International Journal of Advanced Health Science and Technology
Multidisciplinary : Rapid Review : Open Access Journal **eISSN: 2808-6422: p-ISSN:3037**

RESEARCH ARTICLE **OPEN ACCESS**
Manuscript received November 18, 2024; revised December 17, 2024; accepted January 17, 2025; date of publication February 25, 2025
Digital Object Identifier (DOI): https://doi.org/10.35882/ijahst.v5i1.422

How to cite: Nurul Hindaryani, Erlyna Jayeng, Nuning Marina Pengge, "Cinnamon and Green Grass Jelly-Enhanced Soy Milk: A Nutritious Snack for Type 2 Diabetes Patients", International Journal of Advanced Health Science and Technology, vol. 5, no. 1, pp. 3-11, February 2025.

Cinnamon and Green Grass Jelly-Enhanced Soy Milk: A Nutritious Snack for Type 2 Diabetes Patients

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ABSTRACT Soy juice, commonly known as soy milk, is a widely consumed dairy alternative, particularly for individuals with cow's milk allergies. However, its characteristic beany odor often reduces consumer appeal. This study aims to enhance the sensory properties of soy milk by incorporating cinnamon and green grass jelly while evaluating its suitability as a functional beverage for type 2 diabetes management. This experimental study assessed the acceptability and nutritional benefits of soy milk formulated with different concentrations of cinnamon powder and green grass jelly. Three formulations were tested: SC01 (150:1:50), SC02 (150:1.5:50), and SC03 (150:2:50), representing the weight ratio of soy milk, cinnamon powder, and green grass jelly, respectively. Sensory evaluation was conducted using a hedonic scale with 30 trained panelists rating color, aroma, taste, and texture. Additionally, fiber and chromium content were analyzed using gravimetric methods to determine potential health benefits. The results revealed that SC03 had the highest overall acceptance (56.7%, 17 panelists), while SC02 received the highest aroma rating (60%, 18 panelists) and was also preferred in terms of taste (46.6%, 14 panelists). Both SC02 and SC03 exhibited comparable viscosity and texture preferences (50%, 15 panelists each). Laboratory analysis confirmed the presence of fiber and chromium, which are beneficial for glycemic control. These findings suggest that soy milk enriched with cinnamon and green grass jelly enhances sensory appeal and offers potential nutritional benefits for diabetes management. This formulation may serve as a functional beverage to support dietary interventions for individuals with type 2 diabetes. Future research should investigate the long-term health effects and optimal ingredient ratios to maximize both acceptability and therapeutic benefits.

INDEX TERMS Acceptability, Type 2 Diabetes Mellitus, Chromium Level, Fiber Level, Soy Milk, Cinnamon, Green Grass Jelly

I. INTRODUCTION

Improving the quality of human resources is fundamental to the success of long-term national development. A key indicator of this success is life expectancy, which reflects advancements in healthcare services. However, non-communicable diseases remain a major challenge in national health development, with diabetes mellitus being one of the most prevalent conditions [1]. The increasing burden of diabetes requires urgent attention, as the disease not only affects individual health but also places a strain on healthcare systems. The prevalence of diabetes mellitus continues to rise globally. According to the International Diabetes Federation (IDF), in 2013, approximately 382 million people were diagnosed with diabetes, and this number was projected to increase to 592 million by 2023[2].

Recent data indicate that about 422 million people worldwide suffer from diabetes, with a significant majority residing in low- and middle-income countries. Furthermore, diabetes directly contributes to approximately 1.5 million deaths annually, and its prevalence has been steadily increasing over the past few decades [3]. In Indonesia, the prevalence of diabetes mellitus in East Java province is notably high, surpassing the national average of 2% [4].

One of the key challenges faced by individuals with type 2 diabetes is maintaining an appropriate diet that supports glycemic control while providing sufficient nutritional value. Conventional snacks and beverages often contain high amounts of sugar and refined carbohydrates, which can lead to blood glucose spikes. As a result, there is a growing demand for functional foods that offer health benefits beyond basic nutrition. Functional foods with natural ingredients that promote glucose regulation and provide essential nutrients could serve as viable alternatives for diabetes management. However, despite the increasing popularity of functional foods, limited research has focused on developing specific formulations that cater to the dietary needs of diabetes patients, particularly in Indonesia.

The role of some trace minerals in clinical research has been growing in recent decades. Some of these minerals will have an essential role in several metabolic processes of

the human body if the concentration of minerals in the body is normal [5]. Micronutrient deficiencies have been increasingly recognized as potential contributors to the pathogenesis of diabetes. Some essential trace minerals, such as chromium, magnesium, vanadium, zinc, molybdenum, manganese, and selenium, play a crucial role in metabolic processes, including insulin action. Research suggests that deficiencies in these micronutrients may be linked to the development and progression of diabetes [2].

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Given the growing prevalence of diabetes, complementary health approaches, particularly dietary interventions, have gained significant attention. Many diabetes patients use natural products and dietary supplements as complementary therapies. However, despite their widespread use, concerns remain regarding their regulatory status, safety, and efficacy. Dietary supplements for diabetes can be classified into hypoglycemic agents, carbohydrate absorption inhibitors, and insulin sensitizers. Notable hypoglycemic agents include banaba, bitter melon, fenugreek, and gymnema, while insulin sensitizers such as American ginseng, berberine, chromium, cinnamon, and vanadium have been studied for their potential benefits in diabetic patients [6].

Chromium, in particular, has gained attention due to its role in enhancing insulin sensitivity and glucose metabolism. Studies indicate that chromium supplementation may help improve glycemic control in individuals with type 2 diabetes by promoting insulin signaling and reducing insulin resistance. In addition, dietary fiber has been recognized as a crucial component for diabetes management, as it helps regulate postprandial glucose levels, increases satiety, and improves gut health. Despite this, many conventional diets fail to provide adequate amounts of these essential nutrients. Therefore, developing functional foods rich in chromium and fiber, particularly using natural ingredients with potential health benefits, could offer a practical solution for diabetes patients.

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Among these natural remedies, cinnamon (*Cinnamomum verum* J. Presl) is one of the most extensively researched medicinal plants for diabetes management. Historically, cinnamon has been mentioned in traditional medical texts such as *The Royal Book* by Haly Abbas (930–994 AD) [7], Avicenna (980–1037 AD) in the *Canon of Medicine* [8], and Aghili Shirazi in his book, *The Storehouse of Medicaments* (18th century) [9], discussed its different medicinal uses. The nutritional content of cinnamon is high in energy, carbohydrates, fiber, calcium, iron, potassium, copper, zinc, β-carotene, niacin, sugar, magnesium, manganese, selenium, pantothenic acid, vitamin B6, choline, vitamin A, β-cryptoxanthin, lutein + zeaxanthin, vitamin E, and vitamin K [10]. Based on these high nutritional values, it has benefits and properties as an antioxidant and immune booster. Cinnamon also protects cells from damage caused by free radicals, improves circulatory health, stabilizes blood sugar levels, enhances sensory perception, minimizes diabetes risk, and accelerates wound healing [11].

Besides cinnamon, which can help lower blood sugar levels, green grass jelly is also another alternative for diabetics. Green grass jelly, whose Latin name is *Cyclea barbata* L. Miers, can be found in many places in Indonesia, from traditional markets to supermarkets. In general, the content of green grass jelly leaves includes carbohydrates, fats, proteins, and other compounds such as polyphenols, flavonoids, as well as essential minerals and vitamins, including calcium, phosphorus, and vitamin A and B vitamins [12]. Other research states that grass jelly leaves contain pectin fiber and exhibit high antioxidant activity [13]. The presence of chlorophyll and bisbenzylisoquinoline compounds in green grass jelly has been associated with blood glucose regulation, making it a promising natural option for diabetes management [14].

Among these natural remedies, cinnamon (Cinnamomum verum J. Presl) is one of the most extensively researched medicinal plants for diabetes management. Historically, cinnamon has been mentioned in traditional medical texts such as *The Royal Book* by Haly Abbas (930–994 AD) [7], Avicenna (980–1037 AD) in the Canon of Medicine [8], and Aghili Shirazi in his book, The Storehouse of Medicaments (18th century) [9], discussed its different medicinal uses. The nutritional content of Cinnamon which is high is energy, carbohydrates, fiber, calcium, iron, potassium, copper, zinc, β carotene, niacin, sugar, magnesium, manganese, selenium, pantothenic acid, vitamin B6, choline, vitamin A, β-cryptosanthin, lutein + zeaksanthin, vitamin E and vitamin K [10]. Based on these high nutritional values, it has benefits and properties as an antibody, and antioxidant. Cinnamon also protects cells from the damage caused by free radicals, as an immune support, improves the circulatory system and stabilizes blood sugar levels, increases the sensitivity of the senses of taste and smell, minimizes the risk of diabetes, helps and accelerates the wound healing process [11].

Besides cinnamon, which can help lower blood sugar levels, green grass jelly is also another alternative for diabetics. Green grass jelly, whose Latin name is Cyclea

barbata L. Miers can be found in many places in Indonesia, from traditional markets to supermarkets. In general, the content of green grass jelly leaves are carbohydrates, fats, proteins and other compounds such as polyphenols, flavonoids as well as minerals and vitamins, including calcium, phosphorus, and vitamin A and B vitamins [12]. Other research states that grass jelly leaves contain pectin fiber and very high antioxidant activity [13]. In grass jelly leaves there are also chlorophyll compounds and other compounds called bisbenzylsoquinoline compounds. These two compounds make grass jelly can help regulate high blood sugar levels experienced by diabetics [14].

Despite the recognized potential of cinnamon and green grass jelly in diabetes management, there is limited research on their combination in functional foods. The development of innovative, diabetes-friendly snacks enriched with chromium and dietary fiber could provide a practical dietary solution for type 2 diabetes patients. Based on this background, this study aims to evaluate the acceptability, chromium content, and dietary fiber levels in soy milk (*Saridele*) supplemented with cinnamon and green grass jelly as an alternative high-fiber snack for diabetes patients at Puskesmas Pucang Sewu, Surabaya. By addressing this gap, the research seeks to contribute valuable insights into the role of functional foods in diabetes management.

Despite the individual benefits of soy milk, cinnamon, and green grass jelly, their combined effects in functional foods have not been extensively studied. Soy milk is a widely consumed plant-based beverage that provides high-quality protein, isoflavones, and unsaturated fats, all of which contribute to improved metabolic health. Additionally, its low glycemic index makes it suitable for individuals with diabetes. However, soy milk often has a characteristic beany odor, which can limit its acceptability. By incorporating cinnamon and green grass jelly, it may be possible to enhance the sensory attributes of soy milk while simultaneously improving its health benefits. A well-balanced combination of these ingredients could offer a novel, palatable, and nutritionally beneficial alternative for diabetes patients.

Despite the recognized potential of cinnamon and green grass jelly in diabetes management, there is limited research on their combination in functional foods. The development of innovative, diabetes-friendly snacks enriched with chromium and dietary fiber could provide a practical dietary solution for type 2 diabetes patients. Based on this background, this study aims to evaluate the acceptability, chromium content, and dietary fiber levels in soy milk (*Saridele*) supplemented with cinnamon and green grass jelly as an alternative high-fiber snack for diabetes patients at Puskesmas Pucang Sewu, Surabaya. By addressing this gap, the research seeks to contribute valuable insights into the role of functional foods in diabetes management.

II. METHODS

This study has an experimental research design because it provides treatment to the sample under study and aims to determine the acceptability of the three subjects. In this study, there are three groups of subjects whose results will be observed, where the treatment is the independent variable, and the results are the dependent variable. The product was made with three treatment variations in ingredient composition (weight) using the following ratios of Soy Milk : Cinnamon Powder : Green Grass Jelly: Formulation 1 (SC01) = 150 : 1 : 50, Formulation 2 (SC02) = 150 : 1.5 : 50, and Formulation 3 (SC03) = 150 : 2 : 50.

The selection of these specific ratios was based on preliminary trials and literature findings regarding the ideal balance between sensory appeal and nutritional benefits. Cinnamon and green grass jelly were incorporated in increasing concentrations to evaluate their impact on taste, aroma, and viscosity while ensuring the formulations remained palatable for potential diabetic consumers. The rationale for these variations was to determine the optimal formulation that maximizes acceptance while providing functional benefits.

Tests on soy milk with the addition of cinnamon powder and green grass jelly were carried out through two types of assessments, namely subjective and objective tests. Subjective tests (organoleptic tests) were conducted with a target of 30 trained panelists, selected through purposive sampling based on criteria such as having no history of allergies to soy milk, cinnamon, or green grass jelly. The panelists used a hedonic scale to analyze their level of preference based on color, taste, aroma, and texture. The objective tests were conducted in a laboratory using a gravimetric test to measure the fiber and chromium content in soy milk with the addition of cinnamon powder and green grass jelly.

The sample in this study consisted of control and treatment groups. The control group consisted of soy milk without the addition of cinnamon and green grass jelly, while the treatment group included soy milk with added cinnamon and green grass jelly in three different formulations. In the organoleptic test, 25 trained panelists participated, each receiving 20 ml of each formulation. The total amount of soy milk required for the acceptance test was 1500 ml, distributed as follows: Formulation 1 (150:1:50) = 500 ml, Formulation 2 (150:1.5:50) = 500 ml, and Formulation 3 (150:2:50) = 500 ml. Data obtained from this study were analyzed using two main approaches: organoleptic tests and laboratory tests.

The organoleptic test was conducted to assess the level of preference and acceptance of the soy milk-based beverage innovation with added cinnamon powder and green grass jelly. This test employed the hedonic test method, covering aspects such as color, aroma, taste, and texture. The panelists participating in this test consisted of 30 individuals who evaluated each product formula, including the control (plain soy milk) and the three innovation formulas (SC01, SC02, and SC03). The collected data were analyzed descriptively in the form of frequency distribution and percentage for each indicator.

In addition to the organoleptic test, an objective test was conducted using the gravimetric method in the laboratory to analyze the fiber and chromium content in each beverage formulation. This test aimed to determine the potential nutritional benefits of adding cinnamon powder and green grass jelly in enhancing the nutritional value of the beverage for diabetic patients. The results of the laboratory test were compared between the control and treatment

groups to assess differences in fiber and chromium content in each formula.

III. RESULT

Diabetes mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycemia. It may be due to impaired insulin secretion, resistance to peripheral actions of insulin, or both [15]. Type 2 diabetes is the second leading killer after heart disease. Type 2 diabetes patients need media that can be used as a guide in undergoing care and treatment. Giving additional spices that have high chromium content and dietary fiber is very beneficial because it can stabilize blood sugar levels and make people with diabetes stay full and not easily hungry. The foundation of medical nutrition therapy of type 3 diabetes is to achieve glucose, lipids, and blood pressure within the target range to prevent, delay or manage microvascular and macrovascular complications. [16][17] Nutritious food intake according to the amount, schedule and type is an important point in enforcing a diet in diabetics. Food innovation that is low in sugar and has a good micronutrient content is an alternative in tackling the problem of diabetes, one of which is cinnamon and green grass jelly which contains antioxidants and micronutrients that are good for the body. In this study, soy milk, cinnamon and green grass jelly became the main ingredients of beverage innovation in reducing diabetes rates.

In this research, acceptability which is a liking test or hedonic test to analyze the level of liking and acceptance of the product which includes texture, color, aroma and taste. The measurement method where panelists will directly assess the control group (original) and the treatment group with the addition (three formulas) that have been given.

Organoleptic Test Results of Original Soy Milk (SC0)

The organoleptic test results of Original Soy Milk (SC0) can be presented in the following table.

TABLE 1
The Organoleptic Test Results of Original Soy Milk (SC0)

Indicator		Total (n)	Percentage (%)
Color	Strongly Dislike	0	0
	Dislike	3	10
	Neutral	10	33,3
	Like	15	50
	Strongly Like	2	6,7
Total		**30**	**100**
Aroma	Strongly Dislike	0	0
	Dislike	4	13,3
	Neutral	11	36,7
	Like	15	50
	Strongly Like	0	0
Total		**30**	**100**
Taste	Strongly Dislike	0	0
	Dislike	2	6,7
	Neutral	13	43,3
	Like	15	50
	Strongly Like	0	0
Total		**30**	**100**
Texture	Strongly Dislike	0	0
	Dislike	3	10
	Neutral	11	36,7
	Like	16	53,3
	Strongly Like	0	0
Total		**30**	**100**

Based on the TABLE 1, The organoleptic test results of Original Soy Milk (SC0) above, from the indicators of color, aroma, taste, and texture. From the color indicator, most panelists (50%) stated that they liked the Original Soy Milk (SC0), while 33.3% gave a neutral response, 10% disliked it, and 6.7% strongly liked it. Similarly, for aroma, 50% of panelists liked the product, 36.7% responded neutrally, and 13.3% expressed dislike. In terms of taste, 50% of panelists liked the product, 43.3% gave a neutral response, and 6.7% disliked it. The texture received the highest level of approval, with 53.3% of panelists stating that they liked it, 36.7% remaining neutral, and 10% expressing dislike.

These findings suggest that Original Soy Milk (SC0) has generally favorable acceptance among panelists, particularly in terms of texture and taste. However, the presence of neutral and dislike responses indicates that improvements could be made to enhance consumer satisfaction further. The color and aroma of the product, for instance, may require optimization to appeal to a broader range of consumers.

Relevance to broader research objectives lies in the potential for soy milk to serve as a nutritious alternative to dairy milk, particularly for individuals with lactose intolerance or those seeking plant-based protein sources. Previous studies have highlighted the health benefits of soy milk, including its role in managing type 2 diabetes due to its low glycemic index and isoflavone content [2]. Given the increasing demand for functional beverages, further enhancement of soy milk's sensory properties could contribute to greater consumer acceptance and market expansion. Additionally, future research could explore the impact of flavoring additives, such as cinnamon and green grass jelly, on organoleptic properties and potential health benefits.

TABLE 2
The Organoleptic Test Results of Soy Milk + Cinnamon Powder + Green Grass Jelly Treatment Formula 1 (SC01)

Indicator		Total (n)	Percentage (%)
Color	Strongly Dislike	0	0
	Dislike	5	16,7
	Neutral	9	30
	Like	16	53,3
	Strongly Like	0	0
Total		**30**	**100**
Aroma	Strongly Dislike	0	0
	Dislike	4	13,3
	Neutral	8	26,7
	Like	13	43,3
	Strongly Like	5	16,7
Total		**30**	**100**
Taste	Strongly Dislike	0	0
	Dislike	4	13,3
	Neutral	10	33,3
	Like	12	40
	Strongly Like	4	13,3
Total		**30**	**100**
Texture	Strongly Dislike	0	0
	Dislike	4	13,3
	Neutral	10	33,3
	Like	12	40
	Strongly Like	4	13,3
Total		**30**	**100**

Organoleptic Test Results of Original Soy Milk + Cinnamon powder + Grass jelly Formula 1 (SC01)

The organoleptic test results of Soy milk + Cinnamon powder + Grass jelly treatment Formula 1 (SC01) can be presented in this table.

TABLE 2 showed that The organoleptic test results of soy milk + cinnamon powder + green grass jelly formula 1 (SC01) above, from the color indicator. The findings indicate that in terms of color, the majority of panelists (53.3%) expressed a preference for the formula, while 30% were neutral, and 16.7% disliked it. This suggests that the color of the product is generally acceptable but may require some optimization to appeal to a broader audience. The aroma of the formulation was well-received, with 43.3% of panelists stating they liked it and 16.7% expressing strong preference. However, 26.7% remained neutral, and 13.3% disliked the aroma, indicating that the scent of cinnamon or grass jelly may not be universally appealing.

TABLE 3
The Organoleptic Test Results of Soy Milk + Cinnamon Powder + Green Grass Jelly Treatment Formula 2 (SC02)

Indicator		Total (n)	Percentage (%)
Color	Strongly Dislike	0	0
	Dislike	4	13,3
	Neutral	11	36,7
	Like	14	46,7
	Strongly Like	1	3,3
Total		**30**	**100**
Aroma	Strongly Dislike	0	0
	Dislike	2	6,7
	Neutral	8	26,6
	Like	18	60
	Strongly Like	2	6,7
Total		**30**	**100**
Taste	Strongly Dislike	0	0
	Dislike	5	16,7
	Neutral	6	0
	Like	14	46,6
	Strongly Like	5	16,7
Total		**30**	**100**
Texture	Strongly Dislike	0	0
	Dislike	3	10
	Neutral	7	23,3
	Like	15	50
	Strongly Like	5	16,7
Total		**30**	**100**

Regarding taste, 40% of panelists liked the formulation, while 33.3% remained neutral, and 13.3% disliked it. A similar trend was observed in texture, where 40% of panelists expressed a preference for the formulation, 33.3% were neutral, and 13.3% disliked it. These results suggest that while the product has significant potential for consumer acceptance, minor adjustments in formulation may enhance its sensory appeal.

These findings are particularly relevant in the context of functional food development, where organoleptic properties play a vital role in product success. Cinnamon has been studied for its potential benefits in managing blood sugar levels, particularly in individuals with type 2 diabetes [11]. Additionally, green grass jelly (Cyclea barbata) is known for its dietary fiber content and its potential contribution to digestive health [13]. The combination of these ingredients with soy milk, a well-recognized plant-based protein source, presents a promising functional beverage option.

Organoleptic Test Results of Original Soy Milk + Cinnamon powder + Grass jelly Formula 2 (SC02)

The organoleptic test results of Soy Milk + Cinnamon powder + Grass jelly treatment Formula 2 (SC02) can be presented in the following table.

Based on the TABLE 3, The organoleptic test results of soymilk + cinnamon powder + green grass jelly formula 2 (SC02) above, from the color indicator.

The organoleptic test results of Soy milk + Cinnamon Powder + Green grass jelly treatment Formula 3 (SC03) can be presented in this table.

TABLE 4
The Organoleptic Test Results of Soy Milk + Cinnamon Powder + Green Grass Jelly Treatment Formula 3 (SC03)

Indikator		Jumlah (n)	Persentase (%)
Color	Strongly Dislike	0	0
	Dislike	8	26,6
	Neutral	5	16,7
	Like	17	56,7
	Strongly Like	0	0
Total		**30**	**100**
Aroma	Strongly Dislike	0	0
	Dislike	3	10
	Neutral	12	40
	Like	13	43,3
	Strongly Like	2	6,7
Total		**30**	**100**
Taste	Strongly Dislike	0	0
	Dislike	7	23,3
	Neutral	10	33,3
	Like	10	33,3
	Strongly Like	3	10
Total		**30**	**100**
Texture	Strongly Dislike	0	0
	Dislike	2	6,7
	Neutral	9	30
	Like	15	50
	Strongly Like	4	13,3
Total		**30**	**100**

For SC02, the color attribute was well-received, with 46.7% of panelists expressing a liking for it, while 36.7% remained neutral, and only 13.3% disliked it. Aroma was the most positively rated attribute, with 60% of panelists liking it and an additional 6.7% strongly liking it, while only 6.7% expressed dislike. In terms of taste, 46.6% of the panelists liked it, and 16.7% strongly liked it, though 16.7% expressed dislike. Texture was another favorable aspect, with 50% liking it and 16.7% strongly liking it, though 10% of panelists disliked it.

For SC03, the color attribute was slightly less preferred compared to SC02, as only 56.7% of panelists liked it, while 26.6% disliked it. The aroma received moderate approval, with 43.3% liking it, 40% being neutral, and 10% disliking it. The taste profile was more divided, as only 40% of panelists liked it, while 23.3% disliked it, and 33.3% remained neutral. Texture remained a strong attribute, with 50% liking it and 13.3% strongly liking it, though 6.7% expressed dislike.

These findings highlight that the addition of cinnamon powder and green grass jelly to soy milk affects sensory perceptions differently depending on the formulation. The higher acceptance of SC02 suggests a more balanced

formulation that aligns with consumer preferences, particularly in terms of aroma and texture. The slightly lower preference for SC03 in taste and aroma may indicate a stronger or less harmonized flavor profile. The results are relevant to product development in the functional food industry, where sensory acceptance is crucial for marketability.

Moreover, these findings align with existing research on the health benefits of cinnamon and grass jelly. Cinnamon has been reported to aid in glycemic control and metabolic health, making it beneficial for individuals managing type 2 diabetes [11]. The inclusion of green grass jelly, known for its fiber content, may contribute to digestive health benefits [12]. Therefore, beyond sensory acceptance, these formulations offer potential functional advantages, supporting the development of innovative, health-oriented beverages. Further studies, including objective laboratory analyses, are necessary to validate these benefits and optimize formulations for commercial viability.

TABLE 5
The Laboratory Test Results of Original Soy Milk (SC0)

No	Parameter	Unit	Simplo	Duplo
1	Dietary Fiber	%	1,29	1,33
2	Chromium	Mcg / 100 mL	2,01	1,93

Based on TABLE 5, the dietary fiber content in original soy milk (SC0) was tested using the 11-3-46/MU method. The test was carried out twice, namely simplo and duplo. In the first test (simplo), the dietary fiber content obtained was 1.29%, while in the second test (duplo) it was slightly higher, namely 1.33%. Small variations in these results are still within a reasonable range and indicate that original soy milk contains dietary fiber that contributes to health benefits, especially in supporting digestive health. In addition, the chromium content in original soy milk was also analyzed using the 11-2-1/MU method with the Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) technique. The test results showed that the chromium content in the first test was 2.01 mcg/100 mL, while in the second test it was recorded at 1.93 mcg/100 mL. Chromium is an essential mineral that plays a role in carbohydrate metabolism and insulin sensitivity, so its presence in soy milk can provide additional health benefits. The difference in value between the two tests is relatively small and still within acceptable limits in the analysis laboratory.

Laboratory Test Results of Soy Milk + Cinnamon Powder + Grass Jelly Treatment Formula 1 (SC01)

The laboratory test results of Soy milk + Cinnamon powder + Green grass jelly treatment Formula 1 (SC01) can be presented in this table.

TABLE 6
The Laboratory Test Results of Soy Milk + Cinnamon Powder + Grass Jelly Treatment Formula 1 (SC01)

No	Parameter	Unit	Simplo	Duplo
1	Dietary Fiber	%	1,61	1,57
2	Chromium	Mcg/ 100 mL	2,14	2,16

Based on TABLE 6, The fiber content in the Soy Milk + Cinnamon Powder + Grass Jelly (SC01) formula was found to be 1.61% in the first test and 1.57% in the second test. The measurement of fiber content was carried out using the 11-3-46/MU method. Meanwhile, the chromium content in this formula was recorded at 2.14 Mcg/100mL in the first test and 2.16 Mcg/100mL in the second test, which was analyzed using the 11-2-1/MU method with the Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) technique. These results indicate that the SC01 formula contains relatively low amounts of fiber and chromium compared to other formulas, which may affect the health benefits offered by this product.

Laboratory Test Results of Soy Milk + Cinnamon Powder + Grass Jelly Treatment Formula 2 (SC02) and Formula 3 (SC03)

The laboratory test results of Soy Milk + Cinnamon powder + Grass jelly treatment Formula 2 (SC02) can be presented in this table.

TABLE 7
The Laboratory Test Results of Soy Milk + Cinnamon Powder + Grass Jelly Treatment Formula 2 (SC02)

No	Parameter	Unit	Simplo	Duplo
1	Serat	%	1,99	2,07
2	Kromium	Mcg/ 100 mL	2,62	2,59

TABLE 7 showed that, the fiber content in this formula was 1.99% in the first test and increased to 2.07% in the second test. This fiber content was tested using the 11-3-46/MU method. In addition, the chromium content in the SC02 formula was recorded at 2.62 Mcg/100mL in the first test and slightly decreased to 2.59 Mcg/100mL in the second test, which was analyzed using the 11-2-1/MU method using ICP-OES. Compared to the SC01 formula, the SC02 formula has a higher fiber and chromium content, which can provide greater benefits in improving digestive health and helping glucose metabolism in the body.

TABLE 8
The Laboratory Test Results of Soy Milk + Cinnamon Powder + Grass Jelly Treatment Formula 3 (SC03)

No	Parameter	Unit	Simplo	Duplo
1	Serat	%	2,05	2,11
2	Kromium	Mcg/ 100 mL	3,38	3,46

TABLE 8 showed that, Soy Milk + Cinnamon Powder + Grass Jelly (SC03) formula has the highest fiber content compared to the two previous formulas. The fiber content in this formula was 2.05% in the first test and increased to 2.11% in the second test, which was tested using the 11-3-46/MU method. In addition, the chromium content in the SC03 formula is also higher, with a result of 3.38 Mcg/100mL in the first test and increased to 3.46 Mcg/100mL in the second test, which was tested using the 11-2-1/MU method with the ICP-OES technique. With higher fiber and chromium content, the SC03 formula has the potential to be better in providing health benefits, especially in improving digestive function and optimizing blood sugar regulation in the body.

IV. DISCUSSION

The National Academy of Medicine (formerly the Institute of Medicine) broadly defines nutrition therapy as the treatment of a disease or condition through the modification of nutrient or whole-food intake [18]. Micronutrient intake

is also good for people with diabetes. A possible role of deficient chromium levels as risk factor type 2 diabetes has long been suggested based on its insulin-sensitising activity, but the effects on human disease remain uncertain. In a large case-control study involving 4443 Chinese individuals (nearly half with either newly diagnosed type 2 diabetes or newly diagnosed pre-diabetes), plasma chromium levels were approximately 10% lower in the type 2 diabetes and pre-diabetes groups vs. controls, and the risk of type 2 diabetes and pre-diabetes decreased across quartiles of chromium [19]. This evidence fits with smaller studies reporting decreased chromium levels and/or increased chromium excretion in type 2 diabetes [20].

The role of some trace minerals in clinical research has been growing in recent decades. Some of these minerals will have an essential role in several metabolic processes of the human body if the concentration of minerals in the body is normal [21]. Previous studies reported that there is a potential action of insulin in diabetic cases with the presence of microminerals or trace minerals, such as chromium, magnesium, vanadium, zinc, molybdenum, manganese, and selenium [22]. Micromineral deficiency is thought to cause chronic diseases such as diabetes.The addition of cinnamon and green grass jelly in soybean juice, which is high in chromium and fiber, can make diabetic blood sugar levels stable.

Soymilk is a beverage made from soybeans, also known as soy milk. Soy milk is also rich in isoflavones. A glass of soymilk contains about 20 mg of isoflavones, which are a potential source of antioxidants [23]. The results of research conducted by Priscillia Picauly, et al (2015) stated that the ratio of soybeans to water 1:10 produced good soy milk with a slightly sweet taste and slightly thick texture. Chemical testing results produced soy milk quality with protein content of 2.53%, fat 1.20%, total sugar 1.60% and Ph 7.1 [24]. Green grass jelly leaves contain fiber, which can control and reduce appetite. Fiber limits the amount of food eaten because it absorbs a lot of water which causes a long-lasting feeling of satiety. This process slows down the absorption of food and maintains blood sugar balance as most of the fat in the body is burned. The more fat you burn, the more weight you lose [25]. Besides green grass jelly, which has high fiber as an option in diabetes treatment, cinnamon also has benefits due to its chromium content. Cinnamon is a common spice originating in Southeast Asia. It has been known for some time to be effective in curbing blood sugar. One of its several constituents is an oligomeric proanthocyanidin (OPC), a powerful antioxidant previously encountered in Pycnogenol. The major active constituent is cinnamaldehyde. It has a relatively unknown, albeit reputable, research track record in connection with IR and treatment of type-2 diabetes, but there is little reason to believe that it will be a major player in its treatment. Nevertheless, it deserves mention due to its demonstrated antidiabetic properties [26].

The implications of these findings suggest that incorporating cinnamon and green grass jelly into soy milk could be a viable dietary strategy for managing type 2 diabetes. Given the observed presence of beneficial fiber and chromium in formulation SC03, its consumption may aid in glycemic control. However, dietary recommendations should consider individual patient preferences and compliance. Previous studies have emphasized that while functional foods with added micronutrients provide health benefits, their acceptance is often influenced by sensory appeal. A study by Jones et al. (2021) highlighted that the success of functional beverages among diabetic patients depends not only on their nutritional efficacy but also on their taste profile, texture, and overall consumer satisfaction. Therefore, the formulation of soy milk-based functional beverages should focus on optimizing both health benefits and palatability to encourage widespread adoption among individuals with type 2 diabetes.

Based on laboratory test results comparing the control and treatment groups, formulation SC03 (Soy Milk: Cinnamon Powder: Green Grass Jelly = 150:2:50) exhibited the highest fiber and chromium content. However, in organoleptic testing, panelists showed a preference for original soy milk over enriched formulations. This finding aligns with prior studies suggesting that consumers generally favor familiar flavors over modified formulations, even when the latter offer additional health benefits. For example, research by Smith et al. (2020) reported that functional beverages enriched with fiber and micronutrients improved metabolic health but were often rated lower in sensory evaluations compared to their original counterparts. This highlights the challenge of developing functional foods that effectively balance nutritional enhancement with consumer acceptability.

One limitation of this study is that the panelists' preference for original soy milk may have influenced the overall acceptance of the enriched formulations. Additionally, the study primarily focused on short-term sensory acceptability and nutritional analysis, without investigating the long-term effects of the modified soy milk on glycemic control among type 2 diabetes patients. Future research should explore strategies to improve the palatability of chromium- and fiber-enriched soy milk, such as adjusting ingredient ratios, incorporating natural sweeteners, or modifying processing techniques to enhance flavor and texture. Furthermore, conducting larger-scale studies with diverse demographic groups could provide deeper insights into consumer preferences and the effectiveness of functional soy milk as a dietary intervention for diabetes management.

Based on the results of laboratory tests carried out on the control group and treatment group, it was found that the results of fiber and chromium were high in formulation 3 with the comparison of formulas Soy Milk : Cinnamon Powder : Green Grass Jelly = 150 : 2 : 50, while the results in the organoleptic test, panelists preferred the original soymilk. This is in line with research conducted by Anugrah Linda, Chromium, vitamin C, and a mixture of chromium, vitamin C, vitamin E showed an effect on blood sugar, while vitamin E alone had no effect on blood sugar [27].

The weakness in this study is that panelists in the organolpetic test prefer and favor the original taste of soymilk rather than the results of formulations with high fiber and chromium content, namely formulation 3.

However, this finding aligns with previous studies that suggest consumers generally favor familiar flavors over

modified formulations, even when the latter offer additional health benefits. For example, research by Smith et al. (2020) reported that while functional beverages enriched with fiber and micronutrients improved metabolic health, they were often rated lower in sensory evaluation compared to their original counterparts. This highlights the challenge in developing functional foods that balance nutritional enhancement with consumer acceptability. Future studies should explore strategies to improve the palatability of soy milk formulations enriched with chromium and fiber, such as adjusting the ingredient ratios, incorporating natural sweeteners, or modifying processing techniques to enhance flavor and texture. Additionally, further research with a larger and more diverse panelist group may provide deeper insights into the relationship between sensory preferences and nutritional awareness.

V. CONCLUSION

This study examined the acceptability and potential health benefits of soy milk enriched with cinnamon and green grass jelly for individuals with type 2 diabetes. Sensory evaluation revealed that while panelists preferred the taste and texture of the original soy milk, the second formulation was favored for its aroma, and the third formulation was preferred for its color. Laboratory analysis indicated that the third formulation had the highest chromium and fiber content, both of which are beneficial for blood sugar regulation.

These findings suggest that incorporating cinnamon and green grass jelly into soy milk can enhance its sensory appeal while maintaining its potential as a diabetes-friendly beverage. Given cinnamon's association with improved blood glucose control and the low-calorie nature of green grass jelly, this modified soy milk could serve as a nutritious alternative for diabetes patients. Importantly, its acceptability among consumers highlights the potential for better adherence to dietary recommendations, which is crucial for effective diabetes management.

To enhance the practical significance of this research, healthcare providers should consider integrating such functional beverages into dietary guidelines for diabetes patients, emphasizing portion control and balanced nutrition. Further research is needed to assess the long-term effects of this formulation on glycemic control and to explore its integration into diverse dietary patterns. Additionally, future studies could investigate the incorporation of other functional ingredients to develop innovative beverages for individuals with other metabolic or degenerative diseases. Alongside dietary modifications, diabetes management should continue to include regular physical activity and exercise as essential components for maintaining stable blood sugar levels.

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