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Characteristics of Edamame Soygurt with Stevia Sweetener as a Functional Food for Diabetes Mellitus Patients

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Abstract

Type 2 Diabetes Mellitus is a metabolic disorder characterized by increased blood sugar (hyperglycemia) due to decreased insulin secretion. Stevia can be an alternative for people with diabetes mellitus. The addition of stevia sweetener is beneficial because it has a very low calorie content, making it safe for people with diabetes. This study aimed to determine the isoflavone content, physical properties, and sensory characteristics of edamame soygurt containing stevia as a functional sweetener. This study used 5 formulations of sucrose and stevia levels in sequence: 100:0 (F0), 75:25 (F1), 50:50 (F2), 25:75 (F3), and 0:100 (F4). All formulas were tested for isoflavone contents, physical properties (pH and viscosity), and sensory characteristics (hedonic test). The test for differences in isoflavone and pH levels between formulations was carried out using ANOVA. In contrast, the sensory properties test data were analyzed using the Friedman test at the 5% significance level. F0 showed the highest isoflavone content (12.55), the most acidic pH was in the F0 formulation (4.56), and the highest viscosity was in the F4 formulation (0.98). Sensory tests were conducted on aspects of color, aroma, taste, texture, overall, and the best formulation. The hedonic test showed no significant difference in the element of color among the formulas ($\rho > 0.05$). On the other hand, aroma, taste, texture, and overall aspects showed significant differences in several formulations ($\rho < 0.05$). The results of the best formulation test based on panelist perceptions showed that F4 was the most preferred formulation among the majority of panelists.

Keywords: isoflavones; physical properties; sensory characteristics

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a metabolic disorder characterized by increased blood sugar (hyperglycemia) due to decreased insulin secretion by pancreatic beta cells and/or impaired insulin function (insulin resistance). Based on blood sugar level examinations, the prevalence of diabetes in the age group ≥ 15 years in 2023 was 11.7%, higher than the prevalence in 2018, which was 10.9% (Ministry of Health of the Republic of Indonesia, 2023).

Chronic hyperglycemia that occurs in diabetes mellitus sufferers can cause complications, such as nephropathy, retinopathy, and neuropathy due to oxidative stress, which causes the formation of excess free radicals (Tarigan et al., 2015; Pieme et al., 2017). Free radical production in diabetes mellitus occurs due to glucose autooxidation, which exceeds the capacity of intracellular antioxidants, leading to cell damage (Widaryanti et al., 2021). Preventing increased

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oxidative stress can be achieved by consuming foods high in antioxidants, such as edamame. Edamame, or vegetable soybeans (*Glycine max* (L) Merrill), are a type of white soybean native to Japan. Edamame is currently widely cultivated in Indonesia. PT. Mitratani Dua Tujuh, located in Jember Regency, is the largest producer of high-quality edamame in Indonesia, exporting to various countries with 1,615 ha of harvest area, 13,000 tons of annual processing capacity, and 2,000 tons of annual product storage (PT. Mitratani Dua Tujuh, 2026).

Edamame is rich in nutrients and phytochemical compounds that are good for body health (Barikah et al., 2021). One type of phytochemical found in high concentrations in soybeans is isoflavones (Nurmilah et al., 2024; Kim et al., 2025). Isoflavones are a type of antioxidant from the flavonoid group that can improve insulin sensitivity. This antihyperglycemic effect is due to the isoflavone content in edamame, which is higher than in yellow soybeans, at 49 mg 80 g^{-1} (Mardiana et al., 2022). Another study also shows that edamame pudding can serve as a nutritious snack due to its high antioxidant and fiber content (Ismawati and Anggraeni, 2024). Supplementing with antioxidants is an effort to inhibit the production of intracellular free radicals or enhance the ability of defense enzymes against free radicals to prevent oxidative stress and vascular complications in diabetes (Dawi et al., 2024).

One processed edamame product is edamame soy yogurt, known as edamame soygurt. Yogurt is a milk product made by bacterial fermentation, such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. During fermentation, bacteria increase yogurt's nutritional content, especially isoflavones, by converting glycosides into aglycones, making them easier to digest and absorb (do Prado et al., 2022). Fermenting edamame juice into edamame soygurt also helps eliminate the unpleasant odor of edamame juice (Diasari et al., 2021). Furthermore, the fermentation process can lower the pH, increase the total acidity, and improve the antioxidant content of yogurt (Son et al., 2023; Sarıtaş et al., 2024).

Stevia rebaudiana Bertoni has been used as a natural sweetener for years in various countries because it contains natural, non-calorie sweeteners and can produce a sweetness 70 to 400 times that of cane sugar. Stevia offers many health benefits that have been proven by research, such as no effect on increasing blood glucose levels, making it safe for people with diabetes. So, stevia is often used as a substitute for table sugar (sucrose), especially for people with diabetes mellitus (at a dose of 3 mg $kgBW^{-1}$ day^{-1}). Generally, during yogurt fermentation, sucrose, a food source for bacteria, led to a significant increase in total solids, which, in turn, resulted in a higher carbohydrate content (Campos et al., 2024). Using this simple sugar will increase the product's glucose content, which can impact blood glucose levels in people with diabetes mellitus. Therefore, this study uses stevia as a sucrose substitute, as bacteria can obtain glucose from other ingredients besides sucrose, especially heterotrophic bacteria, such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Kadner and Rogers, 2026).

The results of a study indicated that administering stevia leaf extract (60 mg kg^{-1} day^{-1}) for 28 days significantly ($\rho < 0.05$) reduced blood glucose levels and improved liver function, as evidenced by changes in white blood cell, platelet, and liver enzyme (ALT, AST) levels in diabetic rats (Rashid et al., 2024). Another study also showed that consuming biscuits using stevia for 2 weeks can reduce postprandial insulin and insulin response in adults with obesity and overweight (Gibbons et al., 2024). The addition of stevia can improve the quality characteristics of cow's milk yogurt and prevent colon diseases caused by bacteria by increasing intestinal mucin production (Kim et al., 2023).

Unlike saccharin or aspartame, stevia does not experience damage at high temperatures. In addition, stevioside is also resistant to heating up to 200 °C (392 °F), so almost all food recipes can use it (Raini and Isnawati, 2012). Based on limited research, this study was conducted to determine the sensory acceptability of edamame soygurt by panelists. Furthermore, this study analyzed the isoflavone content, pH, and viscosity of soygurt with stevia as a functional food for people with diabetes.

MATERIALS AND METHOD

Study design, location, and time

This study used a completely randomized design (CRD) with 5 sucrose and stevia formulations and 3 replications. The formulation was stevia leaf as a sweetener substitute for

Table 1. Modified edamame soygurt formulations

Material	Formulation				
	F0 (100:0)	F1 (75:25)	F2 (50:50)	F3 (25:75)	F4 (0:100)
Sucrose (g)/(5%)	75.00	56.25	37.50	18.75	-
Stevia (g)	-	2.68	5.36	8.04	10.71
CMC (g)/(1%)	15	15	15	15	15
Plain yogurt (g)/(5%)	75	75	75	75	75
Peeled edamame (g)	190	190	190	190	190
Water (ml)	1,500	1,500	1,500	1,500	1,500

sucrose in yogurt. The dependent variables included sensory characteristics (taste, aroma, color, and texture), physical properties (viscosity and pH), and isoflavone contents. The research took place in 2 locations: (1) production of edamame yogurt (edamame soygurt) and sensory testing were conducted at the Dietetics Laboratory, Faculty of Public Health, Universitas Jember; and (2) testing of physical properties and isoflavones was conducted at the Food Analysis Laboratory, Politeknik Negeri Jember. Time of carrying out this research from March until July 2025, and has received approval from the Research Ethics Commission of the Faculty of Nutritional Medicine, Universitas Jember, with letter number: 3069/UN25.8/KEPK/DL/ 2025.

Materials and tools

The raw materials used in this study were local edamame soybeans obtained from PT. Mitratani Dua Tujuh, sucrose, stevia leaf extract powder, carboxymethyl cellulose (CMC), mineral water, starter culture obtained from the Biokul brand plain yogurt consisting of *Streptococcus thermophilus*, *Lactobacillus bulgaricus*, *Lactobacillus acidophilus*, and *Bifidobacterium*. The tools used in this stage were a knife, blender, filter cloth, spoon, pan, gas stove, plastic wrap, incubator, measuring cup, scale, packaging container, water bath, stirrer, and thermometer. This study used 5 formulations of sucrose and stevia in sequence: 100:0 (F0), 75:25 (F1), 50:50 (F2), 25:75 (F3), and 0:100 (F4), as shown in Table 1. Measurement of isoflavon content using the spectrophotometric method with a UV-Vis spectrophotometer. The physical property measurements included viscosity tests using a Brookfield viscometer, pH tests using a pH meter, and total lactic acid bacteria using the acid-base titration method.

Edamame juice

A total of 950 g of peeled edamame was weighed and ground in a blender with a water-to-edamame ratio of 8:1. The slurry was filtered through cheesecloth and heated at 80 to 90 °C for 20 to 25 minutes to obtain cooked edamame juice.

Edamame soygurt

Sucrose and stevia sweetener were added to the edamame juice, which was then pasteurized at 80 to 85 °C for 10 minutes. The mixture was cooled to 40 to 45 °C, packaged in cups, and inoculated with a starter culture at 5% of the total volume. The samples were incubated at 37 °C for 24 hours. The edamame soygurt was subsequently refrigerated to stop the fermentation.

Data analysis

Data on isoflavone content, physical properties (pH and viscosity), and sensory properties were analyzed using SPSS 16.0. The first step was to conduct a normality test using the Shapiro-Wilk test to determine the distribution of the data obtained. Normally distributed data will be tested to determine differences in the formulation of stevia sweetener addition using the analysis of variance (ANOVA) test and continued with the data from the sensory properties test results, namely the hedonic test (color, taste, aroma, and texture), were processed using a non-parametric test, namely the Friedman test, and continued with Duncan multiple range test (DMRT) at a significance level of 5%.

RESULTS AND DISCUSSION

Analysis of the isoflavone contents

The results of the study showed that the isoflavone levels in edamame soygurt differed significantly across all formulations ($\rho < 0.05$). The highest isoflavone levels were found in the control formulation (F0), namely edamame soygurt with 100% sucrose without stevia (Table 2). It is in line with the results of research by Hidayat et al. (2020), which stated that isoflavone levels in soy products such as edamame can be increased through fermentation, but using different types of sugar can produce varying results. Natural isoflavones are generally found in glycoside form and must be hydrolyzed to aglycones for easier absorption by the body. Unfermented soybeans contain 2 to 3% aglycone; however, the aglycone content in fermented products can increase to 40 to 100%. This glycoside-to-aglycone conversion is aided by the α-glycosidase enzyme produced by microorganisms during fermentation.

In addition to higher absorption rates, the aglycone form has greater antioxidant activity than the glycoside form (do Prado et al., 2022). Another factor that can increase antioxidant levels is an increase in lactic acid levels and a decrease in pH (Ozturk et al., 2024). The results of research by Tandrian et al. (2021) also showed that the addition of natural sweetener stevia leaves decreased total acid and total lactic acid bacteria in cocogurt. Compounds that can increase antioxidant activity and function as stabilizers in fermentation by synergizing in the process of regenerating antioxidant compounds include lactic acid, acetic acid, citric acid, succinic acid, malic acid, acetaldehyde, diacetyl, and acetoin (Triasih and Priyadi, 2021; Komalasari and Yoga, 2022).

Analysis of the physical properties (pH and viscosity)

The sweetness of stevia leaf is derived from the active compounds steviol glycosides found in *Stevia rebaudiana* leaves, which act as a zero-calorie sweetener. Although stevia is considered healthier due to its distinct sweetness compared to regular sugar (sucrose), it can affect yogurt fermentation. The use of sucrose optimizes the fermentation process and increases the available isoflavone levels compared to using the stevia sweetener. Sucrose can serve as a more efficient nutrient source for microorganisms, such as *Lactobacillus* species, which are essential bacteria in yogurt fermentation. During fermentation, these bacteria consume sugar to support their growth and produce lactic acid, which helps maintain isoflavone levels in the final product (Hidayat et al., 2020). Furthermore, previous research has shown that bioactive compounds in stevia leaves (terpenoids and flavonoids) have antibacterial potential (Hasrawati et al., 2024). These antibacterial properties can inhibit the growth of lactic acid bacteria during the soygurt fermentation, thereby reducing lactic acid production (Yang et al., 2023).

This research showed that the lowest pH value was F0; edamame soygurt with 100% sucrose had a pH of 4.56, although it was not significantly different from the soygurt in all formulations. In line with research by Widodo et al. (2015), there was no difference in pH or acidity level of yogurt with the addition of the stevia sweetener. Microbes in yogurt starters can break down sucrose into lactic acid, so the addition of a higher concentration of stevia can help prevent a decrease in pH when making edamame soygurt (Rahman et al., 2019). Stevia sweetener contains no calories, carbohydrate compounds, or sucrose (which can be metabolized by microbes during yogurt fermentation). The main content of stevia is steviol glycosides, which can provide a sweet taste to soygurt without altering its acidity.

Based on Table 2, the highest viscosity was observed in the F4 formulation (0.98), namely edamame soygurt with 100% stevia sweetener. The increase in soygurt viscosity can be due to lactic acid bacteria growing in the presence of sugar/sucrose, and to the gel formed during fermentation, which ultimately produces a semi-solid texture. Although stevia is a natural sweetener that does not contain sucrose, the viscosity value of edamame soygurt tends to increase along with the increasing proportion of

Table 2. Results of analysis of isoflavone content and physical properties of edamame soygurt

Parameter	Formulation				
	F0	F1	F2	F3	F4
Isoflavone	12.55±0.02^{a}	12.08±0.04^{b}	11.58±0.03^{c}	12.41±0.02^{d}	12.27±0.04^{e}
pH	4.56±0.02^{a}	4.65±0.02^{ab}	4.74±0.02^{b}	4.61±0.02^{a}	4.63±0.02^{ab}
Viscosity	0.73±0.03^{a}	0.81±0.02^{ab}	0.77±0.01^{ab}	0.75±0.01^{ab}	0.98±0.02^{b}

Note: Numbers accompanied by different lowercase letters (superscripts) indicate a significant difference ($\rho < 0.05$)

stevia added, and this has a significant effect on the viscosity value in all formulations ($\rho < 0.05$).

In contrast with previous research by Evadewi and Tjahjani (2021), which showed that the addition of black rice extract reduced yogurt viscosity because it has a low glucose content, even though the fermentation process required sugar. The lower the sugar content, the higher the water activity, resulting in lower liquid viscosity. Furthermore, the viscosity of edamame soygurt can also be influenced by the addition of a stabilizer, CMC, at a fixed dose across all formulations. This CMC stabilizer is suitable for use in yogurt products because it is odorless, increases viscosity, and is soluble in both cold and hot water. The addition of CMC aims to prevent syneresis, the separation of solids from liquids (Hidayah et al., 2023).

Sensory characteristics analysis

This sensory test aimed to determine which soygurt sample was most acceptable to panelists when stevia was added as a sweetener. The results of the sensory characteristic analysis are available in Table 3.

Color

The results of the hedonic test based on color parameters show no significant differences among all formulations ($\rho > 0.05$). In line with Sari et al. (2022), there were no significant differences in color between the snack cup formulas, as they used the same ingredients and differed only slightly in the dosages of sucrose and stevia. F4 formulation was the most favored by panelists, with an average score of 4.03. Therefore, the bright green color of edamame soygurt is highly acceptable, supporting its potential as an innovative, visually appealing yogurt product. The decrease in color preference may be due to the fermentation process, which involves lactic acid bacteria that can make the soygurt paler (Pasca et al., 2016). The natural color of the soygurt in this study came from edamame. If the edamame used is not bright or has undergone color changes before processing, it will affect the final soygurt color. In line, other additives such as sugar or coloring can also contribute to color changes (Rahimi and Setiani, 2024). Sugar can affect the color of edamame yogurt through the Maillard reaction and caramelization that occur during heating. Sweeteners, both sucrose and stevia, can contribute to color and flavor changes, although stevia tends to be colorless (Widodo et al., 2015).

Aroma

Aroma plays a crucial role because it stimulates appetite and directly influences a person’s acceptance of a food (Parvin et al., 2024). Based on the hedonic test, the panelists preferred the aroma of the F3 formulation with an average score of 3.06. Statistical analysis revealed a significant difference compared to the control group (F0), whereas F1, F2, and F4 formulations showed no significant difference.

The addition of the natural sweetener stevia sugar increased panelists’ preference for the aroma of edamame soygurt because stevia can mask the sour odor, and panelists preferred soygurt with a milder sour aroma. In line with research by Rizal et al. (2019), which found that panelists disliked yogurt products with a strong sour odor. The addition of stevia sugar during yogurt fermentation can inhibit the growth of lactic acid bacteria and reduce the total acid produced, thereby reducing the sour odor of yogurt (Tandrian et al., 2021).

Lactobacillus bulgaricus forms a characteristic aroma by producing acetaldehyde, while *Streptococcus thermophillus* produces lactic acid, diacetyl compounds, and acetoin, which contribute to the taste of yogurt (Ge et al., 2024; Siddiqi et al., 2024; Zhao et al., 2024). The use of sweeteners such as sucrose and stevia

Table 3. Results of the edamame soygurt acceptability test analysis

Sensory attributes	Formulation				
	F0	F1	F2	F3	F4
Color	$3.92{\pm}0.69^{a}$	$3.67{\pm}0.72^{a}$	$3.69{\pm}0.86^{a}$	$3.92{\pm}0.60^{a}$	$4.03{\pm}0.71^{a}$
Aroma	$2.44{\pm}0.97^{a}$	$2.94{\pm}0.83^{b}$	$2.72{\pm}1.06^{ab}$	$3.06{\pm}0.95^{b}$	$3.00{\pm}1.17^{b}$
Taste	$2.56{\pm}1.00^{a}$	$3.28{\pm}1.06^{b}$	$3.25{\pm}1.05^{b}$	$3.25{\pm}1.02^{b}$	$3.36{\pm}1.07^{b}$
Texture	$3.17{\pm}1.00^{a}$	$3.42{\pm}0.87^{a}$	$3.28{\pm}1.00^{a}$	$3.39{\pm}0.87^{a}$	$3.22{\pm}1.05^{a}$
Overall	$2.69{\pm}0.95^{a}$	$3.36{\pm}0.90^{b}$	$3.17{\pm}1.06^{b}$	$3.44{\pm}0.73^{b}$	$3.39{\pm}1.02^{b}$

Note: Numbers with different lowercase letters (superscripts) indicate a significant difference ($\rho < 0.05$). The numbers in the table indicate: 1 = Strongly dislike, 2 = Dislike, 3 = Neutral, 4 = Like, and 5 = Strongly like in edamame soygurt products significantly affects the aroma. Sugar tends to produce a more complex aroma than stevia (Schiatti-Sisó et al., 2023).

Taste

Streptococcus thermophilus and *Lactobacillus bulgaricus* in yogurt fermentation play a role as one of the bacterial starters that contribute to a distinctive taste (Ge et al., 2024; Siddiqi et al., 2024; Zhao et al., 2024). Yogurt has a sour taste due to several compounds, including lactic acid, acetic acid, and carbonyl compounds (acetaldehyde, acetone, acetoin, and diacetyl) (Papaioannou et al., 2021). Based on the hedonic test results for taste parameters, the F1 formulation was the most preferred by panelists, with the highest average value of 3.42, and the difference between F3 and F4 was significant. The lowest average was observed in the F0 formulation, where 100% sucrose tended to impart a dominant sour taste and could mask the distinctive taste of edamame. In line with research by Tandrian et al. (2021), which states that the addition of natural sweeteners from stevia leaves can increase the level of taste preference in cocogurt, because the addition of natural sweeteners from stevia leaves can provide a sweet taste that panelists prefer. The combination of stevia and sucrose can serve a more balanced taste. The addition of stevia will produce a lighter sweetness in the yogurt and increase acceptance by panelists. The addition of stevia, as a natural sweetener, can reduce sourness and add sweetness to yogurt products (Bilgiç and Seyrekoğlu, 2025). Furthermore, the purpose of adding stevia to edamame yogurt is to create a product that can be adapted for patients with diabetes mellitus, as stevia has no calories.

Texture

Generally, plant-based yoghurt has problems with texture and stability (Zhang et al., 2024). The use of sucrose and stevia sweetener can affect the organoleptic properties of yogurt, including texture. The fermentation process also causes coagulation, which affects yogurt’s texture. Based on the hedonic test, the texture parameter results showed that panelists preferred formula F4 the most, with the highest average value of 3.36. However, there was no significant difference between the formulation groups ($\rho < 0.05$). Edamame soygurt in the F4 formulation had the thickest texture. Tandrian et al. (2021) state that the addition of natural sweeteners from stevia leaves can increase the level of preference for the texture of cocogurt because of the addition of natural sweeteners from stevia leaves, which can increase the viscosity of cocogurt. In addition, panelists also prefer cocogurt with a thick texture. Stevia sweetener contains sugar molecules that can bind water, thereby increasing the viscosity of edamame soygurt compared to regular sugar (Ramadhan et al., 2024). However, the addition of CMC as a thickener and stabilizer can also contribute to the formation of a thick texture in edamame soygurt (Forena et al., 2024).

The best formulation

The best edamame soygurt formulation was determined using the Exponential Comparison Method (ECM) based on isoflavone content, pH, viscosity, and hedonic tests (Makkiyah et al., 2025). Each parameter was assigned a different weighting, reflecting the key parameters highlighted in this study. The best formula was determined by dividing the weighting equally between hedonic and physical and chemical properties (50% each). Hedonic consists of 5 aspects (color, aroma, texture, taste, and overall), each weighing 10%. Meanwhile, the physical and chemical properties consist of 3 factors (isoflavone, pH, and viscosity), each accounting for 16.66%. The best formulation was selected by multiplying the value and scale of each parameter. The highest ranking was designated as the best formulation (Makkiyah et al., 2025).

Based on the results, F0 formulation (ranking 5) has a score of 1.87, a score of 3.27 for F1 formulation (ranking 2), a score of 2.60 for F2 formulation (ranking 3), a score of 3.23 for F3 formulation (ranking 4), and a score of 3.53 for F4 formulation (ranking 1) (Table 4). These results indicate that the addition of 100% stevia (F4) provides the best perception for panelists across isoflavones, viscosity, aroma, texture, taste, and overall acceptability compared to pure sucrose. This combination of alternative sweeteners not only maintains sensory characteristics but can also increase the functional value of edamame soygurt. The production of yogurt using stevia as a natural sweetener has 200 to 300 times the sweetness of sucrose but has no caloric content, making it safer for people with diabetes (Sakthivel and Kumar, 2025).

Table 4. Results of determining the best formulation of edamame soygurt

Parameter	Value (%)	Component alternative scores									
		F0		F1		F2		F3		F4	
		SL	SC	SL	SC	SL	SC	SL	SC	SL	SC
Isoflavone	16.66	5	0.83	2	0.33	1	0.17	4	0.67	3	0.50
pH	16.66	1	0.17	4	0.67	5	0.83	2	0.33	3	0.50
Viscosity	16.66	1	0.17	4	0.67	3	0.50	2	0.33	5	0.83
Color	10.00	3	0.30	1	0.10	2	0.20	3	0.30	4	0.40
Aroma	10.00	1	0.10	3	0.30	2	0.20	5	0.50	4	0.40
Taste	10.00	1	0.10	3	0.30	2	0.20	2	0.20	4	0.40
Texture	10.00	1	0.10	5	0.50	3	0.30	4	0.40	2	0.20
Overall	10.00	1	0.10	4	0.40	2	0.20	5	0.50	3	0.30
Total score	100.00		1.87		3.27		2.60		3.23		3.53
Ranking		5		2		3		4		1	

Note: The lowest scale is 1, the highest scale is 4. The score is obtained by multiplying the value and rank of each parameter. SL = Scale; SC = Score

CONCLUSIONS

The formulation with the highest isoflavone content, viscosity, and the most acidic pH was the F0 formulation. The results of the best formulation test based on panelist perceptions of all aspects, both hedonic and physical and chemical properties, showed that F4 was the formulation most preferred by the majority of panelists. The addition of stevia sweetener to edamame soygurt inhibits lactic acid production, resulting in a higher pH and causing no significant increase in isoflavone content. Furthermore, the addition of stevia significantly increased panelists' preferences for color, aroma, texture, taste, overall, and nutritional value, making it a functional food alternative for people with diabetes. Further research can be conducted by combining stevia with other natural sweeteners to balance flavor and support bacterial growth. Storage stability testing and its effects on sensory quality, pH, and live bacterial counts are also essential to optimize the substitution of stevia and other sweeteners in functional yogurt.

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