e-ISSN: 3030-878X

The 4th International Conference on Nutrition (ICON)

Acceptability and Fiber Content Analysis of Velva Javer (Red Guava (Psidium Guajava L.) with the Addition of Havermout (Avena Sativa) as an Alternative Snack for Patients with Diabetes Mellitus

Nadhiratur Rasyidah[1], Ani Intiyati[2*], Taufiqurrahman[3], Riezky Faisal Nugroho[4]
Department of Nutrition, Poltekkes Kemenkes Surabaya, Indonesia
***Corresponding author:** Triwi@poltekkesdepkes-sby.ac.id*

ABSTRACT
Diabetes mellitus is a condition where blood glucose levels >120 mg/dL. IDF re-ports that in 2021 the number of diabetes patients worldwide reach 537 million. Controlling diabetes risk factors can be done by implementing a healthy lifestyle. Fiber is crucial in regulating the diet of diabetic patients, fiber works by slowing the absorption of nutrients. Guava and havermout are one of the high-fiber food sources that play a role in diabetes management. Using a true experimental re-search design by giving treatment to samples, which then collected data obtained from organoleptic tests by 25 trained panelists. The data were analyzed using the Kruskal-Wallis test and subsequently the Mann-Whitney test. The gavimetric method was used to determine the fiber content. From the organoleptic test, the control formulation got the highest average of 4.06 and for the treatment formula-tion, formulation 2 with a value of 3.77. Formulation 2 has a higher fiber content with 2.02g/100g. While for the statistical test, there was a significant difference in the aroma indicator between the control formulation and the treatment formula-tion. Formulation 2 has the highest fiber content so that it can be used as an alter-native snack for diabetic patients.

Keywords: Diabetes Mellitus, Fiber, Red Guava, Havermout, Velva

INTRODUCTION

Diabetes mellitus, also known as diabetes, is a serious condition that occurs over a long period or is chronic. It occurs when blood glucose levels rise because the body can no longer produce insulin or cannot use the insulin produced effectively[1][2][3]. Someone who suffers from diabetes are at increased likelihood of developing numerous serious and potentially fatal diseases and health issues, leading to costly medical treatments, higher mortality rates, and diminished quality of life[4]. In 2021, the International Diabetes Federation (IDF) said that worldwide the number of adults aged 20 to 79 who suffer from diabetes mellitus is currently 537 million individuals. Projections for 2030 estimate that this number will reach 678 million, and is predicted to jump to 700 million by 2045. Additionally, 541 million people were estimated to have impaired glucose tolerance in 2021[5].

Diabetes is divided into two main types, the first being type 1 diabetes mellitus that arises from an autoimmune response to pancreatic islet cell proteins, so that the pancreas is no longer able to produce sufficient amounts of insulin. This causes hyperglycemia and ketosis, necessitating insulin replacement for proper management. The condition is most commonly diagnosed during puberty and early adulthood, although it can develop at any age[6][7]. And the second is Type 2 diabetes (T2DM) is one of the most widespread metabolic disorders around the world, mainly caused by two factors: inadequate insulin production by pancreatic β-cells and the resistance of insulin-sensitive tissues to insulin. The rise

in T2DM is largely attributed to the global ternds of age, body mass index (BMI), family history, physical activity level, exposure to smoke, hypertension, stress level, lifestyle, HDL cholesterol level, triglycerides, diabetes mellitus in pregnancy, history of abnormal glucose level, and other abnormalities[8].

The foundation of managing type 2 diabetes involves embracing a healthy lifestyle, which includes a maintaining a healthy weight, balanced diet, regular exercise, and quitting smoking[9]. The occurrence of diabetes can be prevented, delayed, or mitigated by managing risk factors. These risk factors are categorized into controllable and uncontrollable types. Uncontrollable factors include gender, race and ethnicity, age, and genetic predispositions. Controllable risk factors involve individual lifestyle choices, such as obesity, insufficient physical activity, dietary habits, a history of hypertension, cholesterol levels, and smoking[10][11]. When blood glucose levels remain elevated for an extended duration and are uncontrolled, it can lead to a variety of other health problems. Diabetes mellitus is frequently linked with complications such as macrovascular issues, including coronary heart disease, peripheral arterial disease, and stroke, as well as microvascular conditions like diabetic kidney disease, peripheral neuropathy, and retinopathy[12].

Fiber has been incorporated into healthy eating patterns and diabetes management strategies. Numerous studies have examined how a high-fiber diet affects mortality rates and how increased fiber intake influences glycemic control and other cardiometabolic risk factors in adults with prediabetes or diabetes[13]. Dietary fiber (DF) consists of plant-based substances that cannot be digested or absorbed by the small intestine but can be partially or fully fermented in the large intestine. It encompasses carbohydrates and their derivatives, including indigestible polysaccharides, oligosaccharides, and other related plant substances[14][15]. Different sources of DF have widely varying cell wall composition and structure, including characteristics such as porosity, cell separation or rupture, and viscosity. These factors influence nutrient bioaccessibility, the rate of gastric emptying, gastrointestinal transit time, as well as digestion and absorption rates of macronutrients. Additionally, fiber plays a role in encapsulating nutrients, with the cell wall often staying intact through chewing and various stages of digestion[16]. This mechanism involves structurally intact plant tissue being digested more slowly, which can also help reduce the rise in blood glucose levels after eating, though to a lesser degree[17].

Guava (Psidium guajava L.), often referred to as a "superfood," is gaining significant attention in the agro-food industry for its appealing fruit features, including health-enhancing bioactive compounds and functional components[18]. The fruit is abundant in nutrients and minerals, including vitamin C, vitamin A, and vitamin B, iron, calcium, dietary fiber, flavonoids, folic acid, thiamin, niacin, cyanogobalamin, pyridoxine, betasianin, phenolics, polyphenols, carotene, lycopene, and quercetin[19][20][21].

Havermout or often referred to as oats (Avena sativa) is a whole grain cereal that is mostly grown in continental Europe and America[22]. Havermout has gained a worldwide reputation as a healthy and nutritious food and as a valuable animal feed due to its high protein content[23]. They are a specialty product that has a good health record and history of use, especially in the field of dermatology. Recent developments in the field of food and nutrition reveal that havermout is part of a type of food source that contains a lot of vitamin B complex, vitamin E, protein, minerals, and functions as an antioxidant and anti-inflammatory[24]. The nutrients contained in havermout differ significantly from other types of cereals, with a high

protein content and an abundant amount of essential amino acids. Havermout contains a higher fat content (6-10%) compared to oats and other cereals (2-3%). Among cereals, oats have the highest fat content, predominantly consisting of unsaturated fats. Oats' high nutritional value is also attributed to their significant β-glucan content[25].

Velva is a type of frozen dessert made from fruits with a texture similar to ice cream. The advantages of velva over frozen foods are low fat content and rich in natural fiber derived from fruit. The nutritional content of the velva produced is highly dependent on the raw materials and has a distinctive flavor that distinguishes it from other types of products[26].

RESULT AND DISCUSSION

The research design used was true experimental. The location for making velva products and organoleptic tests took place at the Nutrition Department Laboratory of the Surabaya Health Polytechnic with the research time, namely October 2023 to May 2024. The population in this study were 25 people who were students of the Surabaya Health Polytechnic of the Ministry of Health nutrition department level 2 and 3. The samples used in the organoleptic test included 1 control form and 2 treatments with a ratio of 200 grams: 0 grams, 180 grams: 20 grams, 170 grams: 30 grams.

For the analysis of fiber content in javer velva products, the method used is the gavimetric method. In the fiber content test, the samples tested were the control formulation and one treatment formulation with the highest value in the organoleptic test results with 2 repetitions. Fiber content testing was carried out at Airlangga Research Hub, Airlangga University.

The results of the organoleptic test will be statistically tested using Kruskal Wallis to determine any differences in the variables. Then indicators that have differences in the results of the Kruskal Wallis test will be tested further using the Mann Whitney test to determine which sample groups have differences.The Root Mean Square (RMS) value denotes the average signal strength over an EMG sample window length. The following mathematical formula can be used to describe this property.

In the results of product manufacturing, the characteristics of each velva formulation can be observed based on indicators of color, aroma, texture, and taste which are presented in tabular form

Table 1. Characteristic of velva javer

Indicator	Formulation		
	JV 0 (Red guava : havermout) (200 : 0)	JV 1 (Red guava : havermout) (180 : 20)	JV 2 (Red guava : havermout) (170 : 30)
Colour	Deep pink	Pink	Slightly pale pink
Aroma	Typical red guava	Typical red guava with a hint of havermout aroma	Typical red guava with havermout aroma
Texture	Smooth and frozen	Smooth, slightly thicker, and frosty	Smooth, thicker, and frosty
Taste	Typical red guava	Typical red guava with a hint of creamy flavor from havermout	Typical red guava with creamy flavor from havermout

In the organoleptic test using the hedonic scale test to determine the level of favorability to 25 trained panelists can be seen in the table.

Table 2. Organoleptic test results

Indicator	Formulation		
	JV 0 (Red guava :	JV 1 (Jambu	JV 2 (Red

	havermout) (200 : 0)	merah : havermout) (180 : 20)	guava : havermout) (170 : 30)
Colour	4.12	3.76	3.84
Aroma	4.08	3.68	3.48
Texture	3.92	3.8	3.8
Taste	4.12	3.76	3.96
Average	4.06	3.75	3.77

Rating Criteria Description: (1) Very Dislike; (2) Dislike; (3) Neutral; (4) Like; (5) Very Like.

Based on table, the formulation of red guava velva with the addition of havermout, the results of liking with organoleptic test assessment (hedonic scale) with the highest mean value, namely the control formulation (JV 0) with a value of 4.06, while for the treatment formulation, the highest value is formulation 2 (JV 2) with a value of 3.77.

Table 3. Kruskall wallis test results

Indicator	Kruskal Wallis Test Values
Colour	0.143
Aroma	0.008
Texture	0.871
Taste	0.303

Based on table 3, the values of the Kruskal Wallis test on aroma indicators have a value ($p < 0.05$), indicating that there are differences in aroma indicators in the 3 velva javer formulations. Meanwhile, the values of the Kruskal Wallis test on color, texture, and taste indicators have a value ($p > 0.05$) which indicates that there are no differences in color, texture, and taste in the 3 velva javer formulations.

Table 4. Mann whitney test results

No.	Indicator	Mann Whitney Test Values		
		JV 0 : JV 1	JV 0 : JV 2	JV 1 : JV 2
1.	Aroma	0.030	0.003	0.327

Based on the table above, Mann Whitney test on aroma indicators of 3 formulations JV 0: JV 1, JV 0: JV 2, and JV 1: JV 2 have a value of ($p < 0.05$) so that H0 is rejected while H1 is accepted and there are differences in aroma in the 3 formulations.

Two javer velva formulations, namely the control formulation sample code JV 0 and from the outcomes sensory evaluation with the hedonic scale of the sample with the highest mean value, namely formulation 2 sample code JV 2, were subjected to laboratory tests related to the fiber content contained therein.

Table 5. Fiber content

No.	Code	Fiber (Average ± RPD) (%b/b)
1.	JV 0	1.13 ± 2.6
2.	JV 2	2.02 ± 0.7

Based on the table above, the velva formulation with the highest fiber content is formulation 2 (JV 2) with fiber content in every 100 grams of product, namely 2.02 g

Characteristics of Velva Javer Formulation (Red Guava with Havermout Addition)

In this study, the organoleptic test used was the hedonic test or what is often called the liking test. This test was carried out using 25 trained panelists. Panelists were asked to give a personal assessment of the javer velva product. Each level of assessment belongs to each formulation, so panelists are asked to provide personal values and not compare one sample with another. Assessment indicators include color, aroma, texture, and taste of the javer velva. This organoleptic test assessment can indicate whether the javer velva product is acceptable or not by the public.

Color

Color is a sensory property seen by consumers for the first time that can determine whether a product is accepted or not. Color can also be a person's attraction to a product. Attractive color and derived from natural ingredients will be an added value of a product. It was found that the

color of red guava velva with the addition of havermout has a pink color with a slight difference in formulation JV 0 has a solid pink color while formulations JV 1 and JV 2 have a slightly pale pink color this is due to the addition of yellowish white pigments derived from havermout but not to cover the red guava color which is quite dominant. Based on the acceptability test, in the color indicator, the highest value is in the control formulation (JV 0) with a value of 4.12 while for formulation 2 (JV 2) has a value of 3.84 and formulation 1 (JV 1) has the lowest value of 3.76.

Aroma

Aroma is an odor that arises due to chemical impulses that are smelled by nerves in the nasal cavity. The more delicious the aroma produced by a food product will make consumers more tempted to consume the product. Red guava velva with the addition of havermout has a distinctive aroma of guava fruit. And formulations 1 and 2 have a creamy aroma that is slightly prominent due to the addition of havermout in the processing process because havermout has a distinctive aroma that is slightly prominent so that it slightly affects the aroma of red guava fruit. This aligns with Rahmawati's research, which indicates that the provision of havermout or oats can affect the aroma of the product[27]. Based on the acceptability test, in the aroma indicator, the highest value is in the control formulation (JV 0) with a value of 4.08 while for formulation 1 (JV 1) has a value of 3.68 and formulation 2 (JV 2) has the lowest value of 3.48.

Texture

Texture is an impression of pressure that can be observed using the mouth and fingers. Texture has a different consistency in each food product. This consistency is something that can determine the taste of a food product because the sense of taste is greatly influenced by the consistency. The texture of each velva formulation is more or less the same, namely smooth and frozen like ice cream. However, there is a slight difference in the texture of formulation 1 (JV 1) and formulation 2 (JV 2), namely the texture which is slightly softer than the control formulation (JV 0), this is due to the addition of havermout to the velva which makes the velva consistency thicker shortly before freezing. Based on the acceptability test, in the texture indicator, the highest value is in the control formulation (JV 0) with a value of 3.92, while formulation 1 (JV 1) and formulation 2 (JV 2) have the same value, namely 3.8.

Taste

Taste is a level of preference that can be observed by utilizing the sense of taste in each individual. Taste can be affected by chemical compounds, temperature, concentration, even interactions with other components or ingredients. The taste of red guava velva with the addition of havermout is sweet with formulation 1 and formulation 2 there is a slight creamy taste due to the addition of havermout in the manufacturing process, but it does not cover the taste of red guava fruit which is quite dominant. This aligns with Natasya's research, which indicates that guava flavor can cover the taste of other ingredients[28]. Based on the acceptability test, in the taste indicator, the highest value is in the control formulation (JV 0) with a value of 4.12 while for formulation 2 (JV 2) has a value of 3.96 and formulation 1 (JV 1) has the lowest value of 3.76.

Fiber Content of Velva Javer (Red Guava with Havermout Added)

The fiber content in 100 grams of velva is 1.13% and 2.02% with the serving weight of 125 grams, so the fiber content per serving is 1.41 grams and 2.52 grams of fiber / portion. The fiber requirement for people with diabetes mellitus is 20 - 35 grams / day which is obtained from snacks 10% of the total fiber requirement in a day. So that patients with diabetes mellitus can consume 3 - 4 servings of velva formulation control (JV 0) to meet fiber needs in a day, while 1 - 2 servings of velva formulation 2 (JV 2) to meet daily fiber needs. This aligns with Luh Putu's research, which indicates that the fiber content in havermout is quite

high[29].

CONCLUSION

According to the research that has been carried out, the javer velva with the highest fiber content is contained in formulation 2 (JV 2) with fiber content of 2.02 g / 100 g. In the organoleptic test, the control formulation (JV 0) received the highest score with an average of 4.06. Meanwhile, formulations 1 (JV 1) and 2 (JV 2) are still acceptable to panelists because the value obtained is included in the neutral category. In the Kruskal Wallis test, the aroma indicator has a value of ($p < 0.05$) so that it shows a difference. Significant differences in aroma indicators were found in the control formulation (JV 0) with formulation 1 (JV 1) and the control formulation (JV 0) with formulation 2 (JV 2) with a value of ($p < 0.05$)

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