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## Effect of Bungur Leaf Extract on Glucose Reduction in Kidney Dysfunction Rats

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### Abstract

*Diabetes mellitus is a metabolic disorder with an increasing prevalence in Indonesia, including in the city of Jambi. Conventional antidiabetic therapies such as metformin, sulfonylureas, and insulin are effective in lowering glucose levels, but long-term use can cause side effects, including the risk of kidney damage. Bungur leaves (*Lagerstroemia speciosa*) contain flavonoids, alkaloids, tannins, triterpenoids, and corosolic acid, which have potential antihyperglycemic and nephroprotective properties. This study aimed to evaluate the effects of bungur leaf ethanol extract on blood glucose levels and kidney function in male white rats induced with alloxan and gentamicin. The study was conducted experimentally with seven treatment groups. The parameters observed included blood glucose and serum creatinine levels. The results showed a significant decrease in glucose, with the highest effectiveness at a dose of 1200 mg/kgBW. The extract also lowered creatinine levels, indicating a renal protective effect. These findings suggest the potential of crape myrtle leaves as a herbal antidiabetic agent while maintaining renal function.*

**Keywords:** *Lagerstroemia Speciosa, Blood Glucose, Creatinine, Nephroprotective, Alloxan*

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## INTRODUCTION

Diabetes mellitus (DM) is the most prevalent disease worldwide and nationally. According to the WHO (2024), there are 830 million people worldwide with diabetes. Meanwhile, in Indonesia, from 2018 to 2023, the prevalence of diabetes increased by 0.2%. Meanwhile, there has been an increase in the number of people with diabetes mellitus in the city of Jambi. In 2022, there were 2,725 people, then in 2023, there were 13,050 people.

DM is usually characterized by frequent urination (polyuria), excessive thirst (polydipsia), increased appetite (polyphagia), and unexplained weight loss. Over time, DM can affect various organ systems in the body and cause long-term complications. These complications are classified into microvascular complications, such as nerve damage (neuropathy), kidney damage (nephropathy), and eye damage (retinopathy), as well as macrovascular complications, which include heart disease, stroke, and peripheral vascular disorders (Lestari, 2021).

The management of DM currently still largely depends on pharmacological therapy, such as the use of metformin, sulfonylureas, and insulin. However, their use often causes side effects, such as digestive disorders, the risk of hypoglycemia, and potential toxicity to the liver, as well as kidney damage (Mitra et al., 2021). This situation has driven growing public interest in herbal medicines, which are considered safer, more economical, and have fewer side effects (Grenvilco et al., 2023).

One herbal plant that can lower blood sugar levels is the bungur plant. The bungur plant is useful as an antibacterial, anti-inflammatory, anti-tumor, and anti-diabetic agent (Kien et al., 2024); (Riyanti, 2021). Bungur leaves contain saponins, flavonoids, alkaloids, corosolic acid, triterpenoids, tannins, and lagerstroemin. These compounds can increase the absorption and utilization of glucose by cells through a stimulated glucose transport mechanism (Alhafizoh et al., 2022).

In studies (Alhafizoh et al., 2022); (Halim et al., 2025), it was found that bungur leaves can be used as an alternative herbal ingredient in the treatment and therapy of DM patients. Meanwhile, in the study (Kien et al., 2024), bungur leaves at a dose of 620 mg/kgBW reduced blood sugar levels by 41.44% over 28 days, while a dose of 1240 mg/kgBW reduced blood sugar levels by 42.73% over 28 days in rats.

Based on the above problems and background, the researcher was interested in testing the effect of bungur leaf extract (*Lagerstroemia speciosa*) on blood glucose levels in male white rats (*Rattus norvegicus*) with kidney dysfunction. Previous studies have only examined the benefits of crape myrtle leaves (*Lagerstroemia speciosa*) on lowering blood glucose levels, and no studies have been conducted on lowering blood glucose levels with renal dysfunction pathology in test rats.

## RESEARCH METHODS

### Research Design

An experimental design with randomized group allocation was used. Male white rats (*Rattus norvegicus*) served as test animals to evaluate the antihyperglycemic and nephroprotective effects of bungur leaf extract under alloxan-induced hyperglycemia and gentamicin-induced kidney dysfunction. Seven treatment groups were assigned:

1. Negative control (NaCMC 0.5 percent)
2. Alloxan only (150 mg/kg BW)
3. Alloxan + gentamicin
4. Alloxan + gentamicin + pioglitazone
5. Alloxan + gentamicin + extract 600 mg/kg BW
6. Alloxan + gentamicin + extract 1200 mg/kg BW
7. Alloxan + gentamicin + extract 2400 mg/kg B

### Materials and Instruments

Materials included male rats, bungur leaves, ethanol 96 percent, alloxan, gentamicin, NaCMC, distilled water, alcohol swabs, feed, and bedding. Instruments consisted of a rotary evaporator, water bath, analytical and animal balances, glassware, glucometer, centrifuge, oral gavage, surgical tools, and a clinical photometer.

### Sample Preparation and Extraction

Fresh bungur leaves were cleaned, shade-dried, and processed into simplicia. Extraction was performed by maceration in ethanol 96 percent at a 1:10 ratio for 24 hours with periodic stirring. The filtrate was concentrated using a rotary evaporator at 50 °C to obtain a thick extract.

### Phytochemical Screening

Qualitative tests were conducted to identify alkaloids, flavonoids, tannins, saponins, and triterpenoids using standard reagent methods.

### Experimental Animals

Rats were acclimated prior to treatment. Diabetes was induced by intraperitoneal injection of alloxan 150 mg/kg BW. Hyperglycemia was confirmed when blood glucose exceeded 135 mg/dL. Kidney dysfunction was induced by gentamicin 60 mg/kg BW for 7 days.

### Treatment and Sample Collection

Extract doses of 600, 1200, and 2400 mg/kg BW were administered orally. Blood glucose levels were measured on days 1, 7, and 14 using a glucometer. Serum creatinine levels were measured on days 0 and 14 using a clinical photometer at 492 nm.

### Data Analysis

Data were analyzed using One-Way ANOVA. If assumptions of normality and homogeneity were not met, the Kruskal–Wallis test was applied. Significant differences were further evaluated using Duncan's multiple range test.

## RESULTS AND DISCUSSION

### Sample Result

**Table 1. Phytochemical Screening of Leaf Extracts**

Test	Reagen	Reference	Color	Result
Alkaloid	Mayer	White, brown, orange deposits	Brown Deposits	(+)
	Dragendorf			(+)
	Wagner			(+)
Flavonoid	HCl Concentrated	Green	Dark Green	(+)
Tanin	FeCl <sub>3</sub> 1 %.	Dark Green	Dak Green	(+)
Saponin	Distilled Water	Foaming	Foaming	(+)
Triterpenoid	Liebermann Burchard	Brownish red	Brownish red	(+)

### Pharmacology Test

**Table 2. Glucose Difference**

Group	Average Glucose Level Difference (mg/dl) ± SD		
	Day-1	Day-7	Day-14
1	-1,33 ± 2,08	-2,66 ± 2,30	-2 ± 3,46
2	-2,33 ± 5,56	-0,33 ± 3,78	-0,33 ± 4,16
3	3,33 ± 11,93	13,66 ± 8,14	31 ± 11,78
4	-36,33 ± 4,50	-84,33 ± 10,11	-135 ± 19,67
5	-48 ± 12,52	-89,33 ± 5,68	-120,33 ± 5,77
6	-55 ± 7,54	-107,33 ± 6,02	-150,33 ± 15,63
7	-68 ± 1,73	-131,66 ± 16,28	-198,33 ± 13,05

**Table 3. Glucose Level Normality Test**

Day	Test	p-value	Result
0			
1	<i>Shapiro Wilk</i>	> 0,05	Normal
7			
14			

**Table 4. Glucose Level Homogeneity Test**

Day	Test	p-value	Result
0			
1	<i>Levene</i>	> 0,05	Homogen
7			
14			

**Tabel 5. Glucose One Way Anova Test**

Day	Test	p-value	Description	Conclusion
0		0,000		
1	<i>One Way Anova</i>	0,000	< 0,05	Significant
7		0,000		
14		0,000		

Based on the results of the normality test, the glucose levels on days 0, 1, 7, and 14 in each group showed a normal distribution ( $p > 0.05$ ). The homogeneity test showed a  $p$  value  $> 0.05$ , which means that the data is homogeneous and meets the assumption of homogeneity and can proceed to the One Way Anova test. The One Way Anova test showed that  $p < 0.05$ , which means that there is a significant difference. Then it can proceed to the Duncan test.

**Table 6. Duncan Glucose Test**

Group	Subset			
	1	2	3	4
1	120,67			
2			281,33	
3				395,33
4	178	178		
5		212	212	
6	185	185		
7		212,33	212,33	

Duncan's follow-up test shows that there are four groups of average scores. Group 1 has the lowest average score. Groups 4 and 6 are in the same subset, so there is no significant difference between them. Furthermore, groups 5, 7, and 2 are in the same subset, so there are no significant differences between them. Meanwhile, group 3 has the highest average score and is in a subset of four, and is significantly different from all other groups.

**Table 7. Difference in Creatinine Level**

Group	Rats	Day-0	Day-14	Differene
1	1	0,5	0,5	0,0
	2	0,5	0,5	0,0
	3	0,5	0,5	0,0
Average ± SD		0,50 ± 0,00	0,50 ± 0,00	0,00 ± 0,00
2	1	0,5	0,4	-0,1
	2	0,5	0,4	-0,1
	3	0,5	0,4	-0,1
Average ± SD		0,50 ± 0,00	0,40 ± 0,00	-0,1 ± 0,00
3	1	1,3	0,6	-0,7
	2	1,2	0,4	-0,8
	3	2,1	0,6	-1,5
Average ± SD		1,53 ± 0,49	0,53 ± 0,11	-1,15 ± 0,49
4	1	1,4	0,4	-1,0
	2	2,4	0,6	-1,8
	3	0,9	0,4	-0,5
Average ± SD		1,56 ± 0,76	0,46 ± 0,11	-1,1 ± 0,65
5	1	1,1	0,7	-0,4
	2	0,9	0,4	-0,5
	3	1,0	0,5	-0,5
Average ± SD		1,00 ± 0,1	0,53 ± 0,15	-0,46 ± 0,05
6	1	1,1	0,4	-0,7
	2	1,4	0,6	-0,8
	3	0,9	0,4	-0,5
Average ± SD		1,1 ± 0,25	0,46 ± 0,11	-0,6 ± 0,15

7	1	1,0	0,3	-0,7
	2	1,0	0,6	-0,4
	3	0,9	0,5	-0,4
Average ± SD		0,96 ± 0,05	0,46 ± 0,15	-0,5 ± 0,17

## Discussion

### Sample Characteristics and Extract Composition

Phytochemical screening revealed the presence of alkaloids, flavonoids, tannins, saponins, and triterpenoids. These findings are consistent with previous reports indicating that *Lagerstroemia speciosa* contains bioactive compounds involved in glucose regulation, antioxidant activity, and  $\alpha$ -glucosidase inhibition. The detection of corosolic acid, a triterpenoid with recognized antihyperglycemic action, supports its potential pharmacological relevance.

### Pharmacological Evaluation

#### Hyperglycemia Induction

Alloxan administration (150 mg/kg BW) produced a marked elevation in blood glucose levels, exceeding the hyperglycemic threshold (>135 mg/dL). The effect is attributable to alloxan-induced oxidative damage to pancreatic  $\beta$ -cells, resulting in impaired insulin secretion and progressive hyperglycemia. Mortality in some animals was associated with severe  $\beta$ -cell necrosis and acute metabolic instability. Glucose elevation following induction was statistically significant ( $p < 0.05$ ).

#### Renal Dysfunction Induction

Gentamicin exposure (60–80 mg/kg BW) induced nephrotoxicity characterized by increased serum creatinine, reflecting tubular epithelial injury and reduced glomerular filtration. This outcome aligns with established evidence that gentamicin induces oxidative stress, mitochondrial dysfunction, and dose-dependent tubular necrosis. The creatinine values exceeded the normal range for rats (0.2–0.8 mg/dL), indicating successful induction of renal impairment.

#### Effect of Bungur Leaf Extract on Blood Glucose

Administration of bungur leaf extract at 600, 1200, and 2400 mg/kg BW resulted in significant reductions in blood glucose levels. The most pronounced antihyperglycemic effect was observed at the 1200 mg/kg BW dose, suggesting a dose–response pattern that reaches an optimal pharmacological window. The reduced efficacy at 2400 mg/kg BW indicates a non-linear dose–response relationship, potentially due to biological saturation or counter-regulatory mechanisms.

The mechanism is likely mediated by corosolic acid and associated phenolic compounds that enhance peripheral glucose uptake, improve insulin sensitivity, inhibit  $\alpha$ -glucosidase, and mitigate oxidative stress. Flavonoids and triterpenoids may additionally contribute through free radical scavenging and modulation of inflammatory pathways.

The pioglitazone group demonstrated glucose levels approaching normal values, consistent with its PPAR- $\gamma$  activation mechanism. The extract at 1200 mg/kg BW showed comparable efficacy, reinforcing its potential as a phytotherapeutic agent for glycemic control.

#### Effect of Bungur Leaf Extract on Serum Creatinine

Serum creatinine decreased following treatment with both pioglitazone and the extract. In extract-treated groups, improvement in renal function is consistent with the nephroprotective actions of corosolic acid, which reduces oxidative stress, suppresses inflammatory signaling, and attenuates renal fibrosis. The observed normalization of creatinine in certain untreated groups may relate to the reversible nature of gentamicin-induced nephrotoxicity, as previously documented.

The overall pattern demonstrates that bungur leaf extract confers protective effects against both hyperglycemia and renal impairment, with the 1200 mg/kg BW dose providing the most balanced therapeutic profile.

## CONCLUSIONS

The Bungur leaf extract significantly reduced blood glucose in male rats with kidney dysfunction ( $p < 0.05$ ), with the 1200 mg/kg BW dose showing the highest efficacy. The extract also provided renal protection, evidenced by a significant decrease in serum creatinine levels ( $p < 0.05$ ).

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