Corn Silk (*Stigma maydis*) Extract Successfully Reduces Blood Glucose Levels in Alloxan-Induced Diabetic Mice

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ABSTRACT
Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder that requires effective therapeutic strategies with minimal adverse effects. The search for complementary antidiabetic agents derived from natural products has gained increasing attention, particularly those with potential antihyperglycemic activity and favorable safety profiles. Corn silk (*Stigma maydis*) contains bioactive compounds reported to influence glucose metabolism, making it a promising candidate for adjunctive therapy in T2DM management. This study aimed to evaluate the antihyperglycemic effect of the optimal dose of *Stigma maydis* ethanol extract (P3) compared with metformin (positive control, K+) in alloxan-induced hyperglycemic male Swiss Webster mice. Male Swiss Webster mice were induced with alloxan at 150 mg/kgBW to establish a hyperglycemic model. The optimal dose of *Stigma maydis* extract (P3) and metformin (K+) were administered orally for 14 days. Blood glucose levels were measured before and after treatment. Paired t-tests were used to assess within-group changes, while independent t-tests were applied to compare post-treatment glucose levels between groups. The P3 group demonstrated a significant reduction in blood glucose levels ($p = 0.003$), with a post-treatment mean of 111.40 mg/dL. Although the numerical decrease in the P3 group exceeded that of the metformin group, the difference between groups was not statistically significant ($p = 0.576$). These findings indicate that the antihyperglycemic activity of *Stigma maydis* extract is statistically comparable to metformin under the experimental conditions tested. In conclusion, the optimal dose of *Stigma maydis* ethanol extract produced a significant antihyperglycemic effect in alloxan-induced mice, with efficacy comparable to metformin. These results support the potential of *Stigma maydis* as a complementary therapeutic option for T2DM management, warranting further investigation in larger preclinical and clinical studies.
Keywords: *Stigma maydis*; metformin; antihyperglycemic activity

INTRODUCTION
Diabetes mellitus is a major non-communicable disease characterized by chronic hyperglycemia resulting from long-standing metabolic disturbances that progressively impair multiple organ systems, particularly the cardiovascular system, kidneys, eyes, and peripheral nerves [1,2]. Type 2 diabetes mellitus (T2DM) represents the predominant form among adults and is primarily associated with insulin resistance accompanied by β-cell dysfunction, whereas type 1 diabetes mellitus (T1DM) results from autoimmune destruction of pancreatic β-cells leading to absolute insulin deficiency [2–6]. These distinct etiological pathways highlight the complexity of diabetes pathophysiology and reinforce the need for therapeutic strategies tailored to the underlying metabolic abnormalities.

Over the past two decades, the global prevalence of diabetes has increased at a rate that exceeds the capacity of health systems to provide adequate disease management. The International Diabetes Federation (IDF) estimates that 11.1% of the world's adult population aged 20–79 years will be living with diabetes by 2025, with projections indicating a rise to approximately 853 million individuals by 2050 [1,7]. These projections are consistent with World Health Organization (WHO) reports showing that nearly 59% of adults with diabetes have not received adequate treatment, particularly in low- and middle-income countries where access to diagnostic and therapeutic services remains limited [1]. In Indonesia, the national trend mirrors global patterns, with an estimated 20.4 million diabetes cases reported in 2024 [7]. This rapid increase underscores persistent gaps in early detection and routine management, suggesting that current strategies have not fully mitigated disease progression or its associated complications.

The Indonesian Society of Endocrinology (PERKENI) recommends metformin as the first-line pharmacological therapy for T2DM due to its well-established efficacy in enhancing insulin sensitivity and reducing hepatic glucose production through activation of the AMP-activated protein kinase (AMPK) pathway [8–10]. Despite its therapeutic benefits, adherence to metformin is often hindered by limited access, variable tolerability, and socioeconomic constraints. Clinically, long-term metformin use is associated with common gastrointestinal adverse effects such as nausea, diarrhea, and abdominal discomfort, as well as more serious risks including lactic acidosis and vitamin B12 deficiency [8–12]. Beyond clinical considerations, disparities in socioeconomic conditions and healthcare availability further influence treatment consistency, prompting some patients to seek complementary approaches outside conventional therapy. These combined factors contribute to the increasing use of herbal medicines as adjunctive treatments [8,13].

This trend aligns with a broader societal shift toward natural or "back to nature" approaches, which are perceived as more affordable, more accessible, and associated with fewer side effects, consistent with cultural values and evolving health beliefs shaped by discomfort with conventional chemical medications [11,14–17]. From a scientific standpoint, this shift underscores the need to identify natural-product-based therapeutic candidates with verified mechanistic pathways and metabolic benefits relevant to T2DM management [18,19]. The rising prevalence of diabetes, coupled with suboptimal coverage of standard therapies, highlights the importance of safe, accessible complementary interventions capable of supporting glycemic control without adding clinical risk. Phytochemical-based complementary approaches become particularly relevant when their biological mechanisms demonstrate potential to address therapeutic gaps not fully covered by standard pharmacotherapy.

Corn silk (*Stigma maydis*), a biological by-product of the maize plant (Zea mays L.), contains a diverse array of bioactive metabolites including flavonoids, saponins, alkaloids, tannins, and polyphenols [20–24]. These compounds have been reported to exert antihyperglycemic effects through several mechanisms identified in both in vitro and in vivo studies, such as enhancement of glucose utilization, modulation of insulin sensitivity via AMPK-related pathways, and inhibition of carbohydrate-digesting enzymes including α-amylase and α-glucosidase [25–28]. This mechanistic profile positions *Stigma maydis* as a promising complementary therapeutic candidate with a potentially low risk of hypoglycemia and mechanistic overlap with metformin [9,25,26]. Although various studies have demonstrated reductions in blood glucose and improvements in glycemic parameters in animal models, direct comparative evidence evaluating its effectiveness relative to standard therapies such as metformin remains limited [25,27,28]. Furthermore, many previous studies have focused on isolated biochemical parameters without examining their direct

relationship to glycemic responses, leaving the comparative therapeutic landscape insufficiently defined. Addressing this scientific gap is essential for assessing the feasibility of *Stigma maydis* as a complementary therapy that could be used alongside or as a supportive alternative to standard T2DM management. Based on this background, the present study aims to evaluate and compare the antihyperglycemic effects of corn silk extract at its optimal dose (P3) with metformin (K+) in alloxan-induced mice as an initial step toward characterizing glycemic response patterns relative to standard therapy.

METHODS

The study was conducted in June 2024 and took place in a controlled laboratory setting, encompassing the sequential phases of extract preparation, phytochemical screening, and experimental evaluation of antihyperglycemic activity. All procedures were performed within the facilities designated for small-animal experimentation and phytochemical analysis. The research employed a laboratory-based experimental design using a pre–post test control group structure to assess the antihyperglycemic effects of ethanol extract of corn silk (Zea mays L.) on alloxan-induced male mice. Fresh corn silk of the Hibrida TKS 234 or Reog 234 variety was sourced from local farmers in Ponorogo. The plant material was cleaned, shade-dried for seven days, and ground into fine powder. Extraction was conducted through maceration in 70% ethanol for seven days at a material-to-solvent ratio of 1:10 (b/v). The filtrate was subsequently concentrated using a rotary evaporator to obtain a viscous extract. Phytochemical screening was performed to identify secondary metabolites including alkaloids, flavonoids, saponins, tannins, and phenolic compounds using the Trease and Evans (1989) protocol [29].

The experimental subjects consisted of male Swiss Webster mice aged 2–3 months and weighing 20–30 grams. Prior to treatment, the animals underwent a seven-day acclimatization period under controlled environmental conditions, including a temperature range of 22–25 °C and a 12-hour light–dark cycle, with unrestricted access to food and water. Mice were fasted for six hours before induction. Diabetes was induced by intraperitoneal injection of alloxan monohydrate at a dose of 150 mg/kg body weight, followed by oral administration of 5% glucose solution after 24 hours to prevent acute hypoglycemia. Seventy-two hours after induction, fasting blood glucose levels were measured, and mice with values ≥ 200 mg/dL were classified as diabetic and included in the study.

Although the main experiment consisted of five groups, the present report focuses on two principal groups, each comprising five animals. The Positive Control group (K+) received metformin at a dose of 100 mg/kg body weight, while the Optimal Dose Treatment group (P3) received ethanol extract of corn silk at 0.273 g/kg body weight, equivalent to 400 mg of dried powder per kilogram body weight [20,30–32]. Random allocation was applied to assign animals to groups, and all interventions were administered orally using an oral gavage tube for a duration of fourteen days.

The primary outcome variable was fasting blood glucose concentration, measured at three time points: baseline (prior to induction), diabetes confirmation (72 hours post-induction), and post-treatment (day 14). Measurements were obtained using a digital glucometer (Easy Touch®) following standardized procedures. Data were assessed for normality using the Shapiro–Wilk test and for homogeneity of variance prior to parametric analysis. When assumptions were met, within-group pre–post changes were analyzed using paired t-tests, while between-group comparisons were conducted using independent t-tests. Despite the small sample size (n = 5 per group), the use of parametric tests remained acceptable because t-tests maintain stable Type I error rates when distributional assumptions are satisfied [33].

All animal procedures adhered to the principles of Replacement, Reduction, and Refinement (3R), ensuring minimization of distress, discomfort, and unnecessary exposure throughout the study. The ethical safeguards implemented in this research affirm the scientific integrity and humane conduct of all experimental activities.

Table 1. Phytochemical profile of corn silk (*Stigma maydis*)

Compound	Reagent	Parameter/expected reaction	Observed result
Flavonoids	Mg powder + HCl	Orange coloration	+
	Mayer's reagent	Deep red coloration	+
Alkaloids	Wagner's reagent	Orange precipitate	+
	Dragendorff's reagent	Brown precipitate	+
Tannins	$FeCl_3$	Dark brown–black coloration	+
Steroids	Liebermann–Burchard	-	-
Saponins	-	Stable persistent froth	+

Table 2. Normality test (pre–post) in K^+ and P3 groups

Indicator	Treatment group	Statistic	df	p-value
Pre-treatment glucose (mg/dL)	Metformin (K^+)	0.926	5	0.568
	Optimal extract (P3)	0.910	5	0.467
Post-treatment glucose (mg/dL)	Metformin (K^+)	0.952	5	0.748
	Optimal extract (P3)	0.888	5	0.349

Table 3. Paired t-test for pre–post glucose levels in K^+ and P3 groups

Treatment group	Mean glucose pre ± SD	Mean glucose post ± SD	t	p-value
Metformin (K^+)	216.20 ± 31.204	114.00 ± 10.559	10.193	<0.001
Optimal extract (P3)	225.80 ± 36.383	111.40 ± 8.620	6.230	0.003

Table 4. Normality test for glucose reduction (Δ mg/dL) in K^+ and P3 groups

Variable	Treatment Group	Statistic	df	p-value
Δ mg/dL	Metformin (K^+)	0.825	5	0.126
	Optimal Extract (P3)	0.912	5	0.480

Table 5. Independent t-test for glucose reduction (Δ mg/dL) between K^+ and P3 groups

Treatment group	Mean ± SD	t	df	p-value
Metformin (K^+)	102.200 ± 22.421	–0.583	8	0.576
Optimal extract (P3)	114.400 ± 41.058			

RESULTS

The qualitative phytochemical screening demonstrated that the *Stigma maydis* extract produced strong positive reactions for flavonoids and positive results for tannins, saponins, and alkaloids, whereas the steroid test yielded a negative result. The predominance of flavonoids is consistent with the antihyperglycemic tendencies observed in the treatment group, given the well-documented role of flavonoid compounds in modulating glucose metabolism and oxidative stress pathways.

The Shapiro–Wilk test indicated that all pre- and post-treatment glucose values in both the K^+ and P3 groups had p-values greater than 0.05, as shown in Table 2. These results confirm that the data were normally distributed and therefore met the assumptions required for parametric statistical analysis.

The paired t-test revealed a statistically significant reduction in fasting blood glucose levels in both the K^+ and P3 groups (Table 3).

Both groups exceeded the α = 0.05 significance threshold, indicating that the pre–post reductions were statistically meaningful. The distribution of ΔKGD values in both the K^+ and P3 groups also showed p-values greater than 0.05 (Table 4), confirming normal distribution and supporting the use of an independent t-test for between-group comparison. The independent t-test comparing ΔKGD between the K^+ and P3 groups showed that although the P3 group exhibited a higher mean reduction in glucose levels, the difference was not statistically significant ($p > 0.05$), as presented in Table 5. These findings indicate that both treatments demonstrated comparable antihyperglycemic effectiveness based on statistical evaluation.

DISCUSSION

The phytochemical screening of the ethanol extract of *Stigma maydis* demonstrated that flavonoids were the most consistently detected class of secondary metabolites across all assays, accompanied by the presence of alkaloids, tannins, and saponins, whereas steroidal compounds were not identified under the extraction conditions applied. This compositional pattern aligns with the findings of Usman et al. (2024), who similarly reported the presence of flavonoids, tannins, and saponins in *Stigma maydis* extracts [20]. Variations in the detection of steroidal constituents across studies have been attributed to multiple biological and technical factors, including differences in plant maturity, maize hybrid type, cultivation region, and solvent polarity, all of which may influence the extraction efficiency and chemical profile of the resulting extract [24]. Considering the mechanistic pathways previously described for flavonoids, their predominance in the extract provides a plausible explanation for the antihyperglycemic activity observed in alloxan-induced diabetic mice, particularly given the well-established role of flavonoids in modulating glucose metabolism [28].

Mechanistically, flavonoids exert antioxidant effects that support the regeneration of pancreatic β-cells and enhance insulin secretion. They also inhibit carbohydrate-hydrolyzing enzymes such as intestinal α-glucosidase, thereby reducing postprandial glucose absorption and attenuating glycemic excursions [34,35]. These biochemical actions are highly relevant in the context of diabetes, where glycemic regulation depends on the integrity of pancreatic function, peripheral insulin sensitivity, and the body's capacity to mitigate oxidative stress and inflammation—two major contributors to metabolic deterioration.

Metformin, the first-line pharmacotherapy for type 2 diabetes, primarily improves glycemic control by enhancing insulin sensitivity and suppressing hepatic glucose production, while also improving β-cell responsiveness to hyperglycemia [9,10,25]. Chen et al. (2020) demonstrated that metformin reduces glucose burden through AMPK activation and increased glucose utilization in peripheral tissues [36]. In contrast, phytochemical-based interventions such as *Stigma maydis* extract offer complementary mechanisms, including enhancement of glucose metabolism, improvement of β-cell function, and inhibition of digestive enzymes like α-glucosidase, which collectively contribute to reduced glucose absorption and improved glycemic stability [28,35].

The glucose-lowering pattern observed in the optimal-dose *Stigma maydis* group (P3) showed an antihyperglycemic effect approaching that of the metformin control group (K^+), although the present study was not designed to establish clinical equivalence. Nonetheless, the findings indicate that the optimal extract dose produced a consistent and biologically meaningful antihyperglycemic response. This observation is supported by Dong et al. (2022), who reported that *Stigma maydis* extract enhances insulin sensitivity and reduces insulin resistance by improving the metabolic environment [37,38]. The parallel improvements in glucose regulation between metformin and *Stigma maydis* extract suggest that both interventions contribute pharmacologically to the mitigation of hyperglycemia, a central determinant of metabolic stability in diabetes.

The effect observed in the P3 group also demonstrated a dose-responsive trend, consistent with previous reports describing dose-dependent antihyperglycemic activity. Sani (2016) documented that increasing doses of methanolic corn silk extract produced progressively greater reductions in blood glucose, while Koloay et al. (2015) reported that ethanol extract of corn silk achieved glucose-lowering effects statistically comparable to glibenclamide under specific experimental conditions [39,40]. These mechanisms are further supported by Guo et al. (2009), who found that corn silk extract enhances insulin secretion and ameliorates β-cell damage in alloxan-induced diabetic rats [41]. Collectively, these findings are consistent with the present study, in which the P3 group exhibited a greater reduction in fasting glucose compared with lower doses and approached the effect magnitude of metformin. The comparison is not intended to position the extract as clinically equivalent to metformin, but rather to illustrate that the extract demonstrates a stable antihyperglycemic response under standardized experimental conditions. These results strengthen the scientific rationale for considering optimal-dose ethanol extract of *Stigma maydis* as a potential complementary therapy in the management of type 2 diabetes.

Study limitations

Despite the promising findings, several limitations should be acknowledged. The sample size in each group was relatively small (n = 5), which may limit the statistical power and generalizability of the results. The study duration of fourteen days, although adequate for observing acute antihyperglycemic effects, may not fully capture long-term metabolic adaptations or potential toxicity associated with prolonged extract administration. The research design focused exclusively on fasting blood glucose as the primary outcome, without evaluating additional metabolic markers such as insulin levels, oxidative stress indicators, lipid profiles, or histopathological changes in pancreatic tissue, which could provide a more comprehensive understanding of the extract's mechanism of action. Furthermore, the study utilized a single optimal dose for comparison with metformin, and the absence of a full dose–response curve limits the ability to determine the precise therapeutic window. Variability in the phytochemical composition of *Stigma maydis* due to environmental and agronomic factors also presents a challenge for standardization and reproducibility. Future studies incorporating larger sample sizes, extended treatment durations, broader biochemical assessments, and standardized extract characterization would be valuable for strengthening the evidence base and supporting translational potential.

CONCLUSION

The ethanol extract of corn silk (*Stigma maydis*) at the optimal dose (P3) of 0.273 g/kg body weight produced a statistically significant reduction in fasting blood glucose levels and demonstrated an antihyperglycemic pattern that closely approximated the effect of metformin in the alloxan-induced diabetic mouse model. These findings indicate that the extract possesses a consistent biological activity capable of improving glycemic regulation under controlled experimental conditions. Taken together, the results support the potential development of *Stigma maydis* ethanol extract as a complementary therapeutic candidate for the management of type 2 diabetes, particularly in settings where phytochemical-based interventions may offer accessible and culturally acceptable adjuncts to standard pharmacotherapy.

Ethical consideration, competing interest and source of funding

-Ethical approval for the study was granted by the Health Research Ethics Committee of the Institut Ilmu Kesehatan Strada Indonesia under approval number 001425/EC/KEPK/I/06/2024, ensuring that all research activities adhered to established standards for the humane use of laboratory animals.
-There is no conflict of interest related to this publication.
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REFERENCES

1. World Health Organization. Diabetes [Internet]. 2025 [cited 2025 Oct 20]. Available from: https://www.who.int/health-topics/diabetes
2. Banday MZ, Sameer AS, Nissar S. Pathophysiology of diabetes: an overview. Avicenna J Med. 2020;10(4):174–88.
3. International Diabetes Federation. About diabetes [Internet]. 2025 [cited 2025 Oct 21]. Available from: https://idf.org/about-diabetes/what-is-diabetes/
4. Moazam M, Khan S, Quiroga I, Parra K, Flores P, Fatima E, et al. Type 1 diabetes mellitus: autoimmune mechanisms and treatment. J Adv Med Med Res. 2024;36(7):142–51.
5. Derrou S, El Guendouz F, Benabdelfedil Y, Chakri I, Ouleghzal H, Safi S. The profile of autoimmunity in type 1 diabetes patients. Ann Afr Med. 2021;20(1):19–23.
6. Roep BO, Thomaidou S, Van Tienhoven R, Zaldumbide A. Type 1 diabetes mellitus as a disease of the β-cell (do not blame the immune system?). Nature Reviews Endocrinology. 2021 Mar;17(3):150-61.
7. International Diabetes Federation. IDF diabetes atlas. 11th ed. 2025.
8. Yang X, Wang Y, Li J, Tai Y, Yang K, Lv J, et al. From waste to wonder: exploring the hypoglycemic and antioxidant properties of corn processing by-products. Front Chem. 2024;12.
9. PERKENI. Pedoman pengelolaan dan pencegahan diabetes melitus tipe 2 di Indonesia 2024. Perkumpulan Endokrinologi Indonesia; 2024. p. 65–66.
10. Herman R, Kravos NA, Jensterle M, Janež A, Dolžan V. Metformin and insulin resistance: a review of the underlying mechanisms behind changes in GLUT4-mediated glucose transport. Int J Mol Sci. 2022;23(1):232-8.
11. Oh KK, Adnan M, Cho DH. Elucidating drug-like compounds and potential mechanisms of corn silk (*Stigma maydis*) against obesity: a network pharmacology study. Curr Issues Mol Biol. 2021;43(3):1906–36.
12. Erpel F, Mateos R, Pérez-Jiménez J, Pérez-Correa JR. Phlorotannins: from isolation and structural characterization to the evaluation of their antidiabetic and anticancer potential. Food Res Int. 2020;137.
13. Zhang X, Qiu H, Li C, Cai P, Qi F. The positive role of traditional Chinese medicine as an adjunctive therapy for cancer. Bioscience Trends. 2021 Oct 31;15(5):283-98.
14. Afsharmanesh MR, Mohammadi Z, Jafari SM. Iranian medicinal plants in diabetes management: a narrative review of traditional herbal remedies and their hypoglycemic effects. J Food Biochem. 2024;8(2):122-8.
15. Andriyani S, Handayani RP. Persepsi masyarakat terhadap pengobatan tradisional berdasarkan profesi di Kabupaten Purwakarta. Sabdariffarma. 2020;8(2):88-92.
16. Tran N, Pham B, Le L. Bioactive compounds in anti-diabetic plants: from herbal medicine to modern drug discovery. Biology. 2020;9:1–31.
17. Andini A, Wasiyem, Hafizza MC, Vellina S, Ramadhina AD, Thamrin AN, et al. Persepsi masyarakat terhadap pengobatan tradisional dan pengobatan medis di Kelurahan Nelayan Indah. Helium J Health Educ Law Inf Humanit. 2025;2:868–74.
18. Fabuyi FS, Olubode SO, Omotosho YO. Computational screening of HPLC-identified phytochemicals from corn silk (*Stigma maydis*) as protein tyrosine phosphatase 1B (PTP1B) inhibitors for the management of type 2 diabetes. Int J Biochem Res Rev. 2024;33(6):465–77.
19. Liu R, Mathieu C, Berthelet J, Zhang W, Dupret JM, Rodrigues Lima F. Human protein tyrosine phosphatase 1B (PTP1B): from structure to clinical inhibitor perspectives. Int J Mol Sci. 2022;23(13).
20. Usman AS, Ali A, Lawal M, Liman MM, Ameh LO, Kaur G. Corn silk: an antidiabetic agent in alloxan-induced diabetic rats. J Pharmacogn Phytochem. 2024;13(2):776–80.
21. Zhang Y, Pang J, Yao L, Wang C, Chen B, Zheng Q, et al. A comparison of chemical composition, bioactive components and hypoglycemic activity of *Stigma maydis* obtained from different growing times. Cogent Food Agric. 2024;10(1).
22. Limmatvapirat C, Nateesathittarn C, Dechasathian K, Moohummad T, Chinajitphan P, Limmatvapirat S. Phytochemical analysis of baby corn silk extracts. J Ayurveda Integr Med. 2020;11(3):344–51.
23. Liu J, Wang C, Wang Z, Zhang C, Lu S, Liu J. The antioxidant and free-radical scavenging activities of extract and fractions from corn silk (Zea mays L.) and related flavone glycosides. Food Chem. 2011;126(1):261–9.
24. Maksimović Z, Malešić D, Kovačević N. Polyphenol contents and antioxidant activity of *Maydis stigma* extracts. Bioresour Technol. 2005;96(8):873–7.
25. Nursapitri A, Aryani R, Rahma H. Kajian literatur profil farmakokinetika metformin pada anak-anak dan dewasa. Bandung Conf Ser Pharm. 2024;4(2):953–62.
26. Hajiaghaalipour F, Khalilpourfarshbafi M, Arya A, Arya A. Modulation of glucose transporter protein by dietary flavonoids in type 2 diabetes mellitus. Int J Biol Sci. 2015;11(5):508–24.
27. Patel KP, Sen DB, Sen AK, Maheshwari RA. An attention-grabbing review on *Stigma maydis* (corn silk). J Nat Remedies. 2023;23:35–46.
28. Guo Q, Chen Z, Santhanam RK, Xu L, Gao X, Ma Q, et al. Hypoglycemic effects of polysaccharides from corn silk (*Maydis stigma*) and their beneficial roles via regulating the PI3K/Akt signaling pathway in L6 skeletal muscle myotubes. Int J Biol Macromol. 2019;121:981–8.
29. Charles W, Fibiol D, Frpharms F. Trease and Evans pharmacognosy. 16th ed. 1989.
30. Junaid NM, Makmun HA, Ningsi IW, Julyani S, Rasfayanah R. Pengaruh puasa 12 jam terhadap kadar glukosa darah puasa dan berat badan pada mencit (Mus musculus) hiperglikemia induksi aloksan. MAHESA. 2024;4(7):2986–98.
31. Mbagwu SI, Oraekei DI, Onah LC. Hypoglycemic activity of ethanol leaf extract of *Grona trifloral* in alloxan-induced diabetic mice. GSC Biol Pharm Sci. 2023;24(3):28–40.
32. Shami A, Mir A, Mir UZ, Butt HA, Ejaz R, Yasmeen M. Shielding effects of corn silk extract against doxorubicin-induced hepatotoxicity in Wistar albino rats. Pak J Physiol. 2025;21(1):60–3.

33. De Winter J. Using the Student's t-test with extremely small sample sizes. Pract Assess Res Eval [Internet]. 2013 [cited 2025 Oct]. Available from: https://www.researchgate.net/publication/274756954
34. Sinata N, Emelina. Uji aktivitas antidiabetes infusa rambut jagung (*Zea mays* L.) pada mencit dengan metode toleransi glukosa. Indones J Pharma Sci. 2021;3(2):63–70.
35. Alvarado-Díaz CS, Gutiérrez-Méndez N, Mendoza-López ML, Rodríguez-Rodríguez MZ, Quintero-Ramos A, Landeros-Martínez LL, et al. Inhibitory effect of saccharides and phenolic compounds from maize silks on intestinal α-glucosidases. J Food Biochem. 2019;43(7):122-8.
36. Cheng Y, Chao H, Liu J, Liu J. Nontargeted metabolomic profiling analysis of patients with type 2 diabetes mellitus undergoing corn silk treatment. Medicine (Baltimore). 2024;103(33):e39396.
37. Ghada M, Eltohami MS, Adurahman HN, Mahmoud ME Mudawi. In vitro study of the effect of corn silk on glucose uptake by isolated rat hemi-diaphragm. World J Pharm Res. 2014;3(4):62-8.
38. Dong W, Zhao Y, Hao Y, Sun G, Huo J, Wang W. Integrated molecular biology and metabonomics approach to understand the mechanism underlying reduction of insulin resistance by corn silk decoction. Journal of Ethnopharmacology. 2022 Feb 10;284:114756.
39. Koloay K, Citraningtyas G, Lolo WA. Uji efektivitas ekstrak etanol rambut jagung terhadap penurunan kadar gula darah tikus putih jantan galur Wistar yang diinduksi aloksan. J Ilm Farm UNSRAT. 2015;4:34–40.
40. Sani UM. Anti-diabetic potential of methanol extract of cooked corn silk (*Stigma maydis*) on alloxan-induced diabetes in albino mice. J Pharm Pharmacol Sci. 2016;1(1):105.
41. Chen H, Guo Q. Corn silk (*Zea mays* L.) as a traditional herb in diabetes mellitus. EC Pharmacol. Toxicol. 2018;6(6):477.