the normal range. Additionally, there is a dose-response relationship, with higher doses of curd resulting in a greater reduction in blood glucose levels.

Dadiah is a traditional fermented dairy product rich in probiotic bacteria, particularly lactic acid bacteria. Probiotics are known to play a key role in regulating glucose metabolism through various mechanisms. One of the primary mechanisms is the enhancement of insulin sensitivity, allowing the body's cells to absorb glucose from the blood more effectively, which ultimately lowers blood glucose levels. An imbalance in gut microbiota (dysbiosis) is known to be closely associated with the development of insulin resistance and hyperglycemia; therefore, improving microbiota composition through probiotics is an effective approach [10]. Consuming probiotics has been shown to help lower blood glucose levels by modulating the gut microbiota and improving metabolic control in diabetes. Additionally, probiotics play a role in improving the composition of the gut microbiota. A well-balanced gut microbiota can reduce insulin resistance and mitigate chronic inflammation, which are key factors in the development of hyperglycemia. Probiotics can also produce short-chain fatty acids (SCFAs) such as acetate, propionate, and butyrate, which play a role in regulating glucose homeostasis and energy metabolism [11]. This study is also consistent with previous research showing a significant decrease in blood glucose levels following the administration of a curd intervention [12].

The decrease in blood glucose levels in the treatment group may also be attributed to the presence of bioactive compounds resulting from fermentation in the curd, such as

http://doi.org/10.22216/jk.v5i2.5717
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bioactive peptides. These compounds are known to inhibit the activity of α-glucosidase and α-amylase enzymes in the digestive tract. Inhibition of these enzymes slows the breakdown and absorption of carbohydrates into glucose, thereby suppressing spikes in blood glucose level [13]. These findings align with previous studies reporting that probiotic consumption can have positive effects on blood glucose control, both in experimental animals and humans. Thus, curd can be categorized as a functional food with potential for the prevention and management of hyperglycemia [14]. This indicates that the results of the study on curd administration were able to significantly lower blood glucose levels in rats, with more optimal effects at higher doses. These findings support the potential of curd as a natural antihyperglycemic agent that can be utilized in blood sugar control.

CONCLUSION

Based on the research results, it can be concluded that the administration of curd can affect changes in body weight and blood glucose levels in hyperglycemic model rats. Regarding body weight, the positive control group showed a decrease in body weight due to hyperglycemia compared to the negative control. Dadiah in the treatment groups showed an increase in body weight, with a greater increase occurring at the higher dose (P2), namely 262.50 g, indicating a dose-dependent response. Regarding blood glucose levels, the positive control group exhibited a very high increase in glucose levels compared to the negative control. Curd administration significantly reduced blood glucose levels in both treatment groups, with the lowest result observed in the P2 group at 101.83 mg/dL, which was close to or even lower than the negative control. Dadiah rich with macronutrients, particularly protein and fat. Protein increases satiety (reducing calorie intake) and slows carbohydrate absorption, thereby aiding blood sugar control. Overall, Dadiah was shown to have an effect on weight loss and blood glucose levels in a hyperglycemic rat model, with more optimal effects at higher doses.

ACKNOWLEDGEMENTS

The authors would like to thank the Department of Pharmacy and Biochemistry Laboratory, Faculty of Medicine, Andalas University, Indonesia, for their assistance with sample analysis.

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