

Original article

A polyol-stevia blended sugar replacer exhibits low glycemic response among human subjects

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SUMMARY

Background & aims: Consumption of sugars in food and beverages has increased at an alarming rate. While excessive daily sugar intake has been well-associated as the onset of medical complications, additional sugars are still used in manufactured food products just to satisfy the consumers' needs. Hence, there is a need to develop sugar replacers that have low glycemic response without compromising the organoleptic characteristics of food products. This study aimed to determine if SUITENA™, a novel sweetener containing erythritol, xylitol, and Stevia, has low glycemic response upon consumption by human subjects.

Methods: Six human subjects were randomly chosen and were healthy at the point of experimentation. Capillary blood was collected via finger-prick method to monitor the glycemic response of every individual for 90 min after ingestion of sugar solution.

Results: It was found that the mean area under the curve (AUC) of the dextrose standard was 11.8-fold higher ($p < 0.05$) than the AUC of SUITENA™. SUITENA™ was not able to increase blood glucose level for up to 90 min while a spike in blood glucose level was observed from 15 min post-consumption of dextrose solution. We found that SUITENA™ has elicited a glycemic response 8% relative to the standard. Such low glycemic response has been reported by studies on other novel sugars.

Conclusion: This preliminary finding suggested that SUITENA™ is a healthier alternative to fast sugars due to its low glycemic response. A larger sampling size is required to confirm the results.

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1. Introduction

Healthier alternatives to table sugar have been sought after due to the known associations between sugar intake and risk of various implications on human health such as diabetes and obesity [1,2]. According to Kim et al. (2018), there is an increased global usage and consumption rate of added sugar amongst modern daily meals [3]. Hence, food industries have now adapted to using alternative intense sweeteners such as aspartame and sucralose to reduce the overall calorie while maintaining the organoleptic characteristics of food products. Nonetheless, application of such sweeteners in foods are often limited as a result of difference in molecular and chemical behaviors of these sweeteners and sucrose [1]. This type of

sweetener does not generally benefit the human health and some even imposed side effects upon consumption [4].

Polyols are sugar replacers that have gained increasing attention due to their potential health benefits. This class of hydrogenated carbohydrates are naturally found in foods and are attributed with low cariogenicity, low glycemic, low insulinaemia, and low energy value with sweetness levels comparable to table sugar [5]. Spike in blood glucose level is unlikely upon consumption of polyols due to the low absorption rate of the sugar replacer [6]. Hence, polyols are better alternatives to the table sugar [5].

The glycemic index (GI) is a tool used to assess the blood glucose-raising ability of a food product. GI is typically quantified by determining the ratio of incremental area under curve (AUC) elicited by 50 g of the food against the AUC elicited by 50 g of a glucose standard [5]. Low GI foods tend to be healthier and allow diabetic patients to enjoy sweet food products due to the slow release of glucose into the blood that does not induce a spike in

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blood glucose level [5,7]. The relative glycemic response of a test food can then be quantified by determining the ratio between the AUC of the test food in relation to the standard.

In this study, we investigated the glycemic response of SUI-TENA™ compared to dextrose monohydrate standard upon human consumption.

2. Materials and methods

2.1. Human ethics and subjects

A randomized, controlled, single-blinded study was conducted at Monash University, Malaysia campus. The study was approved by Monash University Human Research Ethics Committee (MUHREC) (Project number: CF16/1059–2016000561). Six healthy adults were recruited from the University for the study after obtaining written informed consent from all volunteers. Exclusion criteria of the study were pregnant women, patients, and children or teenagers under the age of 18. Characteristics of the human subjects are shown in Table 1.

2.2. Study design and procedures

All subjects were informed to maintain habitual diet and physical activities prior to experimentation. Blood glucose measurements were conducted once a week and all participants were required to fast for at least 10 h before the measurement. A total of four glycemic measurements were conducted throughout a month, during which 250 mL of dextrose monohydrate (50 g) solution was provided as the standard solution on the first, third, and fourth measurement while 250 mL of SUI-TENA™ (50 g) solution was provided on the second measurement. During the day of measurement, blood glucose levels before consumption (0 min) and 15 min, 30 min, 45 min, 60 min, 75 min, and 90 min after consumption of standard or SUI-TENA™ solution were measured. Capillary blood was obtained by finger-prick method and glycemic level was quantified using conventional glucometer with test strips.

2.3. SUI-TENA™

SUI-TENA™ is a mix of erythritol, xylitol, and Stevia at an optimized ratio. SUI-TENA™ powder developed by Fiatic Biosystem Sdn Bhd, Malaysia was packaged as sachets that each contained 50 g of the powder. One sachet of SUI-TENA™ powder was dissolved in 250 mL of drinking water at room temperature and served to each participant.

2.4. Statistical analysis

All data were analyzed using one-way ANOVA and expressed as the average ($n = 6$) blood glucose concentration \pm standard deviation (SD) unless stated otherwise.

3. Results

All participants completed the study. A significantly ($p < 0.05$) lower average AUC was observed when the participants consumed

Table 1
Characteristics of the human subjects.

Body weight (kg)	64.8 \pm 10.9
BMI (kg/m ²)	24.5 \pm 2.94
Waist-to-hip ratio	0.864 \pm 0.0555
Fasting blood glucose level (mmol/L)	4.95 \pm 0.429

All data are expressed as mean ($n = 6$) \pm SD.

SUI-TENA™. The mean observed AUC of SUI-TENA™ was 15.31 mmol/L/90 min while the mean observed AUC of dextrose standard was 177.25 mmol/L/90 min. A spike in blood glucose level after consumption of dextrose was observed from 15 to 45 min post-consumption but remained stagnant throughout the time-frame when SUI-TENA™ was consumed (Fig. 1). These results were in parallel with the results reported by Livesey (2003), where the glycemic responses of xylitol and erythritol were compared with fast sugars [5]. This shows the inability of SUI-TENA™ to elevate blood glucose level, reflecting its low glycemic response (8%) in relation to dextrose (see Fig. 2).

4. Discussion

The main ingredients of SUI-TENA™ are erythritol, xylitol, and Stevia. Despite the reported GI of xylitol as ranging between 7 and 13, the overall glycemic response of SUI-TENA™ was suppressed by the zero GI values of erythritol and Stevia [1]. This could possibly

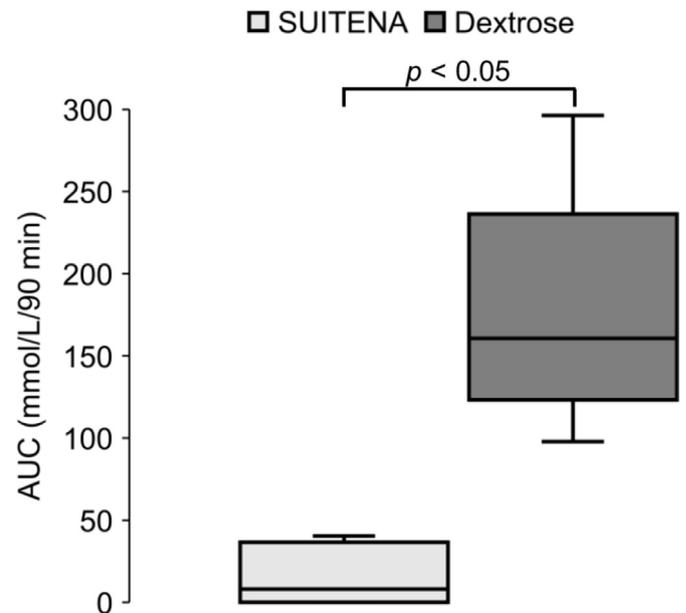


Fig. 1. Area under the curve (AUC) of blood glucose level for 50 g of SUI-TENA™ compared to 50 g of dextrose monohydrate upon ingestion. All data are expressed as box plots with mean ($n = 6$) and SEM. The GI of SUI-TENA™ is 0.08.

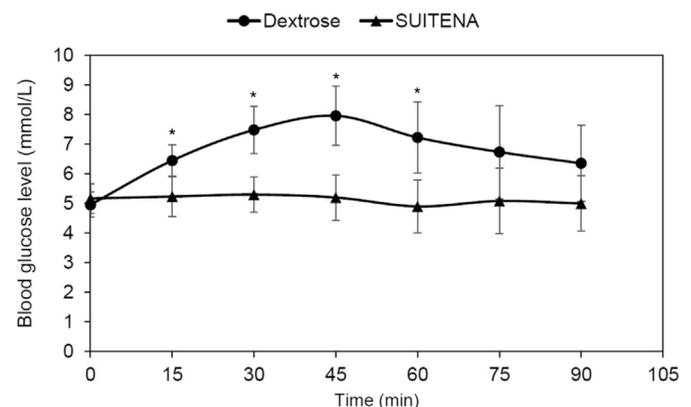


Fig. 2. Glycemic response of participants after ingestion of 50 g dextrose monohydrate standard (●) and SUI-TENA™ (▲). All data are expressed as means ($n = 6$). Error bars represent SD. Statistical significance at $p < 0.05$ are denoted with *.

allow consumers who are diabetic to consume SUITENA™ as the sweetener since it will not induce a spike in the blood glucose level upon consumption.

Most commercially-available sugar replacers have low to zero GI, but some were reported to have a bitter aftertaste or unstable at high temperatures [8]. As for SUITENA™, most of the participants perceived the sugar replacer to be sweeter than dextrose without any aftertaste. This was also reported from other studies on different blends of sweetening agent [7–9].

Since there is an increasing demand of low-calorie drinks in the market and increasing calorie-conscious consumers, it is possible to produce low-calorie drinks by substituting the use of fast sugar in normal drinks with SUITENA™. As SUITENA™ is perceived as sweet without a bitter aftertaste, this sugar replacer can maintain the organoleptic properties of the beverage products. Furthermore, Stevia is known to be a thermally-stable sugar [10]. Thus, inclusion of Stevia in SUITENA™ potentially allows the usage of the sugar replacer in preparation of food products under high temperatures.

One limitation that was observed from SUITENA™ is the mild side effect where there was an increased bowel movement upon consumption of the high dose (50 g) of SUITENA, which is consistent with reported effects caused by high content of xylitol [5,11]. In practical terms, the dose of SUITENA that is consumed, e.g. in beverages, will be in the <10 g range and is unlikely to cause this effect. However, the laxative threshold of SUITENA™ has not been investigated.

In conclusion, this proof-of-concept study has successfully characterized SUITENA™ as a novel sugar replacer that does not affect the blood glucose level upon consumption in healthy human subjects and has the potential for use as a healthier alternative to fast sugars. In the future, a larger sample size including diabetic patients could be tested to draw a more conclusive statement on the health benefits of SUITENA™ upon consumption.

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

A.W.R.N. conducted the study, analyzed data, and wrote the manuscript. K.K.L. developed the SUITENA product and characterized it, analyzed the data, and wrote the manuscript. N.G. designed the study and prepared the consent and ethics documentations. K.N. designed the study, analyzed the data, and wrote the manuscript.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.clnesp.2019.07.014>.

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