

Original Article

Sensory Evaluation And B-Carotene Content Test in The Development of Yellow Pumpkin Brownies Products with The Substitution of Natural Sweeteners from Stevia Leaves (*Stevia rebaudiana*)

Evaluasi Sensori Dan Uji Kadar B-Karoten Pada Pengembangan Produk Brownies Labu Kuning Dengan Substitusi Pemanis Alami Daun Stevia (Stevia Rebaudiana)

Julistin Haidiyanti¹, Arif Sabta Aji^{1,2*}, Winda Irwanti¹, Raudah Nurjanah¹, Faizah Rahma Putri¹

¹Department of Nutrition, Faculty of Health Sciences, Universitas Alma Ata, Bantul 55183, Indonesia

²National Research and Innovation Agency, Cibinong Science Center, Bogor 16911, West Java Province, Indonesia

* Email corresponding author: sabtaaji@almaata.ac.id

Abstract: Excessive sugar consumption can lead to Type 2 Diabetes Mellitus (T2DM). Stevia is a low-calorie natural sweetener. Yellow pumpkin is abundant in antioxidants β -carotene. Utilizing stevia with yellow pumpkin as a functional food option can contribute to improved health benefits. To determine the effect of cane sugar with stevia substitution on sensory evaluation and β -Carotene concentration in steamed yellow pumpkin brownies. This was a quasi-experimental study approach utilizing a Completely Randomized Design (CRD). The experiment consisted of four treatments, each with different proportions of cane sugar and stevia. These treatments were labeled as P0 (100% cane sugar: 0% stevia), P1 (50% cane sugar: 50% stevia), P2 (25% cane sugar: 75% stevia), and P3 (0% cane sugar: 100% stevia). Hedonic tests evaluate sensory features such as color, taste, aroma, and texture. Analysis of β -Carotene levels using the spectrophotometric method with a spectrophotometer. The data were subjected to analysis using One-way ANOVA. There was a significant influence on the sensory evaluation of taste, aroma, and texture ($p < 0,05$). However, there was no significant impact on the color sensory assessment ($p > 0,05$). The substitution of stevia leaf sweeteners had a significant effect on the concentration of β -carotene brownies ($\leq 0,001$), which was the highest concentration in the P3 group ($74.21 \pm 0.74 \mu\text{g}/100 \text{ g}$). Replacing cane sugar with stevia has an important effect on the taste, aroma, texture, and levels of β -Carotene in brownies. Promising functional foods such as pumpkin and stevia have the potential of a healthy snack for T2DM patients.

Key word: Stevia, sensory evaluation; β -Carotene; brownies; yellow pumpkin

1. INTRODUCTION

A high sugar consumption pattern can have adverse effects on health, such as increased blood sugar levels, which can lead to Type 2 Diabetes Mellitus (T2DM). T2DM occurs when the energy consumption from glucose and simple carbohydrates is excessive and is stored in body tissues, which can lead to insulin resistance (1,2). The Basic Health Research (Riskesdas) of 2013 stated that the prevalence of Diabetes Mellitus (DM) reached 1.5% and in 2018 it reached 2.0%, which means an increase of 0.5% (3). The Indonesian Health

Survey (SKI) 2023 states that the prevalence of diabetes mellitus (DM) in Indonesia reached 1.7%, meaning the prevalence of DM has decreased by 0.3% compared to the Riskesdas 2018. Even with the decrease, the 1.7% statistic indicates that diabetes mellitus remains a serious health issue in Indonesia. Diabetes mellitus can lead to numerous severe complications, including cardiovascular disease, cerebrovascular accident, renal failure, visual impairment, and limb amputation. Consequently, it is essential to persist in monitoring the prevalence of diabetes mellitus, enhance public knowledge regarding its hazards, and promote efficient preventative and treatment initiatives.

Based on the current SKI 2023 national survey in Indonesia, the highest type of DM is T2DM, with a prevalence of 50.2% in Indonesia. However, the number has slightly increased by 50.6% in the Special Region of Yogyakarta Province. The SKI 2023 found that 33.7% of respondents consumed sweet foods more than once a day or exceeded the recommended limit (4). This evidence shows that one possible way to prevent excessive sugar consumption from sweet foods is by substituting that sugar with other alternative products. Aside from that, enhancing the nutritional quality of food, particularly compounds such as antioxidants, can counteract the effects of free radicals, which are molecules that can cause damage to human cells.

Functional foods are food products that contain bioactive compounds to enhance a person's health, in addition to their nutritional content and taste (5). The β -carotene concentration in yellow pumpkin and stevia indicates that β -carotene is utilized as a functional food that can help improve insulin response and glycemic control related to its function as an antioxidant that captures free radicals through carotenoid excitation, singlet oxygen, and enhanced antioxidant status in patients with T2DM (6). Stevia contains low-calorie natural sweeteners found in stevia leaves (*Stevia rebaudianai*) and creates a sweetness that is 70 to 400 times sweeter than cane sugar, and can produce functional foods beneficial for health as an anti-hyperglycemic (7,8). Pumpkin has a high content of β -carotene at 1569 μ /100 g of material, with carotenoid content that functions as provitamin A and a source of antioxidants, making pumpkin a functional food beneficial for health (9,10).

Brownies are cakes characterized by a soft, dense texture, a brown hue, and a unique flavor profile. Brownies can be classified into two categories: steamed and baked brownies. Steaming brownies yields a softer texture compared to baking, as it retains more water vapor(11). Unhealthy eating patterns encompass snacking habits that deviate from balanced dietary requirements. Brownies are among the most sought-after cakes and are readily available to the public(12). The sugar concentration in brownies can provide a rapid source of energy; however, excessive consumption may elevate glucose levels in the body(13). Consequently, brownie recipes must be adjusted to incorporate safe food items to prevent diabetes mellitus. The efficacy and nutritional advantages

of pumpkin and stevia are anticipated to serve as an alternative solution for lowering hyperglycemia, as stevia leaves (*Stevia Rebaudiana*) offer a low-calorie sugar substitute, while pumpkin (*Cucurbita Moschata*) significantly contributes as an antioxidant due to its high β -carotene content and low carbohydrate levels.

The development of steamed brownies by adding yellow pumpkin as the main ingredient and Stevia as a sweetener can serve as an alternative to cane sugar with functional food value. The product "BrowPumVi," which stands for "Brownies Yellow Pumpkin with Stevia", was created to determine the effect of substituting cane sugar with stevia sweetener on sensory evaluation and β -carotene content in steamed brownies made with yellow pumpkin as the main ingredient.

2. METHODS

Study design

In this study, a quasi-experimental research type was used with a Completely Randomized Design (CRD) with the treatment being the substitution of the natural sweetener stevia (*Stevia rebaudiana*) (14). This study uses one control group and three treatment levels with the substitution of cane sugar and stevia leaf powder, namely P0 (100% cane sugar : 0% stevia), P1 (50% cane sugar : 50% stevia), P2 (25% cane sugar : 75% stevia), P3 (0% cane sugar : 100% stevia) (Table 1). This formulation was obtained through the modification of the formulation from the study by Pratiwi et al., with initial trials in the form of brownie product experiments using a combination of cane sugar and stevia (15).

Table 1. Research Experiment Design

Treatment Level (%) Sugarcane: Stevia	Replication		
	1	2	3
P ₀ (100 : 0)	Y ₀₁	Y ₀₂	Y ₀₃
P ₁ (50 : 50)	Y ₀₄	Y ₀₅	Y ₀₆
P ₂ (25 : 75)	Y ₀₇	Y ₀₈	Y ₀₉
P ₃ (0 : 100)	Y ₁₀	Y ₁₁	Y ₁₂

The preparation and testing of sensory evaluation of pumpkin brownies with stevia substitution in the Food Technology Laboratory of Universitas Alma Ata. The sensory evaluation assessment was conducted by 30 semi-trained panelists, namely the fourth-year level students from the Bachelor Nutrition Study Program at the Faculty of Health Sciences, Universitas Alma Ata. Before the sensory evaluation test, the panelists received training to understand certain sensory properties. They had attended advanced culinary nutrition courses to study sensory testing material. The criteria of the panelist covered 1) being physically and mentally healthy and having no allergies; 2) not in conditions of sick, empty stomach, or hungry; and 3) volunteering as a panelist. The β -carotene content analysis was conducted at the Chemix Laboratory in Bantul Regency,

Yogyakarta. This study was conducted in February - March 2024. This study's protocol was approved by the Ethics Committee of Universitas Alma Ata Yogyakarta (No: KE/AA/II10111399/EC/2024).

Research Instruments

The ingredients used in making brownies are brand flour, cane sugar, stevia leaf powder, pumpkin flesh, margarine, eggs, dark cooking chocolate, vanilla, and baking powder (16). The materials used in the β -carotene analysis include acetone, aquades, petroleum ether, acetone, and anhydrous Na₂SO₄. The materials used for sensory evaluation are drinking water and samples (17). The tools used for making brownies include a digital kitchen scale, mixing bowl, mixer, baking pan (18 cm long, 10 cm wide, and 4 cm high), steamer, spatula, baking paper, and gloves (16). The tools used for the β -carotene content test are an Erlenmeyer flask, porcelain crucible, funnel, pipette, and test tube. The tools used for sensory evaluation are sensory evaluation forms, plastic plates, and stationery (17).

Research Procedures

The product manufacturing procedure begins with the preparation of tools and materials, the separation of the flesh, seeds, and skin of the pumpkin, the boiling process of the pumpkin flesh, the mixing of the ingredients, and the final steaming stage. The product development procedure can be seen in Figure 1 and other research method procedures can be seen in the previous publication paper (14).

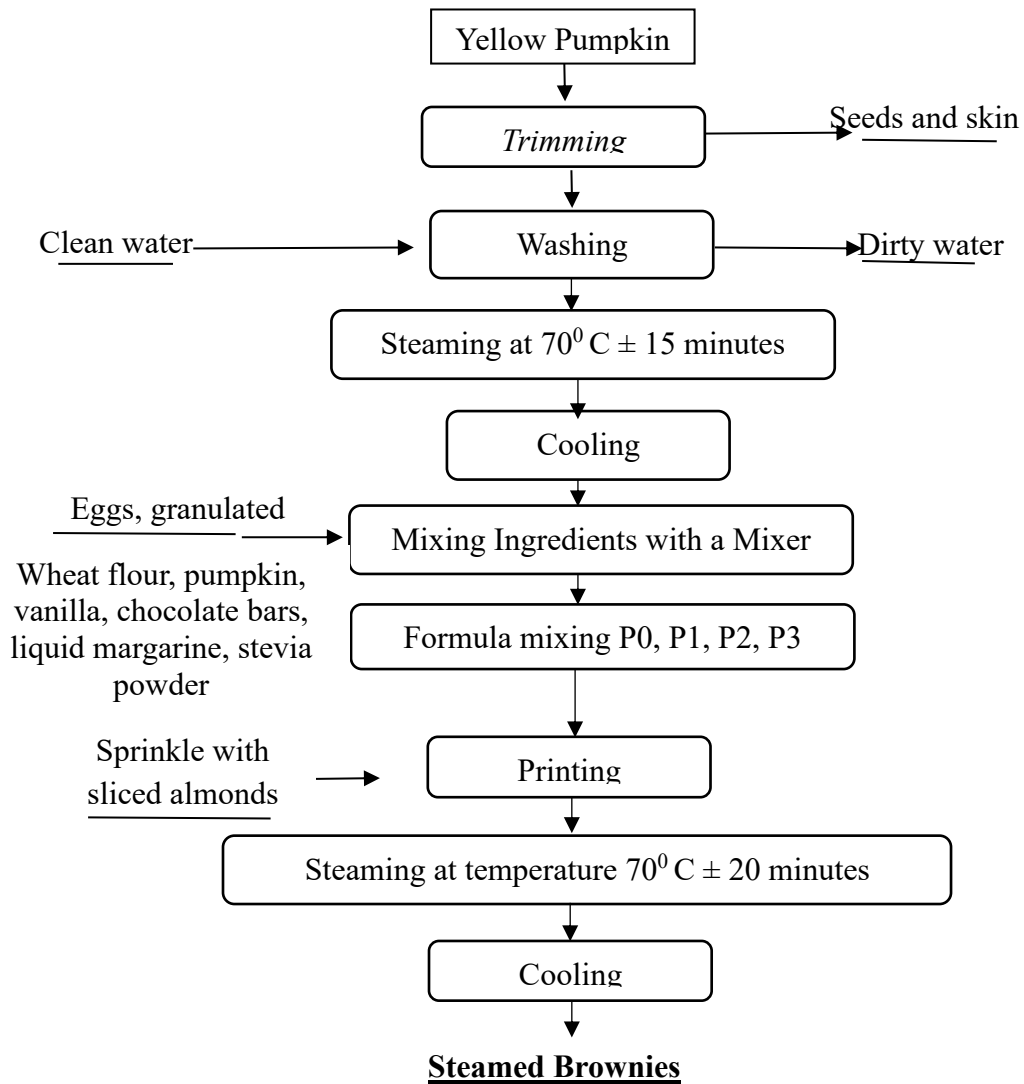


Figure 1. BrowPumVi Product Development(14)

Data Analysis

The data analysis used is sensory evaluation analysis using the hedonic test, which is 4 (very like), 3 (like), 2 (dislike), 1 (very dislike) (18). The research was conducted in three repetitions, namely the β -carotene content test using the spectrophotometry method, with final results expressed in $\mu\text{g}/100\text{ g}$ of product for each treatment (17). The selection of the chosen formulation was based on the highest average value from the sensory evaluation (color, taste, aroma, and texture) using Excel software. The data from the sensory evaluation were analyzed using the Statistical Package for the Social Sciences (SPSS) version 25 with the Kruskal Wallis test at a 95% confidence level ($\alpha=0.05$). If H_0 is rejected, it will be followed by the Mann-Whitney test, while the β -carotene content will be subjected to the One-Way ANOVA statistical test at a 95% confidence level ($\alpha=0.05$). If H_0 is rejected, it will be followed by the Duncan Multiple Range Test (DMRT).

3. RESULTS

Sensory Evaluation

Table 2. Sensory Evaluation of Pumpkin Brownies with Natural Sweetener Substitution of Stevia

Sensory variables	Average Preference of Panelists for the Sensory Evaluation of Brownies				P-value
	Treatment Level (%) Sugarcane: Stevia				
	P ₀ (100:0)	P ₁ (50:50)	P ₂ (25:75)	P ₃ (0:100)	
Color	3.03 ± 0.49 ^a	2.90 ± 0.54 ^a	3.07 ± 0.52 ^a	2.97 ± 0.80 ^a	0.712
Taste	3.40 ± 0.62 ^a	2.50 ± 0.73 ^{bc}	2.83 ± 0.83 ^b	2.40 ± 0.85 ^c	≤0.001
Aroma	3.13 ± 0.50 ^a	2.77 ± 0.62 ^b	2.83 ± 0.70 ^{ab}	2.60 ± 0.67 ^b	0.014
Texture	3.33 ± 0.80 ^a	2.73 ± 0.64 ^b	2.70 ± 0.70 ^{bc}	2.37 ± 0.71 ^c	≤0.001

Different letters ^{a, b, c} in the same column indicates a significant difference between treatments at a significance level of $p < 0.05$ using the Mann-Whitney test. The values in each score of the sensory evaluation results in the table indicate that a score of 1 = Very Dislike, 2 = Dislike, 3 = Like, 4 = Very Like.

Color

Based on the results of the sensory evaluation data analysis of the color of yellow pumpkin brownies at each treatment level, the scores ranged from 2.90 to 3.07, which means they were liked. The color of the brownies most favored by the panelists among the treatments was P2 (brownies with 25 g of sugar cane and 4.68 g of stevia leaf powder). The results of the Kruskal-Wallis test at a 95% confidence level for the color parameter showed no significant difference ($p = 0.712$). This indicates that there is no significant difference in treatment (P0, P1, P2, and P3) on the color of yellow pumpkin brownies with the substitution of stevia leaf sweetener.

Taste

Based on the results of the sensory evaluation data analysis of the taste of pumpkin brownies at each treatment level, the scores range from 2.40 to 3.40, which means they are liked. The flavor of the brownies most favored by the panelists among the treatments was P2 (brownies with 25 g of sugar cane and 4.68 g of stevia leaf powder). The results of the Kruskal-Wallis test at a 95% confidence level for the taste parameter showed a significant difference ($p \leq 0.001$). This indicates that there are significant differences in the treatments (P0, P1, P2, and P3) regarding the taste of pumpkin brownies with stevia leaf substitution.

Aroma

Based on the results of the sensory evaluation data analysis of the aroma of pumpkin brownies at each treatment level, the scores ranged from 2.60 to 3.13, indicating a liking. The aroma of the brownies most favored by the panelists among the treatments was P2 (brownies with 25 g of sugar cane and 4.68 g of stevia leaf powder). The results of the Kruskal-Wallis test at a 95% confidence level for the aroma parameter showed a significant difference ($p= 0.014$). This indicates that there are significant differences in the treatments (P0, P1, P2, and P3) regarding the aroma of pumpkin brownies with stevia substitution.

Texture

Based on the results of the sensory evaluation data analysis of the texture of yellow pumpkin brownies at each treatment level, the scores ranged from 2.60 to 3.13, which means they were liked. The texture of the brownies most favored by the panelists among the treatments was in treatment P1 (brownies with 50 g of sugar and 3.125 g of stevia leaf powder). The results of the Kruskal-Wallis test at a 95% confidence level for the texture parameter showed a significant difference $P<0.001$. This indicates that there are significant differences in the treatments (P0, P1, P2, and P3) regarding the texture of pumpkin brownies with stevia leaf substitution.

β -carotene level

The research on the beta-carotene concentration in pumpkin brownies with natural sweetener substitution of stevia has been conducted, and the results are presented in Table 3.

Table 3. Mean of β -carotene concentration

Treatment Level (%) Sugarcane: Stevia	Concentration of β - karoten ($\mu\text{g}/100\text{ g}$)	<i>p-value</i>
P ₀ (100 : 0)	30.43 ± 1.08 ^a	≤0.001
P ₁ (50 : 50)	60.61 ± 0.68 ^b	
P ₂ (25 : 75)	65.91 ± 0.67 ^c	
P ₃ (0 : 100)	74.21 ± 0.74 ^d	

Different letter notations (a, b, c, d) indicates significant differences in the DMRT test. Data presented in the form of mean ± SD.

Based on the analysis of β -carotene levels in pumpkin-based brownies with stevia leaf sweetener substitution ranging from 30.43 to 74.21 $\mu\text{g}/100\text{ g}$. The results of the One-way Anova statistical analysis at a 95% confidence level indicate that the differences in the proportion of stevia leaf sweetener substitution at each treatment level yield significant differences $P<0.001$. This indicates that there are significant differences in the treatments (P0, P1, P2, and P3) regarding the β -carotene content of pumpkin brownies with the substitution of stevia leaf sweeteners. The greater the proportion of stevia substituted, the higher the β -carotene content in the yellow pumpkin brownies.

Selected Formulation

The selected formulation was determined based on the highest value from the average sensory evaluation scores for each treatment, as shown in Table 4. Variables in each treatment were selected based on the average values. Based on the average values obtained, the selected formulation in the sensory evaluation showed the highest result in P2 with a score of 2.86. Thus, P2 is declared as the selected formulation.

Table 4. Selected Formulation

Variables	Treatment Level (%) Sugarcane: Stevia			
	P ₀	P ₁	P ₂	P ₃
Color	3.03	2.90	3.07	2.97
Taste	3.40	2.50	2.83	2.40
Aroma	3.13	2.77	2.83	2.60
Texture	3.33	2.73	2.70	2.37
Average	3.23	2.73	2.86	2.58

4. DISCUSSION

Color Sensory Evaluation

The determination of food quality by color can be used as a measure to determine taste, texture, nutritional value, and microbiological properties. The color of food products is influenced by the pigments contained in the food ingredients (19). The results of the sensory evaluation of color on steamed pumpkin brownies with stevia sweetener substitution showed the highest value of 3.07 ± 0.52 (very much liked) in treatment P2, while the lowest sensory evaluation value for color was in treatment P1 at 2.90 ± 0.54 (liked). Color is the first sensory quality variable that can be directly seen and assessed by the panelists, as the color of a food product will influence the food quality determined by the panelists (20). In the BrowPumVi product, the color is attractive and well-received by the panelists because color can affect food quality and consumer acceptance.

In this study, pumpkin brownies with stevia leaf sweetener substitution produced a brown color in the P0 treatment, but the P1, P2, and P3 treatments had a darker brown color. The addition of stevia leaf powder and pumpkin does not affect the brown color of the brownies because the use of dark compound chocolate in each treatment has a greater color influence. This is in line with research on baked brownies with the addition of stevia leaf sweetener, which states that the color of baked brownies with the addition of stevia leaf sweetener does not affect the color variables obtained from the analysis (21). The formation of the brown color in brownies comes from melted chocolate bars that are mixed in during the preparation process. In addition, the formation of the brown color is also caused by enzymatic reactions due to the Maillard reaction and caramelization of sugar (22). The same color is caused because the

addition of stevia does not affect the brown color in the brownies due to the use of dark compound chocolate, which contributes a more dominant color (21,23). This study found that the substitution of stevia leaf sweetener does not affect the brown color of yellow pumpkin brownies.

Taste Sensory Evaluation

Taste is the next parameter evaluated by the panelists and an important component for consumers when consuming a product. Taste is one of the factors that influence the acceptance of a food product. The sensory organ used is the taste sensory organ (tongue), where there are four types of taste: salty, sweet, bitter, and sour (24). The results showed the highest value of 2.83 ± 0.83 (liked) in treatment P2 (25 g cane sugar and 4.68 g stevia leaf powder), while the lowest sensory taste evaluation value was in treatment P3 (0 g cane sugar and 6.25 g stevia leaf powder) at 2.40 ± 0.85 (liked). Taste in testing involves the five senses of the tongue; for a compound to be recognized by its taste, it must interact with microvilli and send impulses to the nerve center, and each person has different concentration thresholds for taste (25,26).

In this study, pumpkin brownies with stevia leaf sweetener substitution produced a chocolatey sweet taste in treatment P0 and had a sweet taste with a slight bitter aftertaste in treatments P1 and P2, but treatment P3 had a sweet taste with a bitter aftertaste. The addition of stevia leaf sweetener to kemojo cake indicates that the sample with 1% stevia concentration produces a sweet taste and a lingering bitter taste in the mouth. Kemojo cake with the addition of granulated sugar and stevia was preferred by the panelists (27).

The bitter taste left in the mouth from the BrowPumVi product is influenced by the addition of stevia leaf powder. Based on research on the utilization of stevia as a natural sweetener for starfruit juice, it is mentioned that the powder of green stevia provides a sweetness 30 times greater than sucrose. The sweetness in stevia comes from the compound *stevioside*, and high levels of *stevioside* can cause the use of stevia in large amounts to result in an overly sweet taste. According to research findings, a combination of 8% sucrose with the addition of 1% stevia extract has a slight bitter taste (28). An active compound, *Rebaudioside-A*, in stevia is a component that causes a lingering bitter taste in the mouth; stevia in the form of powdered dried leaves can reduce the lingering bitterness in the mouth (29). Based on the tannin content of stevia extract, it is stated that stevia contain tannins that cause a bitter taste if used in large amounts (30). Tannin is an astringent compound that has a bitter taste due to the presence of polyphenol groups that can bind and precipitate or reduce protein components (31). The higher the proportion of added stevia leaf powder from sugarcane in the BrowPumVi product, the more it is preferred by the panelists compared to the proportion of using stevia without sugarcane.

Aroma Sensory Evaluation

Aroma is one of the sensory attributes that greatly influences the perception of consumers or panelists towards the taste of a product. The aroma or smell emitted by a dish has a strong appeal in stimulating the sense of smell, thereby arousing appetite (32). The results of the sensory aroma evaluation research on steamed pumpkin brownies with stevia sweetener substitution showed the highest value of 2.83 ± 0.70 (like) in treatment P2. However, the lowest sensory aroma evaluation score was in treatment P3, which was 2.60 ± 0.67 (liked). Aroma is subjective, making it very difficult to measure, because each person has different sensitivities and preferences. Even though they can detect it, each individual has different likes and dislikes (33). The aroma in the BrowPumVi product decreases in preference among the panelists as the amount of stevia increases, because the perception of aroma is subjective and influenced by the sensitivity and preferences of different individuals.

In this study, the addition of stevia leaf powder and pumpkin can affect the aroma of brownies. The resulting brownies have the characteristic aroma of pumpkin brownies in treatment P0 and a slightly pumpkin brownie aroma and a characteristic stevia leaf aroma in treatments P1 and P2, but in treatment P3, they have a slightly pumpkin brownie aroma and a strong stevia aroma. Radiani et al., found that the more pumpkin puree is added, the more the cake will smell like pumpkin (34). In the study on the addition of stevia leaf extract to the acceptance of goat milk kefir, it explains that the more stevia leaf powder is used, the more dominant the stevia aroma will be (35). The aroma produced by stevia leaf extract arises from the composition of stevia, which includes tannins, flavonoids, and volatile aromas that make the scent less appealing (36). Furthermore, research on the organoleptic test of kefir with the use of stevia leaf flour shows that the more stevia leaf flour is used in kefir, the more the stevia aroma will dominate, resembling the smell of grass, which is less favored by the panelists (37). In this study, pumpkin brownies with increasing amounts of stevia were less favored by the panelists.

Texture Sensory Evaluation

The texture of food is one of the important factors in determining the quality of food ingredients (32). The results of the sensory evaluation of texture on steamed pumpkin brownies with stevia sweetener substitution showed the highest value of 2.73 ± 0.64 (liked) in treatment P1. However, the lowest sensory texture evaluation score was in treatment P3, which was 2.37 ± 0.71 (liked). The evaluation of texture parameters is conducted to determine the panelists' assessment of the level of preference for a product, which is evaluated through the sense of touch (38).

In this study, the addition of stevia leaf powder and pumpkin can affect the texture of brownies. Treatments P0 and P1 have a moist texture compared to treatments P2 and P3, which have a less moist texture. The addition of pumpkin has an effect on the texture of steamed brownies; the higher the addition of

pumpkin puree, the moister the steamed brownies become. This is due to the water content in the steamed brownies, which can be said to increase with the higher addition of pumpkin puree, resulting in steamed brownies with higher water content (39). The texture of the product is greatly influenced by the moisture content of the materials used; the higher the moisture content, the softer the product's texture (40). Research on the addition of stevia sweetener to baked Bengkuang (*Pachyrhizuserosus*) brownies states that the addition of stevia sweetener has a significant effect on the texture of baked Bengkuang (*Pachyrhizuserosus*) brownies, resulting in a dense and not moist texture. This is because there is no addition of sugar in the ingredients. The addition of sugar in brownie making serves to form the structure of the brownies, improve texture and tenderness, and prolong freshness by binding water (41).

β-carotene Concentration

β-carotene is a strong pigment that gives a red-orange color to foodstuffs such as yellow pumpkin, which has a relatively high *β-carotene* content of 1569 µg/100 g (39). The results of this study indicate that treatment P3 has the highest *β-carotene* content at 74.21 µg/100 g. The heating process in the form of steaming due to high temperatures can affect the degradation of *β-carotene* levels (42). The levels of *β-carotene* can decrease or degrade because they are easily oxidized by light, metals, enzymes, and heat (43). Processing pumpkin through the steaming process in treatment P3 resulted in the highest *β-carotene* content with a value of 74.21 ± 0.74 µg/100 g. However, its content is lower compared to raw pumpkin (1569 µg/100 g) due to the heating process of steaming, which involves high temperatures.

In this study, the addition of stevia affects the increase in *β-carotene* levels. The addition of pumpkin in each treatment P0, P1, P2, and P3 has the same weight, while the stevia in each treatment P1, P2, and P3 have different weights. This is in line with research on the nutritional content of stevia leaf powder, which states that the dry powder obtained from stevia has a high *β-carotene* content of 344.0 µg/100 g (44).

Selected Product Formulation

Functional foods are foods that have been processed and contain one or more functional components such as herbal ingredients that can provide health benefits, as well as added nutrient levels in food products (45). In this study, the materials with potential as functional foods are pumpkin and stevia as a sugar substitute. Both of these ingredients have a high *β-carotene* content, which is 1569 µg/100 g in yellow pumpkin (46). The combination of low-calorie stevia leaf sweeteners and *β-carotene*-rich yellow pumpkin can be utilized as functional food for diabetes mellitus patients. The consumption of foods high in *β-carotene* can help improve insulin response and glycemic control due to their function as antioxidants that capture free radicals through carotenoid excitation, singlet oxygen, and the enhancement of antioxidant status in individuals with T2DM (6). Furthermore, the consumption of *β-carotene* sources

can reduce the risk of diabetes mellitus by 22% with a consumption dose of 10mg/kg body weight to effectively lower blood glucose levels (18,47).

Based on the research results, it was found that the higher the proportion of stevia, the higher the β -carotene content in the brownies. The high β -carotene content must be accompanied by good sensory evaluation results so that it can still be accepted and enjoyed by consumers. Food quality is a set of multidimensional characteristics or factors that consist of nutritional aspects (carbohydrates, proteins, fats, minerals, vitamins, etc.); sensory aspects (tasty, appealing, fresh) in food products that differentiate the level of consumer acceptance of the product (18). Therefore, sensory evaluation must be given attention along with the high β -carotene content in the brownies.

The overall average results of the sensory evaluation showed the highest average in treatment P2 with a sweetener proportion of 25 g of cane sugar and 4.68 g of stevia leaf powder. The average sensory evaluation for treatment P2 was 2.86 and fell into the liked category. The β -carotene content of treatment P2 reached 65.91 μ g. Based on the average sensory evaluation and β -carotene content in the product, formulation P2 was chosen as the best formulation or treatment and is suitable as a high-antioxidant functional food for diabetes mellitus.

5. CONCLUSION

There is a significant effect of substituting cane sugar with stevia sweetener on sensory evaluation (taste, aroma, and texture) and β -carotene concentration in steamed brownies made from pumpkin (BrowPumVi). However, the sensory evaluation of color has no statistically significant difference. The higher the proportion of stevia sweetener, the more it can affect sensory evaluation (taste, aroma, and texture) and the higher β -carotene concentration. In treatment P2, the selected formulation consists of 25 g of cane sugar and 4.68 g of stevia leaf powder. The use of stevia sweetener and pumpkin can be an alternative functional food for health benefits by one of the component option that made into a product. Further study should explore the addition of other basic components to reduce the leftover bitterness of stevia, while brownies can be prepared by baking them in the oven to enhance their durability.

ACKNOWLEDGEMENT (optional)

The author expresses gratitude to the Chemix laboratory, as well as the funding from Indofood Riset Nugraha (IRN) 2023-2024 (No: SKE.037/X/CC/X/2023), which has helped make this research possible. Not to forget the research group friends and supervisors who have helped in the product development and supervising process.

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