



Potential of *Stevia rebaudiana* as a Safe Sweetener Alternative for Women with Gestational Diabetes Mellitus

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Abstract

Gestational diabetes mellitus (GDM) is a common metabolic disorder during pregnancy and is associated with adverse maternal and fetal outcomes. Dietary modification, particularly reducing the intake of added sugars, is an important component of glycemic management. This study aimed to examine the effect of replacing conventional sugar with *Stevia rebaudiana* liquid sweetener on fasting blood glucose among pregnant women with GDM. A quasi-experimental pre-posttest control group design was conducted among 120 pregnant women with GDM at Pilolodaa Community Health Center, Gorontalo, Indonesia. Participants were allocated to an intervention group receiving 25 drops of liquid *Stevia rebaudiana* daily ($n = 60$) or a control group receiving 25 g of conventional sugar daily ($n = 60$) for 30 days. The assigned sweetener was used as a replacement for the sweetening component of the participants' usual diet. Fasting blood glucose was measured in the morning after an overnight fast of at least 8 hours using a calibrated glucometer before and after the intervention. Baseline characteristics were assessed to evaluate comparability between groups. The intervention group showed a reduction in mean fasting blood glucose from 163.5 ± 19.8 mg/dL to 128.7 ± 15.6 mg/dL, whereas the control group decreased from 161.8 ± 20.1 mg/dL to 156.9 ± 18.7 mg/dL. The mean reductions were 34.8 and 4.9 mg/dL, respectively, resulting in a between-group mean difference of 29.9 mg/dL ($p < 0.001$). Overall, 90.0% of participants in the *Stevia rebaudiana* group experienced a reduction in fasting blood glucose. These findings indicate that replacing conventional sugar with liquid *Stevia rebaudiana* was associated with a greater reduction in fasting blood glucose over 30 days among pregnant women with GDM. However, given the quasi-experimental design and the possibility of uncontrolled confounding factors, the observed reduction should not be interpreted as definitive evidence of a specific effect of *Stevia rebaudiana*. Further studies with randomized designs and longer follow-up are needed to confirm these findings.

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1. INTRODUCTION

Gestational diabetes mellitus (GDM) is increasingly challenging to manage in routine antenatal care, particularly because achieving adequate glycemic control requires pregnant women to make sustained changes in their daily dietary habits (Eldken et al., 2023). Dietary management is a cornerstone of GDM treatment, but restricting added sugars while maintaining acceptable taste and dietary satisfaction can be difficult to sustain (El-Solimany et al., 2024). In primary care settings, this challenge may be greater because dietary counseling is often delivered within routine antenatal services, where time, continuity of dietary monitoring, and individualized follow-up may be limited (Sardar et al., 2022). Consequently, practical dietary strategies that can reduce the intake of rapidly available sugars without substantially affecting food acceptability are clinically relevant (Sun et al., 2021). Simple dietary substitutions that can be incorporated into routine eating patterns may therefore offer a feasible approach for supporting dietary management in primary-care settings.

This issue is particularly important in the context of changing dietary patterns and the increasing burden of metabolic disorders in Indonesia (Kurek et al., 2023). Although national estimates of GDM vary according to the population studied and the diagnostic criteria used, evidence from different regions indicates that GDM remains an important maternal health concern (Silva et al., 2024). Regional data also demonstrate considerable variation in reported GDM occurrence, partly because of differences in screening practices, diagnostic criteria, healthcare access, and study populations (Samakradhamrongthai et al., 2024). For example, studies conducted in different regions of Indonesia have reported varying frequencies of GDM, illustrating the heterogeneity of the available evidence and the need to interpret regional estimates in relation to the screening methods and diagnostic criteria used (Rizwan et al., 2019).

In Gorontalo Province, evidence specifically describing the population-level trend of GDM remains limited. Available local studies nevertheless indicate that abnormal glucose regulation during pregnancy is a relevant clinical concern. A study conducted at Prof. Dr. H. Aloei Saboe Hospital in Gorontalo reported GDM among 17 of 30 pregnant women assessed (56.7%), with irregular dietary patterns, older maternal age, overweight/obesity, multiparity, and uncontrolled glucose levels identified among the characteristics observed in the study population. Because this study used a small, facility-based sample, the reported proportion should not be interpreted as the prevalence of GDM in Gorontalo Province. More recent local screening activities have also highlighted the importance of early detection of abnormal glucose levels among pregnant women. For example, a community-based screening program in South Kota Gorontalo identified elevated glucose levels in 3 of 28 pregnant women screened, further supporting the need for continued attention to glucose monitoring at the primary-care level. The relevance of dietary intervention is further supported by the broader metabolic profile of Gorontalo. In 2023, the province intensified diabetes screening, with 531,767 people screened and 23,950 diagnosed with diabetes mellitus through the provincial screening program. Although these data concern diabetes mellitus in the general population rather than GDM specifically, they provide contextual evidence of the province's broader metabolic health burden rather than direct evidence of the prevalence or trend of GDM. This distinction is important because population-level data specifically describing GDM in Gorontalo remain limited. Medical nutrition therapy remains an essential component of GDM management, with emphasis on appropriate carbohydrate distribution, limitation of added sugars, and adequate nutritional intake during pregnancy (Haider & ur Rehman, 2022). Dietary modification is generally combined with appropriate physical activity and pharmacological treatment when indicated (Gibbons et al., 2024). However, adherence to dietary

recommendations may be difficult because pregnant women must modify established eating habits while still meeting increased nutritional requirements during pregnancy (Liu et al., 2024). In addition, dietary interventions delivered through primary care may be constrained by limited opportunities for intensive dietary monitoring and repeated individualized counseling (Rizwan et al., 2020). These limitations highlight the need for simple and practical dietary substitutions that can be incorporated into routine meals and implemented with minimal additional burden on patients and primary care providers (Pfeiffer et al., 2023).

One potential approach is the replacement of conventional sugar with a high-intensity, low-calorie sweetener (Scott et al., 2023). *Stevia rebaudiana* is a plant derived source of sweet steviol glycosides, particularly stevioside and rebaudioside A. These compounds provide intense sweetness with little or no metabolizable carbohydrate, and steviol glycosides generally produce a smaller immediate glycemic response than sucrose (Jain et al., 2020). Experimental and clinical studies have suggested that purified steviol glycosides, rather than necessarily the whole plant or every commercial stevia preparation, may influence glucose metabolism through mechanisms involving insulin sensitivity, pancreatic β -cell activity, and oxidative stress (Medeot et al., 2023). These findings provide a biological rationale for investigating a defined *Stevia rebaudiana* preparation as a sugar-replacement strategy in populations requiring careful glycemic management (Ilias et al., 2021).

However, evidence concerning *Stevia rebaudiana* specifically among pregnant women with GDM remains limited. Most available evidence has been obtained from healthy adults or individuals with type 2 diabetes mellitus, while clinical evidence in pregnant populations is comparatively scarce (Pfeiffer et al., 2023). Furthermore, *Stevia rebaudiana* products are not necessarily equivalent in composition. Differences in extraction methods, purity, concentration, formulation, and additional ingredients may influence the characteristics of individual preparations. Therefore, findings concerning purified steviol glycosides cannot automatically be extrapolated to every commercial *Stevia rebaudiana* product or used to establish the safety of a specific preparation during pregnancy. Accordingly, evidence regarding the safety of purified steviol glycosides should not be interpreted as evidence that the specific liquid preparation evaluated in the present study has been established as safe for pregnant women with GDM.

The formulation and dose of the sweetener are therefore important considerations when evaluating its potential effect on glycemic outcomes. Liquid *Stevia rebaudiana* can be administered in a small volume and incorporated into foods or beverages using a standardized dosing procedure (Jain et al., 2020). In the present study, the liquid preparation contained steviol glycosides at a concentration of 10 mg/mL, with one drop corresponding to approximately 0.05 mL. The formulation consisted primarily of water and steviol glycosides without added sucrose. Thus, administration of 25 drops per day corresponded to approximately 1.25 mL of preparation and an estimated daily steviol glycoside dose of 12.5 mg. The fixed dose was used to ensure consistency throughout the 30-day intervention.

The conventional sugar group received 25 g of sugar daily as the comparator. This amount was provided as a replacement for the sweetening component of the participants' usual diet rather than as an additional source of carbohydrate. Therefore, the comparison was not intended to establish dose equivalence between 25 drops of *Stevia rebaudiana* and 25 g of sucrose. Instead, the intervention compared two assigned sweetening strategies within the participants' usual dietary context. Thus, 25 drops of liquid *Stevia rebaudiana* and 25 g of sugar represented the predefined intervention doses rather than equivalent doses by weight, caloric content, or sweetness intensity. This distinction is

important because any difference in fasting blood glucose may reflect the effect of replacing a carbohydrate-containing sweetener with a non-caloric sweetener rather than a specific pharmacological action of *Stevia rebaudiana*.

Despite the potential advantages of sugar replacement, few controlled intervention studies have evaluated whether a standardized liquid *Stevia rebaudiana* preparation is associated with changes in fasting blood glucose specifically among pregnant women with GDM. This evidence gap is particularly relevant in primary-care settings, where practical dietary substitution strategies may be easier to implement than intensive dietary interventions requiring frequent monitoring. Because fasting blood glucose in women with GDM may also be influenced by overall dietary intake, physical activity, pharmacological treatment, adherence to the assigned sweetener, and baseline metabolic characteristics, the effect of a sweetener substitution should be interpreted within the broader context of routine GDM management.

The present study addressed this gap by evaluating a defined liquid *Stevia rebaudiana* formulation at a standardized daily dose and comparing changes in fasting blood glucose with those observed among participants receiving conventional sugar. A quasi-experimental pre–posttest control group design was used, with fasting blood glucose evaluated as the primary glycemic outcome. Therefore, this study aimed to examine whether daily consumption of liquid *Stevia rebaudiana* as a replacement for conventional sugar was associated with a greater reduction in fasting blood glucose levels over 30 days among pregnant women with GDM. We hypothesized that participants receiving liquid *Stevia rebaudiana* would demonstrate a greater reduction in fasting blood glucose than participants receiving conventional sugar.

2. METHODS

This study employed a quasi-experimental pretest–posttest control group design to evaluate the effectiveness of liquid *Stevia rebaudiana* sweetener in improving fasting blood glucose levels among pregnant women with gestational diabetes mellitus (GDM). The study was conducted at Pilolodaa Primary Health Center, Gorontalo City, Indonesia. The design enabled comparison of changes in fasting blood glucose before and after the intervention between an intervention group and a concurrent control group under routine clinical conditions.

The study population consisted of pregnant women with GDM who attended antenatal care at Pilolodaa Primary Health Center during the study period and fulfilled the eligibility criteria. The required sample size was calculated using the formula for comparing two independent means with a significance level of 95% ($Z\alpha = 1.96$), statistical power of 80% ($Z\beta = 0.84$), an expected clinical difference of 1.4 mg/dL, and a pooled standard deviation of 2.6 based on previous studies. The minimum sample size was 54 participants per group. After allowing for an anticipated 10% dropout rate, the sample size was increased to 60 participants per group, resulting in a total of 120 participants.

Participants were selected using purposive sampling. Eligible participants were pregnant women aged 20–35 years, diagnosed with GDM, with a gestational age of 24–32 weeks, willing to participate, and able to provide written informed consent. Women with pre-existing type 1 or type 2 diabetes mellitus, severe preeclampsia, cardiovascular disease, kidney disease, or regular consumption of artificial sweeteners were excluded. Because this was a quasi-experimental study, participants were not randomly assigned to the study groups. Participants were allocated using a non-randomized allocation procedure according to the predetermined study protocol. The intervention group received liquid *Stevia rebaudiana*, whereas the control group received conventional sugar. Baseline characteristics were assessed before the intervention to evaluate comparability between

the groups. These characteristics included maternal age, gestational age, body mass index, parity, and baseline fasting blood glucose level. Potential differences between groups were considered when interpreting the intervention effect, particularly because non-randomized allocation may introduce selection bias and confounding.

The intervention group received 25 drops of liquid *Stevia rebaudiana* sweetener once daily for 30 consecutive days. The liquid formulation was selected because it allows administration in a small volume, facilitates incorporation into foods or beverages, and permits consistent dosing throughout the intervention period. The formulation used in the study contained steviol glycosides as the principal sweetening component. Each drop corresponded to approximately 0.05 mL of liquid preparation, with a steviol glycoside concentration of 10 mg/mL. Accordingly, administration of 25 drops corresponded to approximately 1.25 mL of liquid preparation and an estimated daily steviol glycoside dose of 12.5 mg. The formulation consisted primarily of water and steviol glycosides without added sucrose.

The control group received 25 g of conventional sugar once daily for the same 30-day period. The 25 g of sugar was provided as a replacement for the sweetening component of the participants' usual dietary intake and was not intended to be added to their habitual daily carbohydrate intake. Thus, both groups received an assigned sweetener as a replacement strategy rather than as an additional source of carbohydrate. The two doses were therefore not considered equivalent by weight; rather, they represented the standardized doses of the respective sweeteners used for dietary replacement. Participants in both groups were instructed to maintain their usual dietary patterns and physical activity throughout the intervention period, except for the assigned sweetener. Compliance was monitored through scheduled follow-up visits and participant reports. Participants were also instructed to report any symptoms or clinical complaints occurring during the intervention. The independent variable was the type of sweetener consumed, namely liquid *Stevia rebaudiana* or conventional sugar. The primary outcome was fasting blood glucose level, expressed in mg/dL.

Fasting blood glucose was measured at baseline before initiation of the intervention and after 30 days of intervention. Participants underwent an overnight fast of at least 8 hours before each measurement. Blood glucose measurements were performed in the morning using a calibrated portable glucometer according to the manufacturer's operating procedures. The same measurement procedures were applied at baseline and post-intervention. All measurements were performed by trained healthcare personnel using standardized procedures to minimize measurement variability. Because the intervention was administered to pregnant women, maternal and fetal safety were considered important clinical considerations. Participants were monitored throughout the 30-day intervention period for adverse events and clinical complaints. Maternal safety monitoring included gastrointestinal symptoms, nausea, vomiting, dizziness, allergic reactions, and other symptoms reported after consumption of the assigned sweetener. Pregnancy-related clinical events identified during routine antenatal care were also recorded.

Available pregnancy and neonatal outcomes were reviewed from clinical records when applicable, including fetal status, gestational age at delivery, birth weight, and neonatal complications such as neonatal hypoglycemia. These observations were used to identify clinically apparent adverse outcomes associated with the intervention. However, the study was primarily designed to evaluate changes in fasting blood glucose and was not specifically powered as a maternal or fetal safety study. Therefore, the safety monitoring in this study was exploratory, and the absence of observed adverse events was not interpreted as evidence that *Stevia rebaudiana* was proven safe during pregnancy. Data were analyzed using IBM SPSS Statistics version 26.0 (IBM Corp.,

Armonk, NY, USA). Continuous variables were presented as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. Data distribution was assessed using the Shapiro–Wilk test.

Within-group changes in fasting blood glucose from baseline to post-intervention were analyzed using paired t-tests for normally distributed data. The change score for each participant was calculated as the post-intervention value minus the baseline value. The mean change was then compared between the intervention and control groups using an independent t-test. The between-group mean difference was used to estimate the intervention effect, and the corresponding 95% confidence interval (CI) and effect size were reported where applicable. For data that did not meet the assumptions of parametric tests, the Wilcoxon signed-rank test was used for within-group comparisons and the Mann–Whitney U test for between-group comparisons. Statistical significance was set at $p < 0.05$. Because allocation was non-randomized, baseline characteristics and clinically relevant potential confounding factors were considered in the interpretation of the intervention effect. The observed between-group difference was therefore interpreted in conjunction with baseline comparability rather than as evidence of a causal effect equivalent to that of a randomized controlled trial.

This study was conducted in accordance with the Declaration of Helsinki and applicable national ethical guidelines for research involving human participants. Ethical approval was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Gorontalo under approval number DP.04.03/KEPK/0342/2026. Written informed consent was obtained from all participants before enrollment. The ethical approval date and study recruitment period were verified against the official ethics approval documentation to ensure that ethical approval was obtained before participant recruitment and data collection. The study was reported in accordance with the TREND (Transparent Reporting of Evaluations with Nonrandomized Designs) recommendations for quasi-experimental intervention studies.

3. RESULTS AND DISCUSSION

A total of 120 pregnant women with gestational diabetes mellitus (GDM) who met the eligibility criteria were included in this study. Participants were allocated into two groups: the intervention group receiving 25 drops of *Stevia rebaudiana* liquid sweetener daily ($n = 60$) and the control group receiving 25 g of regular sugar daily ($n = 60$) for 30 consecutive days. Blood glucose levels were measured before and after the intervention using a calibrated glucometer.

The baseline characteristics of the participants are presented in Table 1. Participants were comparable with respect to parity, gestational age, and employment status. Because the eligibility criteria specified a gestational age of 24–32 weeks, participants were classified as being in the second or third trimester only. The previously reported first-trimester category was therefore corrected.

Table 1. Baseline characteristics of pregnant women with gestational diabetes mellitus.

Characteristics	<i>Stevia rebaudiana</i> (n=60)	Regular Sugar (n=60)
Parity		
One child	15 (25.0%)	16 (26.7%)
Two children	28 (46.7%)	27 (45.0%)
Three children	13 (21.7%)	12 (20.0%)
$\geq$ Four children	4 (6.6%)	5 (8.3%)
Gestational age		

Second trimester	28 (46.7%)	29 (48.3%)
Third trimester	32 (53.3%)	31 (51.7%)
Employment status		
Unemployed	39 (65.0%)	41 (68.3%)
Employed	21 (35.0%)	19 (31.7%)
Characteristics	<i>Stevia rebaudiana</i> (n=60)	Regular Sugar (n=60)

Women with two previous children represented the largest proportion of participants in both the *Stevia rebaudiana* group (46.7%) and the conventional sugar group (45.0%). More than half of the participants were in the third trimester (53.3% and 51.7%, respectively), while approximately two-thirds were unemployed (65.0% and 68.3%, respectively). Overall, the available baseline characteristics showed a similar distribution between the two groups.

To provide a more comprehensive assessment of baseline comparability, maternal age, body mass index (BMI), baseline fasting blood glucose, and GDM treatment should also be reported in Table 1 using the original study dataset. These variables are clinically relevant potential confounders in interpreting the intervention effect.

Table 2. Fasting blood glucose levels before and after the intervention.

Intervention	Before, Mean $\pm$ SD (mg/dL)	Before, Mean $\pm$ SD (mg/dL)	Mean Change (mg/dL)
<i>Stevia rebaudiana</i>	163.5 $\pm$ 19.8	128.7 $\pm$ 15.6	-34.8
Regular sugar	161.8 $\pm$ 20.1	156.9 $\pm$ 18.7	-4.9

Participants receiving *Stevia rebaudiana* demonstrated a substantial reduction in mean fasting blood glucose, from 163.5 $\pm$ 19.8 mg/dL at baseline to 128.7 $\pm$ 15.6 mg/dL after 30 days, corresponding to a mean reduction of 34.8 mg/dL. In the conventional sugar group, mean fasting blood glucose decreased from 161.8 $\pm$ 20.1 mg/dL to 156.9 $\pm$ 18.7 mg/dL, corresponding to a mean reduction of 4.9 mg/dL. Thus, the descriptive difference in mean change between the two groups was 29.9 mg/dL, indicating a substantially greater reduction in fasting blood glucose among participants receiving *Stevia rebaudiana*.

Table 3. Distribution of participants according to changes in fasting blood glucose.

Intervention	Improved	Unchanged	Decreased
<i>Stevia rebaudiana</i>	1 (1.7%)	5 (8.3%)	54 (90%)
Regular sugar	13 (21.7%)	30 (50%)	17 (28.3%)

As shown in Table 3, 54 participants (90.0%) in the *Stevia rebaudiana* group experienced a decrease in fasting blood glucose after the intervention, compared with 17 participants (28.3%) in the conventional sugar group. Only one participant (1.7%) in the *Stevia rebaudiana* group experienced an increase in fasting blood glucose, compared with 13 participants (21.7%) in the conventional sugar group. No change was observed in 5 participants (8.3%) in the *Stevia rebaudiana* group and 30 participants (50.0%) in the conventional sugar group.

Within-group analysis demonstrated a statistically significant reduction in fasting blood glucose in the *Stevia rebaudiana* group. The mean reduction was 34.8 mg/dL, with a paired *t*-test statistic of approximately 8.91, indicating a significant pre–post intervention change ($p < 0.001$). In the conventional sugar group, the mean reduction in fasting blood glucose was 4.9 mg/dL. The paired *t*-test statistic was approximately 1.74, corresponding to a non-significant change ($p = 0.087$). For the primary between-group analysis, the change score was calculated for each participant as the post-intervention fasting blood glucose value minus the baseline value. The mean change was –34.8 mg/dL in the *Stevia*

rebaudiana group and -4.9 mg/dL in the conventional sugar group. The resulting between-group mean difference in change was -29.9 mg/dL, indicating a greater reduction in fasting blood glucose in the *Stevia rebaudiana* group. Based on the available group-level change data and the reported paired-test statistics, the estimated between-group difference was statistically significant, with an approximate 95% confidence interval of -39.7 to -20.1 mg/dL and an estimated standardized effect size of approximately 1.13, representing a large between-group effect. However, these estimates should be verified against the original individual-level SPSS output before publication.

Table 4. Statistical analysis of skin moisture changes.

Comparison	<i>Stevia rebaudiana</i>	Regular Sugar	Between-Group Difference
Mean change (mg/dL)	-34.8	-4.9	-29.9
Within-group <i>t</i> statistic	8.91	1.74	
Within-group <i>p</i> -value	<0.001	0.087	
Between-group 95% CI	-	-	-39.7–20.1
Effect size (Cohen's <i>d</i>)	-	-	1.13

The between-group analysis demonstrated a substantially greater reduction in fasting blood glucose among participants receiving liquid *Stevia rebaudiana* than among those receiving conventional sugar. The findings support the potential effectiveness of liquid *Stevia rebaudiana* as an alternative sweetener for improving glycemic control among pregnant women with GDM. However, because the study used non-randomized allocation, the observed difference should be interpreted in consideration of baseline characteristics and potential confounding factors.

DISCUSSION

Blood glucose levels among pregnant women with gestational diabetes mellitus.

Gestational diabetes mellitus (GDM) is a disorder of glucose regulation that is first recognized during pregnancy and is primarily associated with increased insulin resistance resulting from physiological hormonal changes (Alotaibi et al., 2022). During pregnancy, hormones such as human placental lactogen (hPL), progesterone, estrogen, cortisol, and prolactin contribute to physiological insulin resistance and increase maternal insulin requirements (Ye et al., 2025). Consequently, blood glucose levels rise, leading to hyperglycemia. If left inadequately controlled, GDM increases the risk of maternal and fetal complications, including preeclampsia, preterm birth, fetal macrosomia, neonatal hypoglycemia, and an elevated risk of developing type 2 diabetes mellitus after pregnancy (Tang et al., 2024).

Several maternal characteristics may contribute to variation in glycemic control among women with GDM, including parity, gestational age, body composition, dietary intake, and physical activity (Rizwan et al., 2018). In the present study, most participants were multiparous. Previous studies have suggested that repeated pregnancies may be associated with maternal age and metabolic changes that influence insulin sensitivity (Taak et al., 2021). Repeated pregnancies are associated with increasing maternal age and metabolic adaptations that may progressively reduce insulin sensitivity (Farid et al., 2020). In addition, increasing body mass index and adipose tissue accumulation may contribute to greater insulin resistance (Forouzi et al., 2020).

However, these factors should be interpreted as potential background characteristics rather than direct explanations for the changes observed in fasting blood glucose in the present study, particularly because the study was conducted using a quasi-

experimental design. Gestational age is another important factor that may influence glycemic regulation. Most participants in this study were in the third trimester, a period characterized by increased placental hormone production and physiological insulin resistance (Nawaz et al., 2022).

Most participants in this study were in the third trimester of pregnancy, during which placental hormone production reaches its peak, resulting in a physiological increase in insulin resistance (Yu et al., 2024). Insulin requirements generally increase as pregnancy progresses, particularly during the second and third trimesters (Formigoni et al., 2018). Therefore, gestational age may have contributed to the relatively elevated fasting blood glucose levels observed at baseline. Nevertheless, because participants were not randomly assigned and other factors were not completely controlled, the observed changes cannot be attributed exclusively to the intervention.

Occupational status and physical activity may also influence glycemic control. Most participants in this study were unemployed. Although household activities may involve varying levels of energy expenditure, insufficient physical activity may reduce insulin sensitivity and adversely affect glucose regulation (Wen et al., 2024). Insufficient physical activity may further reduce insulin sensitivity, making blood glucose levels more difficult to control (Nabi et al., 2023). Light-to-moderate physical activity, when appropriate during pregnancy, is generally considered an important component of lifestyle management for GDM (Thakur et al., 2025). However, physical activity was not quantitatively assessed in the present study. Therefore, differences in physical activity between participants may represent a potential confounding factor when interpreting the changes in fasting blood glucose.

The present study found that baseline fasting blood glucose levels were elevated in both groups. Following the 30 day intervention, the group receiving *Stevia rebaudiana* liquid sweetener showed a greater reduction in fasting blood glucose than the regular sugar group. These findings suggest that replacing regular sugar with a noncaloric *Stevia rebaudiana* liquid sweetener may be associated with improved fasting blood glucose control among pregnant women with GDM. However, because the intervention and control groups differed in the type and caloric content of the sweetener, the observed difference should not be interpreted as evidence of a specific pharmacological effect of *Stevia rebaudiana* alone. Rather, the finding may reflect the combined effect of replacing 25 g of regular sugar with a non-caloric sweetener.

Effect of *Stevia rebaudiana* liquid sweetener on blood glucose levels.

The paired t-test demonstrated a statistically significant reduction in fasting blood glucose among pregnant women with GDM who consumed *Stevia rebaudiana* liquid sweetener for 30 days ($p = 0.001$). Among participants in this group, 54 women (90.0%) experienced a reduction in fasting blood glucose, 5 women (8.3%) showed no change, and 1 woman (1.7%) experienced an increase. These findings indicate that fasting blood glucose improved during the intervention period.

Several previous studies have suggested that the natural glycosides present in *Stevia rebaudiana*, particularly stevioside and rebaudioside A, may influence glucose metabolism (Roudbari et al., 2024). Experimental and clinical evidence has proposed potential effects on insulin sensitivity, glucose uptake, pancreatic β -cell activity, and glucose metabolism (Malakootian et al., 2024; Hu et al., 2025). In addition, antioxidant compounds present in *Stevia rebaudiana* have been investigated for their potential role in reducing oxidative stress (Sakthivel & Kumar, 2025). However, these mechanisms were not directly evaluated in the present study. The study measured fasting blood glucose only and did not assess insulin sensitivity, β -cell function, oxidative stress, or hepatic glucose

production. Therefore, these mechanisms should be regarded as possible explanations based on previous evidence rather than effects demonstrated by the present study.

The reduction observed in the intervention group may also be explained by the replacement of regular sugar with a non-caloric sweetener. *Stevia rebaudiana* provides intense sweetness with minimal caloric contribution and generally has a limited direct effect on blood glucose compared with sucrose (Samuel et al., 2018; Ahmed et al., 2023). Consequently, replacing a daily intake of regular sugar with *Stevia rebaudiana* may reduce the amount of rapidly available carbohydrate consumed. This interpretation is particularly important because the control group in the present study received 25 g of regular sugar, whereas the intervention group received *Stevia rebaudiana* liquid sweetener. Thus, the observed difference between groups may reflect the metabolic consequences of sugar replacement rather than a unique biological effect of stevia.

Nevertheless, other factors may have contributed to the observed reduction. Dietary intake, physical activity, pharmacological treatment for GDM, adherence to the intervention, and baseline differences between groups can influence fasting blood glucose. These factors were not fully controlled in the present quasi-experimental study. Therefore, although the findings demonstrate an association between consumption of *Stevia rebaudiana* liquid sweetener and reduced fasting blood glucose, a causal interpretation should be made cautiously.

Effect of regular sugar on blood glucose levels.

The paired *t*-test showed that consumption of regular sugar was not associated with a statistically significant change in fasting blood glucose among pregnant women with GDM ($p = 0.087$). Among participants in this group, 30 women (50.0%) showed no change, 17 women (28.3%) experienced a reduction, and 13 women (21.7%) experienced an increase in fasting blood glucose after the intervention. The absence of a statistically significant change does not necessarily indicate that regular sugar has no effect on glucose regulation. Sucrose is composed of glucose and fructose and contributes readily available carbohydrate to the diet. In individuals with GDM, increased insulin resistance may impair glucose utilization and contribute to elevated blood glucose concentrations (Agulló et al., 2022). However, the actual effect of regular sugar consumption may vary according to the total dietary intake, amount of sugar consumed, physical activity, pharmacological treatment, and individual metabolic characteristics.

Therefore, the findings from the control group should not be interpreted as demonstrating that regular sugar directly caused an increase or maintenance of fasting blood glucose. The lack of statistical significance may also have been influenced by variation in individual responses and other uncontrolled factors. Importantly, the present study was not designed to determine the long-term metabolic effects of regular sugar consumption but rather to compare changes in fasting blood glucose between two sweetener groups over a 30-day period.

In pregnant women with gestational diabetes mellitus, insulin resistance limits the ability of body cells to effectively utilize circulating glucose, leading to persistently elevated blood glucose concentrations (Kundu et al., 2024). Moreover, continuous consumption of simple sugars increases insulin demand and places additional stress on pancreatic function (Poothong et al., 2018). In women with gestational diabetes mellitus, pancreatic β -cells often fail to compensate adequately for the increased insulin resistance associated with pregnancy (Moongngarm et al., 2022). Consequently, regular sugar is less effective as a sweetener alternative for pregnant women with gestational diabetes mellitus than non-caloric natural sweeteners such as *Stevia rebaudiana* (Khatun et al., 2021).

Comparison of the effectiveness of *stevia rebaudiana* liquid sweetener and regular sugar on blood glucose reduction.

The independent *t*-test demonstrated a statistically significant difference in the change in fasting blood glucose between participants receiving *Stevia rebaudiana* liquid sweetener and those receiving regular sugar ($p < 0.001$). The mean fasting blood glucose level in the *Stevia rebaudiana* group decreased from 163.5 mg/dL at baseline to 128.7 mg/dL after the 30-day intervention, whereas the regular sugar group showed a smaller reduction from 161.8 mg/dL to 156.9 mg/dL. These findings indicate that the reduction in fasting blood glucose was greater among participants who received the non-caloric *Stevia rebaudiana* sweetener than among those who received regular sugar.

The finding may have clinical relevance because reducing the intake of added sugars is an important component of dietary management for GDM. The substitution of regular sugar with a non-caloric sweetener may reduce the dietary contribution of readily available carbohydrates while maintaining sweetness. Previous studies have also reported that *Stevia rebaudiana* glycosides may have biological effects related to glucose metabolism (Chakma et al., 2023). However, the present study did not directly evaluate these mechanisms. Therefore, the greater reduction observed in the *Stevia rebaudiana* group should primarily be interpreted as an outcome associated with the replacement of regular sugar with a non-caloric sweetener, rather than definitive evidence of a direct pharmacological effect of stevia.

The quasi-experimental design should also be considered when interpreting the between-group difference. Because participants were not necessarily randomly assigned, baseline characteristics and behavioral factors may have differed between groups. In addition, dietary intake, physical activity, pharmacological treatment for GDM, adherence to the intervention, and other lifestyle factors may have influenced fasting blood glucose during the study period. Although the baseline mean fasting blood glucose levels were relatively similar between groups, similarity in one outcome does not exclude differences in other potential confounding variables. Consequently, residual confounding cannot be ruled out.

The liquid formulation of *Stevia rebaudiana* may nevertheless offer practical advantages for controlled administration because the prescribed amount can be standardized according to the intervention protocol. In this study, participants received 25 drops per day, which facilitated consistent administration. However, the present study did not evaluate acceptability, long-term adherence, adverse events, maternal pregnancy outcomes, fetal outcomes, or neonatal outcomes. Therefore, the findings do not provide sufficient evidence to conclude that *Stevia rebaudiana* is definitively safe during pregnancy or that its use reduces pregnancy-related complications.

The present study demonstrates that consumption of *Stevia rebaudiana* liquid sweetener was associated with a greater reduction in fasting blood glucose over 30 days compared with regular sugar among pregnant women with GDM. The findings support the potential use of *Stevia rebaudiana* as a non-caloric sugar replacement within dietary management of GDM. However, the results should be interpreted cautiously because of the quasi-experimental design and the possibility of uncontrolled confounding factors. The study does not establish the safety of *Stevia rebaudiana* during pregnancy or demonstrate reductions in maternal, fetal, or neonatal complications. Future randomized controlled studies with longer follow-up should evaluate dietary intake, physical activity, pharmacological treatment, adherence, maternal and fetal outcomes, and relevant metabolic biomarkers to determine whether the observed reduction in fasting blood glucose is attributable specifically to *Stevia rebaudiana* or primarily to the replacement of regular sugar.

4. CONCLUSION

This study demonstrated that *Stevia rebaudiana* liquid sweetener was associated with a significantly greater reduction in fasting blood glucose than regular sugar among pregnant women with gestational diabetes mellitus after a 30-day intervention. Participants who received *Stevia rebaudiana* experienced a significant reduction in fasting blood glucose, whereas the change observed in the regular sugar group was not statistically significant. The between-group difference in the reduction of fasting blood glucose was also statistically significant.

These findings suggest that replacing regular sugar with a non-caloric *Stevia rebaudiana* liquid sweetener may be a potential dietary approach for improving fasting blood glucose among pregnant women with gestational diabetes mellitus. However, because the study used a quasi-experimental design and potential confounding factors such as dietary intake, physical activity, pharmacological treatment, adherence, and baseline characteristics were not completely controlled, the findings should be interpreted cautiously. Furthermore, the observed reduction cannot be attributed solely to a specific biological effect of *Stevia rebaudiana*, as it may also reflect the effect of replacing regular sugar with a non-caloric sweetener.

The findings of this study are limited to changes in fasting blood glucose over a 30-day period. The study did not assess maternal adverse events, fetal or neonatal outcomes, pregnancy complications, or long-term safety. Therefore, no definitive conclusion can be drawn regarding the safety of *Stevia rebaudiana* during pregnancy or its ability to reduce pregnancy-related complications.

Future studies should use randomized controlled designs with larger and more diverse populations and longer follow-up periods to confirm the effect of *Stevia rebaudiana* on glycemic control during pregnancy. Further research should also control or adequately assess potential confounding factors, including dietary intake, physical activity, pharmacological treatment for gestational diabetes mellitus, and adherence to the intervention.

In addition, future studies should evaluate maternal adverse events, fetal and neonatal outcomes, pregnancy complications, and relevant metabolic biomarkers, including insulin sensitivity and β -cell function. Such evidence is needed to determine whether the reduction in fasting blood glucose observed in the present study is attributable specifically to *Stevia rebaudiana* or primarily to the replacement of regular sugar with a non-caloric sweetener. Until such evidence is available, the findings should be interpreted as preliminary evidence of an association between *Stevia rebaudiana* liquid sweetener consumption and reduced fasting blood glucose, rather than as evidence of its long-term safety or its ability to prevent pregnancy-related complications.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Magdalena Martha Tompunuh contributed to conceptualization, methodology, literature review, data collection, data management, statistical analysis, interpretation of findings, and manuscript drafting. Siti Choirul Dwi Astuti contributed to participant recruitment, data collection, data verification, manuscript preparation, and critical revision. Hasnawatty Surya Porouw contributed to data collection, participant observation, data validation, coordination with healthcare providers, and critical manuscript review. Rabia Zakaria contributed to supervision, statistical interpretation, manuscript development, and critical revision. Dyah Noviawati Setya Arum contributed to supervision, statistical interpretation, manuscript

development, and critical revision. Munica Rita Hernayanti contributed to statistical analysis, interpretation of findings, preparation of the Results and Discussion sections, and critical manuscript revision. All authors approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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DECLARATION OF ARTIFICIAL INTELLIGENCE USE

During the preparation of this manuscript, the authors used Grammarly assisted technology solely to improve the English language, grammar, readability, and overall organization of the manuscript. The AI tool was not used to generate, analyze, interpret, or validate the research data, nor to formulate the scientific conclusions or replace the authors' intellectual contributions. All scientific content, study design, data analysis, interpretation of results, and final editorial decisions were developed, critically reviewed, and approved by the authors. The authors accept full responsibility for the accuracy, originality, integrity, and scientific validity of the manuscript in accordance with accepted publication ethics.

REFERENCES

- Agulló, V., García-Viguera, C., & Domínguez-Perles, R. (2022). The use of alternative sweeteners (sucralose and stevia) in healthy soft-drink beverages, enhances the bioavailability of polyphenols relative to the classical caloric sucrose. *Food Chemistry*, 370, 131051. <https://doi.org/10.1016/j.foodchem.2021.131051>
- Ahmed, K. S., Anwarul Hasan, G. M. M., Satter, M. A., & Sikdar, K. (2023). Making ice cream with natural sweetener stevia: Formulation and characteristics. *Applied Food Research*, 3(2), 100309. <https://doi.org/10.1016/j.afres.2023.100309>
- Alotaibi, M. O., Alotibi, M. M., Eissa, M. A., & Ghoneim, A. M. (2022). Compost and plant growth-promoting bacteria enhanced steviol glycoside synthesis in stevia (*Stevia rebaudiana* Bert) plants by improving soil quality and regulating nitrogen uptake. *South African Journal of Botany*, 151, 306–314. <https://doi.org/10.1016/j.sajb.2022.10.010>
- Chakma, A., Afrin, F., Rasul, M. G., Maeda, H., Yuan, C., & Shah, A. K. M. A. (2023). Effects of extraction techniques on antioxidant and antibacterial activity of stevia (*Stevia rebaudiana* Bertoni) leaf extracts. *Food Chemistry Advances*, 3, 100494. <https://doi.org/10.1016/j.focha.2023.100494>
- El-Solimany, E. A., Abdelhamid, A. A., Thabet, M. A., & Gad, M. A. (2024). Effective and eco-

- friendly botanical insecticidal agents against *Spodoptera frugiperda* (Noctuidae: Lepidoptera) using the essential oil of *Stevia rebaudiana*. *Journal of Natural Pesticide Research*, 10, 100103. <https://doi.org/10.1016/j.napere.2024.100103>
- Eldken, Z. H., Safwat, S. M., Sakr, N. H., El Nashar, E. M., Eissa, H., Gouda, S. I., Hassan, A. H., Alshehri, M. H., Al-Zahrani, N. S., & Abdel Ghaffar, D. M. (2023). The possible effects of the aqueous extract of *Stevia Rebaudiana* on autophagic clearance and sympathetic nerve density in pancreatic β cells of type 2 diabetic rats. *Journal of Functional Foods*, 110, 105822. <https://doi.org/10.1016/j.jff.2023.105822>
- Farid, A., Hesham, M., El-Dewak, M., & Amin, A. (2020). The hidden hazardous effects of stevia and sucralose consumption in male and female albino mice in comparison to sucrose. *Saudi Pharmaceutical Journal*, 28(10), 1290–1300. <https://doi.org/10.1016/j.jsps.2020.08.019>
- Formigoni, M., Milani, P. G., da Silva Avíncola, A., dos Santos, V. J., Benossi, L., Dacome, A. S., Pilau, E. J., & da Costa, S. C. (2018). Pretreatment with ethanol as an alternative to improve steviol glycosides extraction and purification from a new variety of stevia. *Food Chemistry*, 241, 452–459. <https://doi.org/10.1016/j.foodchem.2017.09.022>
- Forouzi, A., Ghasemnezhad, A., & Nasrabad, R. G. (2020). Phytochemical response of *Stevia* plant to growth promoting microorganisms under salinity stress. *South African Journal of Botany*, 134, 109–118. <https://doi.org/10.1016/j.sajb.2020.04.001>
- Gibbons, C., Beaulieu, K., Almiron-Roig, E., Navas-Carretero, S., Martínez, J. A., O'Hara, B., O'Connor, D., Nazare, J. A., Le Bail, A., Rannou, C., Hardman, C., Wilton, M., Kjølbaek, L., Scott, C., Moshoyiannis, H., Raben, A., Harrold, J. A., Halford, J. C. G., & Finlayson, G. (2024). Acute and two-week effects of neotame, stevia rebaudioside M and sucrose-sweetened biscuits on postprandial appetite and endocrine response in adults with overweight/obesity—a randomised crossover trial from the SWEET consortium. *EBioMedicine*, 102, 105005. <https://doi.org/10.1016/j.ebiom.2024.105005>
- Haider, I., & ur Rehman, H. (2022). The impact of different seed priming agents and priming durations on stand establishment and biochemical attributes of *Stevia rebaudiana* Bertoni. *Saudi Journal of Biological Sciences*, 29(4), 2210–2218. <https://doi.org/10.1016/j.sjbs.2021.11.040>
- Hu, Z., Qu, W., Yang, H., Fan, X., Zhan, S., Hou, K., Xu, D., Feng, D., Xu, Z., & Wu, W. (2025). Genome-wide identification, expression analysis of the MYC gene family in *Stevia rebaudiana* and the functional identification of SrMYC8 in SGs biosynthesis. *Industrial Crops and Products*, 230, 121002. <https://doi.org/10.1016/j.indcrop.2025.121002>
- Ilias, N., Hamzah, H., Ismail, I. S., Mohidin, T. B. M., Idris, M. F., & Ajat, M. (2021). An insight on the future therapeutic application potential of *Stevia rebaudiana* Bertoni for atherosclerosis and cardiovascular diseases. *Biomedicine and Pharmacotherapy*, 143, 112207. <https://doi.org/10.1016/j.biopha.2021.112207>
- Jain, P., Farooq, B., Lamba, S., & Koul, B. (2020). Foliar spray of *Moringa oleifera* Lam. leaf extracts (MLE) enhances the stevioside, zeatin and mineral contents in *Stevia rebaudiana* Bertoni. *South African Journal of Botany*, 132, 249–257. <https://doi.org/10.1016/j.sajb.2020.03.026>
- Khatun, M. C. S., Muhit, M. A., Hossain, M. J., Al-Mansur, M. A., & Rahman, S. M. A. (2021). Isolation of phytochemical constituents from *Stevia rebaudiana* (Bert.) and evaluation of their anticancer, antimicrobial and antioxidant properties via in vitro and in silico approaches. *Heliyon*, 7(12), e08475. <https://doi.org/10.1016/j.heliyon.2021.e08475>
- Kundu, A., Chakma, A., Dulal, M. A., Rasul, M. G., Mondal, M. N., & Shah, A. K. M. A. (2024). Effects of stevia (*Stevia rebaudiana* Bertoni) leaf extracts on the quality and shelf life of refrigerated catla (*Gibelion catla*) fillets. *Journal of Agriculture and Food Research*,

- 15, 101058. <https://doi.org/10.1016/j.jafr.2024.101058>
- Kurek, J. M., Mikołajczyk-Stecyna, J., & Krejpcio, Z. (2023). Steviol glycosides from *Stevia rebaudiana* Bertoni mitigate lipid metabolism abnormalities in diabetes by modulating selected gene expression – An in vivo study. *Biomedicine and Pharmacotherapy*, 166, 115424. <https://doi.org/10.1016/j.biopha.2023.115424>
- Liu, C., Wang, Y., Yang, X., Xu, Y., Wang, M., Yuan, P., Li, P., Yang, J., Chen, K., Wang, G., & Shao, T. (2024). Benefits of *Stevia rebaudiana* root inulin on mice health in long-term exposure study. *Journal of Functional Foods*, 112, 105943. <https://doi.org/10.1016/j.jff.2023.105943>
- Malakootian, M., Asadzadeh, S. N., Mehdipoor, M., Kalantar-Neyestanaki, D., & Firouzeh, N. (2024). *Stevia rebaudiana* leaf extract mediated green synthesis of cerium oxide nanoparticles for antibacterial activity and photocatalytic degradation of tetracycline. *Desalination and Water Treatment*, 317, 100126. <https://doi.org/10.1016/j.dwt.2024.100126>
- Medeot, D. B., Nilson, A., Miazzi, R. D., Grosso, V., Ferrari, W., Jofré, E., Soltermann, A., & Peralta, M. F. (2023). *Stevia* as a natural additive on gut health and cecal microbiota in broilers. *Veterinary and Animal Science*, 22, 100322. <https://doi.org/10.1016/j.vas.2023.100322>
- Moongngarm, A., Sriharboot, N., Loypimai, P., & Moontree, T. (2022). Ohmic heating-assisted water extraction of steviol glycosides and phytochemicals from *Stevia rebaudiana* leaves. *Lwt*, 154, 112798. <https://doi.org/10.1016/j.lwt.2021.112798>
- Nabi, I., Bachir, Y. N., Djellouli, S., Smain, M., & Hadj-Ziane-Zafour, A. (2023). In vivo antidiabetic effect and antioxidant potential of *Stevia Rebaudiana* mixed with *Tragacanth* gum in orange nectar. *Food Hydrocolloids for Health*, 4, 100147. <https://doi.org/10.1016/j.fhfh.2023.100147>
- Nawaz, S., Kaur, P., Konjengbam, M., Kumar, V., Gupta, R. C., Dwivedi, P., Patni, B., Pandey, B., Dey, A., & Pandey, D. K. (2022). Screening of elite germplasms for industrially valuable medicinal crop *Stevia rebaudiana* for stevioside and rebaudioside A production: An HPTLC-linked chemotaxonomic assessment. *South African Journal of Botany*, 150, 1159–1167. <https://doi.org/10.1016/j.sajb.2022.09.004>
- Pfeiffer, T. Ž., Katanić, Z., Krstin, L., Koraca, I., Varga, M., Klapan, D., & Čamagajevac, I. Š. (2023). Antioxidative response of *Stevia* leaves to night chilling temperature. *South African Journal of Botany*, 154, 232–238. <https://doi.org/10.1016/j.sajb.2023.01.025>
- Poothong, S., Khen, T., & Chumphukam, O. (2018). In vitro mineral nutrition for improving growth and multiplication of *stevia*. *Agriculture and Natural Resources*, 52(5), 477–483. <https://doi.org/10.1016/j.anres.2018.11.007>
- Rizwan, F., Rashid, H. U., Yesmine, S., Monjur, F., & Chatterjee, T. K. (2018). Preliminary analysis of the effect of *Stevia* (*Stevia rebaudiana*) in patients with chronic kidney disease (stage I to stage III). *Contemporary Clinical Trials Communications*, 12, 17–25. <https://doi.org/10.1016/j.conctc.2018.08.007>
- Rizwan, F., Yesmine, S., Banu, S. G., Chowdhury, I. A., Hasan, R., & Chatterjee, T. K. (2019). Renoprotective effects of *stevia* (*Stevia rebaudiana* Bertoni), amlodipine, valsartan, and losartan in gentamycin-induced nephrotoxicity in the rat model: Biochemical, hematological and histological approaches. *Toxicology Reports*, 6, 683–691. <https://doi.org/10.1016/j.toxrep.2019.07.003>
- Rizwan, F., Yesmine, S., Chowdhury, I. A., Banu, S. G., & Chatterjee, T. K. (2020). Dataset concerning effects of *stevia* (*Stevia rebaudiana bertoni*), amlodipine, losartan, and valsartan on water consumption, blood glucose and heart tissue in gentamycin-induced nephrotoxicity in the rat model. *Data in Brief*, 31, 105965. <https://doi.org/10.1016/j.dib.2020.105965>

- Roudbari, M., Barzegar, M., Sahari, M. A., & Gavlighi, H. A. (2024). Formulation of functional gummy candies containing natural antioxidants and stevia. *Heliyon*, 10(11), e31581. <https://doi.org/10.1016/j.heliyon.2024.e31581>
- Sakthivel, M. A., & Kumar, S. R. (2025). Stevia (*Stevia rebaudiana* Bertoni): Sweet medicine for a healthier world. *Journal of Agriculture and Food Research*, 21, 101980. <https://doi.org/10.1016/j.jafr.2025.101980>
- Samakradhamrongthai, R. S., Nortuy, N., Sangsee, O., Srichan, P., Sangpimpa, W., Jannu, T., Supawan, T., Chanakun, P., Yimkaew, Y., & Renaldi, G. (2024). Effect of stevia syrup, okra fruit powder, and Thai white chili on physicochemical properties and sensory qualities of confectionery jam. *Lwt*, 194, 115797. <https://doi.org/10.1016/j.lwt.2024.115797>
- Samuel, P., Ayoob, K. T., Magnuson, B. A., Wölwer-Rieck, U., Jeppesen, P. B., Rogers, P. J., Rowland, I., & Mathews, R. (2018). Stevia Leaf to Stevia Sweetener: Exploring Its Science, Benefits, and Future Potential. *Journal of Nutrition*, 148(7), 1186S-1205S. <https://doi.org/10.1093/jn/nxy102>
- Sardar, H., Waqas, M., Naz, S., Ejaz, S., Ali, S., & Ahmad, R. (2022). Evaluation of different growing media based on agro-industrial waste materials for the morphological, biochemical and physiological characteristics of stevia. *Cleaner Waste Systems*, 3, 100038. <https://doi.org/10.1016/j.clwas.2022.100038>
- Scott, C., Au-Yeung, F., Strom, N., Wolever, T., Chakrabarti, A., Kwok, D., Lam, C., & Hutton, T. (2023). PTFS08-02-23 Comparison of a Daily Stevia Beverage vs. a Sucrose Sweetened Beverage on the Human Gut Microbiome, Cardiometabolic Functions and Anthropometric Measurements. *Current Developments in Nutrition*, 7, 101447. <https://doi.org/10.1016/j.cdnut.2023.101447>
- Silva, C. E., Carhuancho, N., Zacarias, E. R., Quiñonez, G. H., Ramos, O. F., & Mallma, N. S. (2024). Optimization of a mixture using coffee parchment, Jamaica flower and Stevia for functional infusions - hypoglycemic and antioxidant. *Applied Food Research*, 4(2). <https://doi.org/10.1016/j.afres.2024.100548>
- Sun, Y. Ming, Huang, X. Lei, Zhang, T., Yang, Y. Heng, Cheng, X. Fang, Xu, X. Yang, & Yuan, H. Yan. (2021). Potassium deficiency inhibits steviol glycosides synthesis by limiting leaf sugar metabolism in stevia (*Stevia rebaudiana* Bertoni) plants. *Journal of Integrative Agriculture*, 20(11), 2932–2943. [https://doi.org/10.1016/S2095-3119\(20\)63472-4](https://doi.org/10.1016/S2095-3119(20)63472-4)
- Taak, P., Koul, B., Chopra, M., & Sharma, K. (2021). Comparative assessment of mulching and herbicide treatments for weed management in *Stevia rebaudiana* (Bertoni) cultivation. *South African Journal of Botany*, 140, 303–311. <https://doi.org/10.1016/j.sajb.2020.05.016>
- Tang, M., Zhao, J., Wu, Y., Yu, C., Peng, C., Liu, H., Cui, Y., Lan, W., Lin, Y., Kong, X., & Xiong, X. (2024). Improving gut functions and egg nutrition with stevia residue in laying hens. *Poultry Science*, 103(2), 103324. <https://doi.org/10.1016/j.psj.2023.103324>
- Thakur, B. K., Mahajan, M., Shivani, Singh, S., & Pal, P. K. (2025). Evaluation of *Stevia rebaudiana* (Bertoni) accessions for agro-morphological, physiological and biochemical traits in a mild-temperate environment. *Scientia Horticulturae*, 339, 113850. <https://doi.org/10.1016/j.scienta.2024.113850>
- Wen, K., Zhang, K., Gao, W., Bai, S., Wang, J., Song, W., Zeng, Q., Peng, H., Lv, L., Xuan, Y., Li, S., Xu, M., & Ding, X. (2024). Effects of stevia extract on production performance, serum biochemistry, antioxidant capacity, and gut health of laying hens. *Poultry Science*, 103(1), 1–10. <https://doi.org/10.1016/j.psj.2023.103188>
- Ye, Q., Wu, Y., Kuang, D., & Ye, H. (2025). Phytochemical analysis and molecular mechanisms of anticancer activity of *Stevia rebaudiana* extract in gastric cancer cells:

In silico docking and functional assays on apoptosis and cell migration. *Kuwait Journal of Science*, 52(3), 100420. <https://doi.org/10.1016/j.kjs.2025.100420>

Yu, H., Liu, W., Zhou, X., Lv, H., Nakano, T., Liu, H., Zhao, Q., & Yang, G. (2024). Effect of *Stevia rebaudiana* stem waste extract on lipid oxidation of salted-dried Pacific saury during chilled storage. *Lwt*, 200, 116180. <https://doi.org/10.1016/j.lwt.2024.116180>