

The role of *Gymnema sylvest* tea in modulating the perception of sweetness

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SUMMARY

The increasing prevalence of type 2 diabetes has prompted interest in natural products that may assist with blood sugar regulation and appetite control. *Gymnema sylvest*, a medicinal plant traditionally used in Ayurvedic medicine, contains gymnemic acids that are hypothesized to interfere with sweet taste perception by competitively inhibiting sweet taste receptors (T1R2/T1R3). We aimed to investigate whether *G. sylvest* tea could suppress sweetness perception across a variety of foods in human participants. We hypothesized that *Gymnema sylvest* tea would reduce the perceived sweetness intensity of various foods by interfering with sweet taste receptors. We designed and conducted repeated taste trials, followed by replication trials conducted by 21 student participants, using a simple pre/post-test design. Sweetness ratings of eight food items were assessed before and after consuming *Gymnema* tea using a 10-point rating scale. Our results demonstrated consistent reductions in perceived sweetness for most food items following *Gymnema* tea consumption, with greater suppression observed for high-sugar foods. Our findings provide experimental support for *G. sylvest*'s potential role in modifying sweet taste perception, complementing previously reported molecular mechanisms of gymnemic acid activity. Our results suggest that *G. sylvest* tea may serve as a natural adjunct to help reduce sugar cravings and manage dietary sugar intake, which may have implications for supporting diabetes management and healthier eating behaviors.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has become a significant and rapidly expanding public health challenge, with more than 400 million people estimated to be living with the condition across the globe (1). This chronic metabolic disease is marked by sustained elevations in blood glucose, arising from the body's reduced responsiveness to insulin, insufficient insulin production, or a combination of these factors (2). Without effective management, T2DM can lead to serious complications including cardiovascular disease, nephropathy, neuropathy, and retinopathy. While conventional management approaches—such as lifestyle adjustments, oral hypoglycemic agents, and insulin administration—are common, they can be hindered by financial burden, limited availability, adverse reactions, and challenges in maintaining long-term compliance (2,3). Consequently, there is increasing interest in complementary and alternative therapies that can support glycemic control with fewer adverse effects.

Among natural products under investigation, *Gymnema sylvest* (commonly known as “gurmar” or “sugar destroyer”) has emerged as a promising antidiabetic botanical due to its diverse bioactive components and multifaceted mechanisms of action (4). Traditionally used in Ayurvedic medicine, *G. sylvest* contains gymnemic acids, saponins, and flavonoids that contribute to reducing blood glucose levels and influencing glucose metabolism. Gymnemic acids may help curb cravings for sweet foods by interacting with sodium-glucose co-transporter 1 (SGLT1) and glucose transporter 2 (GLUT2). These are the primary transport proteins responsible for absorbing glucose in the small intestine. However, the degree to which gymnemic acids affect these transporters depends on the specific extract composition (5,6).

Insulin is produced by pancreatic β -cells, and dysfunction or loss of these cells plays a major role in the development of T2DM. Therefore, compounds that protect β -cell function or enhance insulin secretion may help improve glycemic control. Notably, previous studies indicate that gymnemic acids may stimulate pancreatic β -cell activity, enhance insulin secretion, and potentially support β -cell protection or regeneration (7–12). Experimental studies have reported β -cell regeneration in streptozotocin-induced diabetic rats treated with *G. sylvest* extract (10). Other study has demonstrated that *G. sylvest* extract increases insulin release in both mouse β -cells and human islets and showed improved glucose tolerance and stimulated insulin secretion *in vivo* and *in vitro* (11). A systematic review further reported that these effects were consistently observed across studies in both humans and animals (12). In human trials, Baskaran et al. observed decreased fasting glucose levels after supplementation, while Daisy et al. reported improvements in lipid profiles and glucose tolerance in diabetic rats (13, 14).

In addition to its effects on glucose regulation, *G. sylvest* has been studied for several other pharmacological properties. Beyond its primary role in glucose regulation, research has highlighted the plant's significant antioxidant, anti-inflammatory, and anti-arthritic actions (15). Recent evidence even suggests a microbiome-mediated mechanism, as the extract has been shown to modulate gut microbiota in diabetic models (16). Furthermore, toxicological and pharmacokinetic evaluations have confirmed the extract's safety profile and the metabolic stability of its key bioactive compounds, such as gymnemagenin (17, 18).

Together, findings from animal experiments, human studies, and mechanistic investigations support the potential of *G. sylvest* as a complementary approach for metabolic health management (5–14, 19, 20). In diabetic rat models, gymnemic acids have been shown to improve glucose

tolerance and insulin sensitivity by activating signaling pathways such as AMPK and PI3K/Akt (5, 6, 11, 21). These findings are mirrored in human clinical trials, where patients with impaired glucose tolerance or non-insulin-dependent diabetes demonstrated improved insulin secretion and glycemic control following administration of the extract (13, 19).

Despite this extensive investigation into metabolic effects, relatively few studies have focused on the *G. sylvestre*'s immediate influence on sweet taste perception in humans under controlled experimental conditions.

While it is established that gymnemic acids can inhibit sweet taste receptors at a molecular level, potentially reducing sugar cravings and improving dietary compliance, systematic testing across a diverse range of common food items has been limited (4-8,11-14).

Our study helps to address this gap by investigating whether the acute consumption of *G. sylvestre* tea suppresses perceived sweetness intensity across foods containing natural and artificial sweeteners. We hypothesized that *G. sylvestre* tea would reduce the perceived sweetness of common food items by transiently inhibiting sweet taste perception. To test this hypothesis, we conducted repeated author self-testing and collected replication data from 21 student participants to assess reproducibility. Participants independently rated the sweetness of eight food items on a 10-point scale before and after consuming *Gymnema* tea using a controlled pre/post tasting protocol.

The results consistently demonstrated reduced sweetness perception following *G. sylvestre* tea consumption, supporting its potential utility as a complementary strategy to reduce sugar cravings and promote better dietary behavior in diabetes management.

RESULTS

To evaluate the effect of *Gymnema sylvestre* tea on sweet taste perception, participants rated the sweetness of several food items before and after consuming the tea. A total of 21 student participants (12 boys and 9 girls, aged 16–18 years)

completed the tasting protocol in addition to repeated author self-testing trials. Participants were given eight food items representing natural sweeteners, simple sugars, complex processed foods, artificial sweeteners, and a non-sweet control. Sweetness intensity was rated on a 10-point scale before and after consumption of *G. sylvestre* tea.

All participants successfully completed the taste-testing protocol. Prior to the administration of the *G. sylvestre* tea, baseline sweetness ratings were established for all food items. To ensure that taste receptor sensitivity was not impacted by thermal interference, the *Gymnema* tea was administered only after it had reached room temperature (22°C), thereby eliminating the risk of accidental tongue burns that could confound the perceptual data. Following consumption, a consistent suppression of sweetness was observed across most glucose-based items.

For the purpose of this study, food items were classified as natural sweeteners (bananas, apples), simple sugars (pure sugar), or complex processed foods (M&M's, cookies, Sweet Tarts). The sensory evaluation demonstrated that *G. sylvestre* tea influenced the perception of sweetness across a variety of food profiles.

We chose several items with a variety of expected sweetness levels (Table 1). Reductions in perceived sweetness—defined as decreases in intensity ratings on the 10-point scale—were observed for most tested items (Figure 1). Similar reductions in sweetness were observed for several foods. Pure sugar, M&M's, and cookies each showed a 2-point decrease in average sweetness ratings. Additional reductions were observed across other food categories, though the magnitude varied. Sweet Tarts showed a smaller decrease, with average ratings declining from 2 to 1. Participants noted that the sour taste of Sweet Tarts remained noticeable after tea consumption. Replication trials conducted with 21 participants demonstrated the reproducibility of the observed effects. Although minor individual variation occurred, participants generally reported decreases in sweetness ratings after consuming the tea.

The artificial sweetener showed a smaller decrease

Food Item	Classification	Primary Sweetener/Source	Expected Sweetness Level
Pure sugar	Simple sugar	Sucrose (granulated)	Extremely high (anchor)
Banana	Natural sugar	Fructose / Glucose	Moderate
Apple	Natural sugar	Fructose / Sorbitol	Low to moderate
M&M's®	Processed food (complex matrix)	Sucrose / Lactose	High
Cookies	Processed food (complex matrix)	Sucrose / Flour starch	High
Sweet Tarts®	Processed (sour + sweet)	Dextrose / Malic acid	Low (tart-dominant)
Splenda®	Artificial sweetener	Sucralose	Extremely high
Hot sauce	Non-sweet control	N/A (0 g sugar)	None

Table 1: Classification of food items used in the study, including primary sweetener sources and expected sweetness levels. Items were selected to span a range of sweetness stimuli and compositional profiles, including simple sugars, natural sugars, processed foods, artificial sweeteners, and a non-sweet control. Expected sweetness levels reflect typical sensory perception prior to testing.

in sweetness, with ratings declining from 9 to 8 (Figure 1). A similar 1-point reduction was observed for apples, which decreased from 3 to 2. In contrast, no change was observed for the non-sweet control (hot sauce), for which sweetness ratings remained constant at 2 before and after tea consumption. Across all tested items, sweetness ratings either decreased or remained unchanged following consumption of *G. sylvestre* tea.

DISCUSSION

In this study, we found *G. sylvestre* tea was able to suppress sweet taste perception across a variety of food items containing both natural and artificial sweeteners.

Sweetness ratings consistently decreased following *Gymnema* tea consumption across most tested foods. Notably, similar reductions in perceived sweetness were observed for pure sugar, M&M's, and cookies, each showing a 2-point decrease on the 10-point scale.

In contrast, Sweet Tarts exhibited a smaller reduction in perceived sweetness (1-point decrease). This difference may be related to the product's sensory composition, as Sweet Tarts are characterized by a strong sour component (e.g., malic acid), which may influence overall taste perception. Because Sweet Tarts are typically perceived as sour before sweet, the relative contribution of sweetness to the overall flavor profile may be lower, reducing the observable impact of *Gymnema*-induced sweetness suppression.

The reductions observed are consistent with the proposed mechanism by which gymnemic acids competitively inhibit sweet taste receptors (T1R2/T1R3), preventing activation by glucose and related compounds. We also saw that artificial sweeteners experienced only limited suppression of perceived sweetness, consistent with prior study indicating that gymnemic acids more effectively target glucose-like molecules while exhibiting weaker binding to non-glucose-based sweeteners (12,20). This suggests that receptor binding affinity is influenced by structural differences between sugar

molecules and synthetic sweeteners.

Sweetness ratings decreased for all sweet-containing foods, while no change was observed for the non-sweet control (hot sauce), indicating that *G. sylvestre* selectively affects sweet taste perception. The limited reduction observed for the artificial sweetener may reflect a weaker interaction between gymnemic acids and non-carbohydrate sweeteners, which may engage sweet taste receptors differently from glucose-based sugars. Similarly, the absence of change in the non-sweet control item (hot sauce) is consistent with the possibility that *Gymnema* tea primarily affects sweet taste perception rather than general flavor perception or response to spicy stimuli. However, these interpretations should be made cautiously, because the present study did not directly measure receptor-level mechanisms.

An interesting observation in the baseline data was that pure sugar received a mean sweetness rating of 8.0, despite being defined as the reference anchor for a score of 10. This discrepancy likely reflects the subjective nature of sensory scaling and 'ceiling effects' in participant judgment. Some participants may have reserved the score of 10 for perceived sweetness intensities higher than the provided sample, or they may have been influenced by the concentrated sweetness of processed items like cookies (9.0) and Splenda (9.0), which are often formulated to surpass the sweetness profile of table sugar.

Furthermore, the use of a subjective 10-point scale introduces inherent variability; while participants could visually identify the pure sugar, their internal calibration of 'extreme sweetness' may have been moderated by prior dietary experiences with highly processed, hyper-palatable foods. We chose to retain these participants in the analysis to preserve the ecological validity of the study and to reflect the natural variance in human taste perception. Removing these 'under-raters' would likely have artificially inflated the baseline without altering the consistent downward trend observed post-tea consumption.

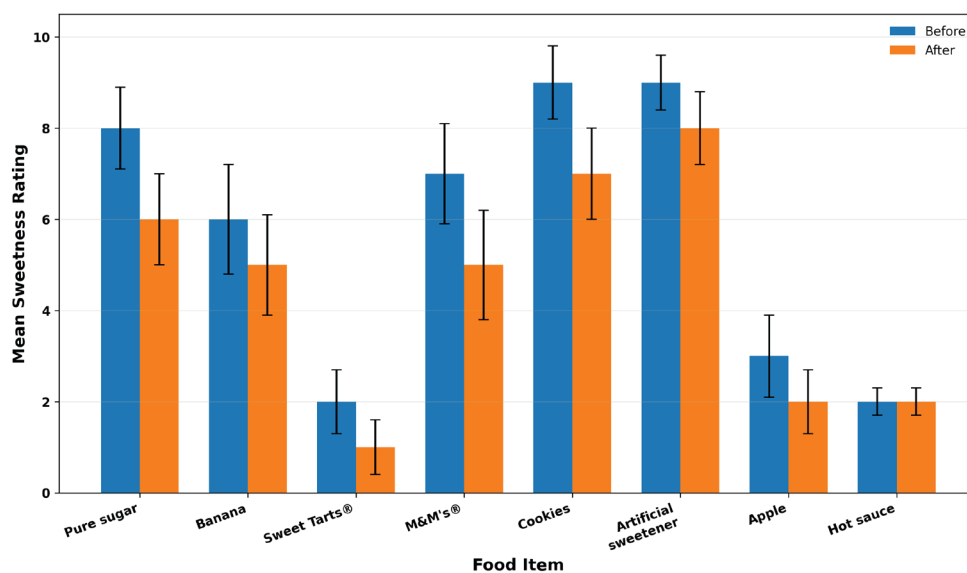


Figure 1: Effect of *Gymnema sylvestre* tea on sweetness perception. Mean sweetness ratings given by participants before (blue) and after (orange) *G. sylvestre* tea consumption (10-point scale; 0 = not sweet at all, 10 = extremely sweet). Error bars represent standard deviations across participants (n = 22). The non-sweet control (hot sauce) showed no change in perceived taste.

Overall, our findings support that *G. sylvestre* tea can partially suppress sweet taste perception in humans, complementing previous molecular and preclinical findings on its competitive antagonism at sweet taste receptors (11,12,20). While previous studies have primarily examined the molecular or metabolic effects of *Gymnema* compounds largely focused on cellular or animal models, our work contributes additional human perceptual data demonstrating that acute consumption of *G. sylvestre* tea can alter sweetness perception in real food contexts work contributed additional human perceptual data across commonly consumed foods, providing translational evidence for *Gymnema*'s potential role in reducing sweet cravings and supporting healthier dietary choices (6-12). Future studies incorporating larger participant groups, controlled clinical study designs, and statistical analyses will help clarify the potential role of *Gymnema* in dietary interventions for metabolic health and diabetes management.

Several limitations should also be noted. First, sweetness ratings were subjective and based on a simple 10-point scale, which may introduce variability between participants. Second, although replication was performed with 21 student participants, the sample size remained relatively small. Third, participant demographic information was limited, and future studies should include a more detailed demographic summary like age- or sex-related differences in sweetness perception can be evaluated. Finally, because this study focused on perceptual outcomes only, future work should combine sensory testing with larger participant groups, statistical analysis, and more controlled experimental designs to better clarify the mechanisms and reproducibility of *Gymnema*-related sweetness suppression.

MATERIALS AND METHODS

Study Design

This independent research study was designed to investigate the effects of *Gymnema sylvestre* (*Gymnema*) tea on sweet taste perception in humans. In addition to the author's own repeated trials, 21 high school student participants were selected on a voluntary basis (ages 16-18). To minimize expectation bias, participants were not informed of the specific hypothesized outcome; instead, they were told the research investigated general taste changes. All procedures involving human participants, including verbal informed consent, were reviewed and approved by the Scientific Review Committee at Blacksburg High School.

Tea Preparation

Commercially available *G. sylvestre* tea bags (Herbal Goodness, Lot# 1023; Sugar Land, TX, USA) were used to ensure consistent gymnemic acid content. Each tea bag contained approximately 2 g of dried *Gymnema* leaves. Tea was prepared by steeping one tea bag in 250 mL of boiling distilled water for 5 minutes. The tea was cooled to room temperature (approximately 22°C) before consumption to maintain palatability while preserving gymnemic acid activity.

Food Samples

Eight food items were selected to provide a range of sweet stimuli, including both natural and artificial sweeteners. Food

items were classified into three categories based on their nutritional composition and baseline sweetness intensity: simple sugars (pure granulated sugar), natural sweeteners (fructose-based whole fruits, such as bananas and apples), and complex processed foods (multi-ingredient items with added sucrose, such as cookies and candies). Bananas and apples were considered sweet natural foods because they provided a benchmark for how *Gymnema* tea interacts with naturally occurring fruit sugars compared to refined or artificial sweeteners.

The tested foods included: granulated pure sugar (Domino Sugar, Cat# 01111), banana slices (Chiquita Bananas, Lot# 2035), Sweet Tarts® candies (Nestlé, Lot# ST2051), M&M's® candies (Mars, Lot# MM3401), chocolate chip cookies (Chips Ahoy!®, Lot# 2075), artificial sweetener (Splenda®, sucralose-based, Cat# SPL245), apple slices (Fuji apples, Lot# 1143), and hot sauce (Tabasco®, Lot# 1120), which served as a non-sweet control.

All samples were prepared into uniform small tasting portions (approximately 5–10 g each) to ensure consistency across trials. To provide objective context for high versus low sugar environments, the sugar content for each serving was calculated as follows: pure sugar (7.5 g sugar), Sweet Tarts® (~6.2 g sugar), M&M's® (~4.8 g sugar), chocolate chip cookies (~2.5 g sugar), banana slices (~0.9 g sugar), and apple slices (~0.8 g sugar). Splenda® and hot sauce both contained 0 g of sugar per serving. Tabasco® hot sauce was selected as the non-sweet control because its nutritional label confirmed it contains zero grams of sugar and zero grams of total carbohydrates per serving. This confirmed absence of fermentable or perceived sugars ensured that any taste perception changes following *Gymnema* tea consumption were specific to sweet stimuli and not a result of general flavor numbing or an interaction with hidden sugars often found in other condiments.

Sweetness Rating Procedure

The experiment consisted of two phases: baseline (pre-tea) and post-tea assessment. In each phase, food samples were presented in randomized order to reduce order bias. The sweetness intensity of each item was rated using a standardized 10-point scale, where 0 represented "not sweet at all" (equivalent to the perception of plain distilled water) and 10 represented "extremely sweet" (equivalent to the perception of pure granulated sugar). After the baseline ratings were recorded, each participant consumed 250 mL of the prepared *Gymnema* tea. A five-minute waiting period followed to allow gymnemic acids to bind to the sweet taste receptors. To ensure that the sweetness of a given item was not influenced by the preceding sample, participants used distilled water as a palate cleanser between each food item. Participants were instructed to rinse their mouths thoroughly and wait thirty seconds before proceeding to the next tasting. Following the waiting period and the tea consumption, participants repeated the sweetness evaluations using the same randomized food order and 10-point scale as the baseline assessment.

Data Collection and Analysis

Sweetness ratings before and after *Gymnema* tea

consumption were recorded for each participant. The change in sweetness ratings for each food item was calculated to assess the degree of sweetness suppression. Data were compiled and summarized descriptively using Microsoft Excel to illustrate overall trends in sweet taste suppression across participants. Due to the exploratory nature of this student-led project, no formal statistical analysis was performed, and p-values were not calculated. Outliers were checked visually, but no data points were excluded from the analysis, and all ratings were reported as collected. Mean and standard deviation (SD) were calculated across participants for each food item before and after tea.

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