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Evaluation of Nutritional Content and Antioxidant Activity of Purple Sweet Potato Pudding Enriched with Red Dragon Fruit

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ABSTRACT

Degenerative diseases remain a leading cause of mortality worldwide, including in Indonesia. Unhealthy dietary patterns are among the major modifiable risk factors, highlighting the importance of developing nutritious functional foods. This study aimed to analyze the nutritional composition, antioxidant activity, acceptability, and serving size of purple sweet potato pudding enriched with red dragon fruit as a potential functional snack. This descriptive observational study was conducted through laboratory analyses and sensory evaluation. Protein content was determined using the UV–Vis spectrophotometric method, fat content using Soxhlet extraction, carbohydrate content using the anthrone method, and antioxidant activity using the DPPH assay. Acceptability was evaluated through a hedonic test. Data were analyzed using One-Way ANOVA. The results showed that the best formulation was P3, consisting of 37.5% purple sweet potato and 62.5% red dragon fruit. This formulation showed the highest acceptability in terms of color and taste. The nutritional composition of P3 per 100 g included 65.1 kcal energy, 3.9 g protein, 0.3 g fat, 11.7 g carbohydrates, and 3.7 g fiber, with an antioxidant capacity of 67.3 mg. A 100 g serving contributed 3% of the recommended dietary allowance (RDA) for energy, 4% for protein and carbohydrates, and 12% for fiber. These findings indicate that purple sweet potato pudding enriched with red dragon fruit has potential as a functional snack with antioxidant properties that may support degenerative disease prevention.

Keywords: Glycemic index; glycemic load; nutritional content; antioxidant activity; purple sweet potato pudding

INTRODUCTION

Degenerative diseases remain the leading cause of mortality globally and in Indonesia, driven largely by unhealthy dietary patterns and sedentary lifestyles. Functional foods have gained attention as a preventive strategy due to their bioactive compounds, particularly antioxidants and dietary fiber, which may modulate oxidative stress and glycemic response. Snack products, widely consumed across age groups, represent a practical vehicle for functional food development. However, most commercially available snacks prioritize palatability over nutritional quality [1].

Snacks, or complementary foods, refer to foods consumed outside of the main meals (breakfast, lunch, dinner). They function to supplement nutrients that may not be sufficiently obtained from main meals [2]. Snacks are widely favored by Indonesians across all age groups. However, consumers often prioritize taste over nutritional value, resulting in snacks that contribute minimally to daily macronutrient and micronutrient intake. Therefore, there is a need for snack products that are not only palatable but also nutritious [3].

Purple sweet potato is rich in anthocyanins, which are recognized as potent antioxidant compounds with potential antihyperglycemic and metabolic regulatory effects. Several studies have reported that anthocyanin extracts from purple sweet potato can reduce oxidative stress and improve metabolic parameters associated with hyperglycemia [4]; [5]. Red dragon fruit (Hylocereus polyrhizus) contains dietary fiber, phenolic compounds, flavonoids, and betalain pigments that contribute to strong antioxidant activity and various metabolic health benefits. Previous studies have demonstrated that red dragon fruit and its by-products contain significant levels of phenolics and bioactive compounds with radical-scavenging properties and potential functional food applications [6]; [7]. Although both ingredients have been widely studied individually for their nutritional and functional properties, evidence on their combined use in a formulated snack product remains limited. In addition, only a few studies have simultaneously evaluated nutritional composition, antioxidant capacity, and sensory acceptability within a single functional snack model. Therefore, investigating the incorporation of purple sweet potato and red dragon fruit into a functional snack formulation is important to provide a more comprehensive understanding of their nutritional value, antioxidant potential, and consumer acceptance.

In Indonesia, degenerative diseases such as hypertension, diabetes mellitus, stroke, and chronic kidney disease showed a notable increase between 2013 and 2018. According to the Basic Health Research (BHR) report, hypertension prevalence rose from 25.8% (2013) to 34.1% (2018), stroke from 7% to 10.9%, and chronic kidney disease from 2% to 4%. Diabetes mellitus prevalence also slightly increased from 1.8% to 1.9% during the same period, with higher prevalence among individuals with higher education and civil servants [8]; [9]. Alarmingly, these diseases are now also affecting younger populations (≥15 years), highlighting the importance of increasing awareness and early prevention [10]. In Central Sulawesi, Basic Health Research [9] reported degenerative disease

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prevalence rates of 2.23% for cancer, 1.54% for diabetes mellitus, 1.92% for heart disease, 8.69% for hypertension, 10.40% for stroke, and 7.72% for joint diseases [9].

Purple sweet potato is a rich source of carbohydrates, calories, vitamins, and minerals. It contains high levels of anthocyanins, with concentrations reaching 519 mg/100 g fresh weight [11]. Anthocyanins function as antioxidants and free radical scavengers, helping to prevent aging, cancer, and degenerative diseases. They also possess antimutagenic and anticarcinogenic properties, hepatoprotective effects, antihypertensive potential, and blood glucose–lowering abilities [12]. Red dragon fruit (Hylocereus polyrhizus) is also popular in Indonesia dueto its pleasant taste and health benefits [13]. According to the Indonesian Food Composition Table [14], 100 g of red dragon fruit provides 71 kcal of energy, 1.7 g of protein, 3.1 g of fat, 9.1 g of carbohydrates, and 3.2 g of fiber. It is also rich in antioxidants (phenols, flavonoids, vitamin C, and betacyanin), niacin (vitamin B3), dietary fiber, and unsaturated fatty acids (MUFA and PUFA) [15]. Red dragon fruit contains carotene, which supports immunity, as well as thiamine, which aids in energy metabolism [16].

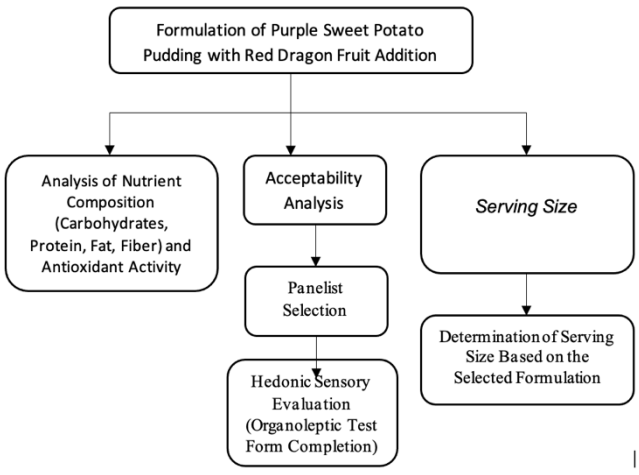
This growing burden highlights the importance of preventive strategies, particularly through dietary approaches. Functional foods have attracted increasing attention due to their potential health benefits, especially those rich in antioxidants and dietary fiber. Snack products, which are widely consumed across all age groups, offer a practical opportunity for developing functional foods that are not only appealing but also nutritionally beneficial. Purple sweet potato is known to be rich in anthocyanins, while red dragon fruit contains various bioactive compounds, including phenolics, flavonoids, and betalains, all of which contribute to antioxidant activity. Although both ingredients have been extensively studied individually, research on their combined use in a formulated snack product remains limited. Moreover, only a few studies have evaluated nutritional composition, antioxidant activity, and sensory acceptability simultaneously within a single product. Therefore, this study aims to develop a functional snack in the form of purple sweet potato pudding enriched with red dragon fruit and to evaluate its nutritional composition, antioxidant activity, and sensory acceptability.

MATERIALS AND METHODS

This experimental study aimed to develop and evaluate a purple sweet potato–red dragon fruit pudding with optimal nutritional and functional characteristics. The study was conducted through laboratory analyses and sensory evaluation. Nutrient composition, including protein, fat, and carbohydrate content, was analyzed using standard laboratory methods. Protein content was determined using the UV–Vis spectrophotometric method, fat content using Soxhlet extraction, and carbohydrate content using the anthrone method. Antioxidant activity was assessed using the DPPH assay. All laboratory analyses were conducted in duplicate, and the results were expressed as mean ± standard deviation. Product acceptability was evaluated through an organoleptic (hedonic) test involving 25 semi-trained panelists. The inclusion criteria were individuals aged 18–35 years, in good health, without known allergies to the product ingredients, and willing to participate voluntarily. Sensory evaluation included color, aroma, taste, and texture, assessed using a structured 5-point hedonic scale. The validity of the instrument was established through expert judgment by specialists in nutrition and food science prior to data collection. Data were analyzed using One-Way Analysis of Variance (ANOVA) to determine differences among formulations. A significance level of $p < 0.05$ was applied. The study protocol involving human participants was approved by the Ethics Commission of the Faculty of Medicine, Tadulako University (Ethics Approval No. 2376/UN28.1.30/KL/2022).

RESULTS

Research flow diagram



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Energy Value Analysis

Based on the findings, the energy content analysis of purple sweet potato pudding formulations with the addition of red dragon fruit is presented in Table 1. The results showed that the highest energy content was observed in formulation P0 (105.3 kcal/100 g), while the lowest was recorded in P3 (65.1 kcal/100 g). All formulations provided relatively low energy values, contributing less than 10% of the reference intake based on the Indonesian Recommended Dietary Allowance (RDA) (Ministry of Health Regulation No. 28/2019), equivalent to 193.5–236.5 kcal per serving. Statistical analysis using One-Way ANOVA revealed significant differences among formulations ($p = 0.000$), which is below the predetermined significance level of 0.05 ($p < 0.05$).

Table 1. Energy Value (kcal/100 g)

Formulation	Mean ± SD Energy Value (Kcal/100 g)	Reference Energy 10% (2.150 kcal)	P Value
P0	105,3 ± 2,5	193,5 – 236,5 kcal	0,000
P1	86,5 ± 1,7		
P2	72,9 ± 0,4		
P3	65,1 ± 0,04		

Information: P0: 100% Purple Sweet Potato, 0% Red Dragon Fruit P1: 62.5% Purple Sweet Potato, 37.5% Red Dragon FruitP2: 50% Purple Sweet Potato, 50% Red Dragon Fruit P3: 37.5% Purple Sweet Potato, 62.5% Red Dragon Fruit

Protein Content Analysis

Protein content of purple sweet potato pudding enriched with red dragon fruit, determined using the UV–Vis spectrophotometric method, is summarized in Table 2. The highest protein content was observed in P0 (5.9 g/100 g), approaching the 10% reference value (6 g), whereas the lowest was found in P3 (3.9 g/100 g). One- way ANOVA revealed a significant difference among formulations ($p = 0.027$), indicating that increasing the proportion of red dragon fruit significantly reduced protein content.

Table 2. Protein Content (100 g)

Formulation	Mean ± SD Protein Value (g/100 g)	Reference Protein 10% (60 g)	P Value
P0	5,9 ± 0,7	5,4 – 6,6 g	0.027
P1	4,5 ± 0,4		
P2	4,1 ± 0,04		
P3	3,9 ± 0,1		

Information: P0: 100% purple sweet potato, 0% red dragon fruit P1: 62.5% purple sweet potato, 37.5% red dragon fruit P2: 50% purple sweet potato, 50% red dragon fruit P3: 37.5% purple sweet potato, 62.5% red dragon fruit

Fat Content Analysis

The fat content of purple sweet potato pudding formulations enriched with red dragon fruit, determined using the Soxhlet extraction method, is presented in Table 3. The highest fat content was observed in formulation P0 (0.5 g/100 g), while all formulations contained fat levels well below the 10% reference value (6.03–7.37 g). One-Way ANOVA demonstrated significant differences among formulations ($p = 0.001$), indicating that variation in the proportion of red dragon fruit significantly influenced the fat content of the pudding.

Table 3. Fat Content (100 g)

Formulation	Mean ± SD Fat Value (g/100 g)	Reference Fat 10% (67 g)	P Value
P0	0,5 ± 0,02	6,03 – 7,37 g	0,001
P1	0,4 ± 0,03		

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Formulation	Mean ± SD Fat Value (g/100 g)	Reference Fat 10% (67 g)	P Value
P2	0,3 ± 0,004		
P3	0,3 ± 0,01		

Information: P0: 100% purple sweet potato, 0% red dragon fruit P1: 62.5% purple sweet potato, 37.5% red dragon fruit P2: 50% purple sweet potato, 50% red dragon fruit P3: 37.5% purple sweet potato, 62.5% red dragon fruit

Carbohydrate Content Analysis

The carbohydrate content of purple sweet potato pudding formulations enriched with red dragon fruit, determined using the anthrone method, is presented in Table 4. The highest carbohydrate content was observed in formulation P0 (19.2 g/100 g), whereas the lowest was recorded in P3 (11.7 g/100 g). All formulations contained carbohydrate levels below the 10% reference value (29.5–35.7 g). One-Way ANOVA revealed significant differences among formulations (p = 0.000), indicating that variation in the proportion of red dragon fruit significantly affected the carbohydrate content of the pudding.

Table 4. Carbohydrate Content (100 g)

Formulation	Mean ± SD Carbohydrate Value (g/100 g)	Reference Carbohydrate 10% (325 g)	P Value
P0	19,2 ± 0,1		
P1	16,1 ± 0,04	29,5 – 35,7 g	0,000
P2	13,5 ± 0,5		
P3	11,7 ± 0,2		

Information: P0: 100% purple sweet potato, 0% red dragon fruit P1: 62.5% purple sweet potato, 37.5% red dragon fruit P2: 50% purple sweet potato, 50% red dragon fruit P3: 37.5% purple sweet potato, 62.5% red dragon fruit

Fiber Content Analysis

The dietary fiber content of purple sweet potato pudding formulations enriched with red dragon fruit, determined through laboratory-based fiber analysis, is presented in Table 5. The highest fiber content was observed in formulation P0 (6.6 g/100 g), whereas the lowest was recorded in P3 (3.7 g/100 g). All formulations provided fiber levels exceeding the 10% reference value (2.7–3.3 g). One-Way ANOVA revealed significant differences among formulations (p = 0.002), indicating that variation in the proportion of red dragon fruit significantly affected the fiber content of the pudding.

Table 5. Fiber Content (100 g)

Formulation	Mean ± SD Fiber Value (g/100 g)	Reference Fiber 10% (30 g)	P Value
P0	6,6 ± 0,5		
P1	5,9 ± 0,05	2,7 – 3,3	0,002
P2	4,9 ± 0,1		
P3	3,7 ± 0,2		

Information: P0: 100% purple sweet potato, 0% red dragon fruit P1: 62.5% purple sweet potato, 37.5% red dragon fruit P2: 50% purple sweet potato, 50% red dragon fruit P3: 37.5% purple sweet potato, 62.5% red dragon fruit

Antioxidant Activity Analysis

The antioxidant activity of purple sweet potato pudding formulations enriched with red dragon fruit, determined using the DPPH radical scavenging assay, is presented in Table 6. The highest antioxidant activity was observed in P0 (IC_{50} = 76,6 ppm), while the lowest IC_{50} value, indicating the strongest antioxidant activity, was recorded in P3 (67.3 ppm). All formulations were classified as strong antioxidants. One-Way ANOVA revealed a

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significant difference among formulations (p = 0.005), indicating that increasing the proportion of red dragon fruit significantly enhanced the antioxidant capacity of the pudding.

Table 6. Antioxidant Activity (100 g)

Formulation	Mean ± Antioxidant Value (ppm)	Category	P Value
P0	76,6 ± 1,6	Strong antioxidant	
P1	71,4 ± 0,4	Strong antioxidant	0,005
P2	69,4 ± 0,03	Strong antioxidant	
P3	67,3 ± 1,4	Strong antioxidant	

Information: P0: 100% purple sweet potato, 0% red dragon fruit P1: 62.5% purple sweet potato, 37.5% red dragon fruit P2: 50% purple sweet potato, 50% red dragon fruit P3: 37.5% purple sweet potato, 62.5% red dragon fruit Acceptance Analysis of Purple Sweet Potato Pudding with Red Dragon Fruit Addition

Sensory evaluation was conducted using 25 semi-trained panelists and a 5-point hedonic scale (1 = strongly dislike; 2 = dislike; 3 = neutral; 4 = like; 5 = strongly like). The results indicated that formulation P3 achieved the highest preference scores for color (4.28) and taste (3.88), while formulation P0 received the highest score for aroma (3.40), and formulation P1 for texture (3.88). Overall, formulation P3 demonstrated the highest level of overall acceptability among the tested formulations.

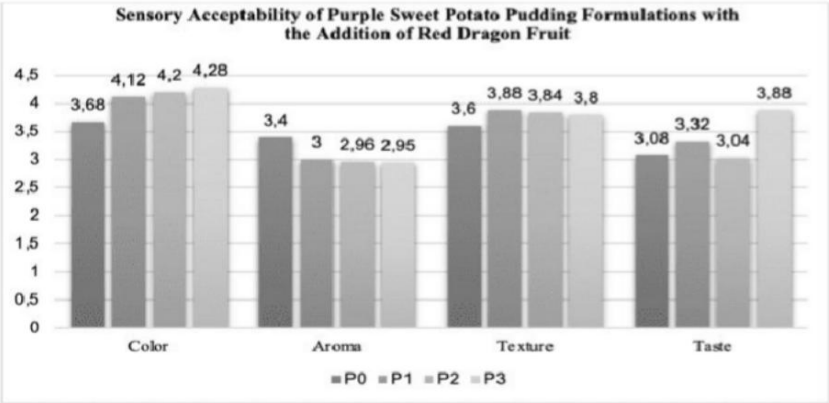

Figure 1. Acceptability Test Result

DISCUSSION

Analysis of Energy and Nutrient Content of Purple Sweet Potato Pudding with Red Dragon Fruit. Energy Content

The study showed that formulation P0 had the highest energy value (105.3 Kcal /100 g), whereas P3 had the lowest (65.1 Kcal/100 g). Statistical analysis confirmed significant differences among formulations ($p < 0.05$). All formulations provided less than 10% of the reference daily energy requirement (193.5–236.5 kcal). The relatively low energy content of the pudding can be attributed to its limited sources of macronutrients, as it was formulated only with agar flour, purple sweet potato, and red dragon fruit. Consequently, carbohydrate, protein, and fat contributions were below 10% of the recommended snack intake, supporting the view of [17] that food energy values depend primarily on macronutrient composition. The reduced energy value of the pudding was linked to the higher proportion of red dragon fruit and the lower proportion of purple sweet potato, as the latter provides greater energy content [18]. Energy intake is primarily derived from carbohydrates, proteins, and fats [19], and excessive intake of high-calorie and high-fat foods may elevate blood cholesterol levels [20]. Maintaining energy balance is therefore essential, as deficits lead to weight loss through fat mobilization, while surpluses promote fat storage.

Excessive energy intake stored in the body, particularly in adipose tissue as fat, may lead to obesity, which in turn can cause insulin resistance and metabolic syndrome. Moreover, excessive fat accumulation increases the risk of hypertension, obesity, cardiovascular disease, and stroke [21]. Given the energy content of purple sweet potato pudding with red dragon fruit in this study, the product is suitable as a complement to a low- energy, high-fiber diet. Similarly, [22] reported that the low energy content of cookies was considered an added value when

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positioned as a low-energy product for individuals with obesity.

Protein Content

Formulation P0 had the highest protein content (5.9 g/100 g), close to the 10% reference value (6 g), while P3 had the lowest (3.9 g/100 g). Significant differences were observed among formulations ($p = 0.027$, $p < 0.05$). Only P0 met the average reference range (5.4–6.6 g), whereas P1 (4.5 g), P2 (4.1 g), and P3 (3.9 g) were below this threshold. Notably, the protein content of all formulations was higher than that of purple sweet potato alone 1.8 g/100 g, [14], indicating the positive contribution of additional ingredients.

The reduction in protein content across formulations was associated with the decreased proportion of purple sweet potato. This aligns with [23], who reported a similar trend in purple sweet potato–based products. Protein, as a macronutrient essential for tissue maintenance and immune function, must meet dietary requirements [24]. However, the protein levels observed in the pudding with added red dragon fruit did not reach the 10% contribution recommended for snack foods by the Nutrition Facts Reference Standard [25]. This suggests the need for complementary protein sources to optimize the nutritional quality of the product.

Adequate protein intake is particularly important for children and adolescents to support growth and development [26]. However, in certain conditions such as kidney failure, protein intake must be carefully restricted, and thus lower levels of protein are recommended [27]. Based on the protein content of purple sweet potato pudding with the addition of red dragon fruit in this study, the product is suitable to be included as part of a healthy diet, particularly for individuals with kidney disease who require limited protein intake.

Fat Content

The highest fat content was observed in formula P0 (0.5 g/100 g), while P1, P2, and P3 contained 0.4g, 0.3 g, and 0.3 g, respectively. Statistical analysis showed a significant difference among formulations ($p = 0.001$, $p < 0.05$). All formulations contained fat levels below the 10% reference intake value (6.03–7.37 g). The decrease in fat content corresponded with the reduction of purple sweet potato, which is naturally low in fat (0.6 g/100 g) [28], and was further influenced by processing, as heating causes fat to melt and volatilize into other components such as flavor compounds [29]

Purple sweet potato pudding with red dragon fruit addition was found to have low fat content, making it safe for health and suitable as a dessert for individuals on low-fat or low-cholesterol diets. This aligns with [30], who reported that red dragon fruit juice reduced total cholesterol in women with diabetes mellitus. Although fat is essential for energy supply, fat-soluble vitamin absorption, and cell membrane formation, excessive intake can increase the risk of metabolic disorders. The fat levels observed in all formulations did not meet the 10% contribution threshold for snack foods based on the Nutrition Label Reference [25], indicating the need for complementary ingredients to achieve adequate dietary fat intake.

Carbohydrate Content

The highest carbohydrate content was observed in formula P0 (19.2 g/100 g), while the lowest was found in P3 (11.7 g/100 g). Statistical analysis confirmed significant differences among formulations ($p = 0.000$; $p < 0.05$). All formulations contained carbohydrate levels below the 10% reference intake range (29.5–35.7 g). These findings are consistent with **[31]**, who reported similar carbohydrate values of approximately 19 g/100 g in purple sweet potato pudding. The decrease in carbohydrate content across formulations was associated with the reduction in the proportion of purple sweet potato and the increased addition of red dragon fruit.

Purple sweet potato is known to be a major source of carbohydrates due to its high starch content, whereas red dragon fruit contains considerably lower carbohydrate levels. Previous studies reported that dragon fruit generally contains approximately 8–13 g of carbohydrates per 100 g, depending on cultivar and growing conditions **[32]**. As a result, increasing the proportion of red dragon fruit in the pudding formulation contributed to the reduction of total carbohydrate content. Overall, the pudding formulations showed relatively low carbohydrate levels, suggesting potential suitability for individuals following low-carbohydrate dietary patterns. Research has shown that low-carbohydrate diets can be effective in reducing body weight and improving metabolic risk factors, including lipid profiles and glycemic control **[33]**. However, none of the formulations met the 10% carbohydrate contribution recommended for snack foods (32.5 g). Therefore, future product development may require a higher proportion of purple sweet potato to increase carbohydrate levels while maintaining acceptable sensory and nutritional characteristics. Although glycemic index and glycemic load were not directly measured in this study, the carbohydrate composition and dietary fiber content suggest that the pudding may be associated with a moderate to low glycemic response.

Fiber Content

The highest fiber content was found in P0 (6.6 g/100 g) and the lowest in P3 (3.7 g/100 g), with significant differences among formulations ($p = 0.002$, $p < 0.05$). Fiber levels consistently decreased with reduced purple sweet potato and increased red dragon fruit, reflecting the higher fiber content of purple sweet potato (4.72%)

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compared to red dragon fruit (3.2%) ([34] ; [14]). These findings are consistent with [35] and [36]. who reported that the addition of red dragon fruit lowers fiber levels in food products. Overall, the results confirm that higher proportions of purple sweet potato contribute to greater dietary fiber content.

Dietary fiber is associated with multiple health benefits, including weight management, diabetes control, gastrointestinal health, colon cancer prevention, and a reduced risk of cardiovascular disease. Adequate intake according to dietary reference guidelines is therefore essential. Several studies have reported that sufficient dietary fiber consumption contributes to improved metabolic health by increasing satiety, slowing gastric emptying, and reducing overall energy intake, which supports body weight regulation [37]. In addition, dietary fiber can delay carbohydrate absorption in the intestine, thereby helping to reduce postprandial blood glucose levels and improve glycemic control [38]. From a gastrointestinal perspective, dietary fiber plays an important role in maintaining digestive health by increasing stool bulk and stimulating intestinal motility, which helps prevent constipation and other digestive disorders. Fermentable fibers can also serve as substrates for beneficial gut microbiota, producing short-chain fatty acids that support intestinal health and metabolic regulation [38]. Furthermore, epidemiological studies have shown that higher fiber intake is associated with a reduced risk of colorectal cancer and other chronic diseases [39].

Antioxidant Activity

The results showed that F3 had the highest antioxidant capacity (IC50 = 67.3 ppm), while P0 exhibited the lowest (IC50 = 76.7 ppm), with significant differences among formulations ($p = 0.005$). Antioxidant activity increased with higher proportions of red dragon fruit, which is consistent with previous findings reporting that red dragon fruit is rich in natural antioxidants, particularly anthocyanins and betalains, contributing both functional activity and red-purple pigmentation.

Oxidative stress contributes to aging and degenerative diseases when endogenous antioxidants are insufficient to neutralize free radicals [4]. Purple sweet potato pudding enriched with red dragon fruit offers a potential alternative snack with high antioxidant capacity. The antioxidant capacity observed in this study may have potential nutritional relevance. Dietary antioxidants play an important role in reducing oxidative stress, which has been associated with aging and the development of degenerative diseases such as cardiovascular disease, diabetes, and certain cancers. The presence of bioactive compounds in purple sweet potato and red dragon fruit, including anthocyanins and betalains, may contribute to these protective effects. Therefore, the development of pudding enriched with these ingredients may provide a functional snack option that supports antioxidant intake in daily diets. Overall, the formulation characteristics, particularly its fiber content and carbohydrate profile, indicate potential benefits in modulating postprandial glycemic response, although direct GI and GL measurements are required for confirmation.

Acceptability Test of Purple Sweet Potato Pudding with the Addition of Red Dragon Fruit Color

Color is a key determinant in organoleptic evaluation, as it provides the first visual impression of food products and strongly influences consumer acceptance. One Way ANOVA showed significant differences among formulations ($p = 0.038$), with P3 (mean score 4.28) being the most preferred. The addition of red dragon fruit produced a brighter red color, enhancing panelists' acceptance compared to darker purple hues at lower additions. This effect is attributed to the presence of natural pigments in red dragon fruit, particularly betalains (betacyanins), which are responsible for the characteristic red-purple coloration and are widely used as natural food colorants. Recent studies have reported that increasing the concentration of dragon fruit pigments can enhance the red color intensity in food products and improve their visual appeal [40]; [41].

Aroma

Aroma is an important determinant of food quality because it quickly reflects consumer acceptability (43). The One-Way ANOVA analysis of the four treatments showed no significant differences in aroma among formulations ($p = 0.233$; $p > 0.05$). However, sensory evaluation indicated that P0 (mean score = 3.40) was the most preferred formulation, while P3 (mean score = 2.95) was the least preferred by the panelists. The difference in preference may be related to the aroma intensity resulting from the addition of red dragon fruit. At higher concentrations, red dragon fruit may produce a stronger characteristic aroma that influences panelists' perception of the product. In contrast, formulations with lower proportions of dragon fruit tended to have a milder aroma, closer to the natural aroma of the main ingredient, purple sweet potato, which was more acceptable to the panelists.

In addition, aroma in food products is generally influenced by volatile compounds derived from raw materials and formed during processing. These volatile compounds contribute to the characteristic aroma profile of a product and can either enhance or reduce consumer acceptance. Increasing the proportion of ingredients with distinctive aromas may alter the overall aroma profile of the product and consequently affect panelist preference. These findings are consistent with previous research [35], which reported that higher proportions of red dragon fruit in food formulations increased the intensity of its characteristic aroma, but did not necessarily improve panelist acceptance.

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Texture

Texture is an important attribute of food quality, perceived through tactile and gustatory sensations during consumption ([42]; [43]). The One-Way ANOVA analysis of the four treatments showed no significant differences in texture among formulations ($p = 0.512$; $p > 0.05$). Nevertheless, sensory evaluation indicated that P1 (mean score = 3.88) was the most preferred formulation, whereas P3 (mean score = 3.60) received the lowest preference score. The variation in panelists' preference may be associated with the proportion of red dragon fruit added to the formulation, which can influence the water content and gel structure of the pudding. A moderate addition level (25%) produced a texture that was perceived as smoother and more balanced, while higher levels tended to increase moisture content, potentially weakening the gel matrix and resulting in a softer texture.

Texture characteristics in pudding products are largely determined by the interaction between starch, water, and other ingredients during the heating and gelation process. Purple sweet potato contains starch that contributes to gel formation and firmness, whereas red dragon fruit has relatively high moisture content that may modify the overall consistency of the product. Therefore, an appropriate balance between these ingredients is necessary to achieve a desirable texture. These results are consistent with previous findings [35], which reported that moderate incorporation of red dragon fruit improved the texture of pudding products by providing adequate moisture while maintaining structural stability.

Taste

Taste is a critical determinant of consumer acceptance [44]. One-Way ANOVA revealed a statistically significant difference among treatments ($p = 0.022$; $p < 0.05$). Sensory evaluation indicated that formulation P3 (mean = 3.88) was the most preferred. The increased proportion of red dragon fruit in this formulation produced a more pronounced and balanced sweet–sour flavor profile, thereby enhancing panelist preference. From a chemical standpoint, these taste characteristics can be attributed to the presence of natural sugars such as glucose and fructose in red dragon fruit, which contribute to sweetness perception, as well as organic acids (e.g., citric acid and malic acid) that impart a fresh sour sensation.

The interaction between sugars and organic acids establishes a balanced flavor profile (sugar–acid balance), which is recognized as an important factor in improving food palatability. Furthermore, phenolic compounds present in purple sweet potato and red dragon fruit may modulate taste perception by contributing to overall flavor complexity. Therefore, differences in preference among formulations are not solely due to variations in ingredient proportions but are also influenced by changes in chemical composition that affect the overall flavor profile. These findings are consistent with [45] who reported that the natural balance between sugars and acids in dragon fruit positively influences taste acceptability.

CONCLUSION AND RECOMMENDATIONS

This study evaluated the nutritional composition, antioxidant activity, and sensory acceptability of purple sweet potato pudding enriched with red dragon fruit. The results demonstrated that formulation differences influenced nutritional characteristics, antioxidant capacity, and consumer acceptance. Among the tested formulations, pudding containing 37.5% purple sweet potato and 62.5% red dragon fruit showed the highest overall acceptability. The product also exhibited notable antioxidant activity and dietary fiber content, with relatively low energy and fat levels. These findings suggest that this formulation has potential as a nutritious snack alternative, providing antioxidant compounds and dietary fiber that may support healthier dietary patterns and contribute to the development of functional food products.

AUTHOR'S CONTRIBUTION STATEMENT

St. Ika Fitrasyah: Conceptualization, methodology, supervision, project administration, and manuscript review & editing.
Sukmawati: Investigation, laboratory analysis, data curation, and formal statistical analysis.
Ariani: Investigation, sensory evaluation, data interpretation, and drafting of the original manuscript.
Abdul Fandir: Data validation, visualization, and critical revision of the manuscript for important intellectual content.
All authors contributed to the writing of the manuscript, approved the final version, and agree to be accountable for all aspects of the work.

CONFLICTS OF INTEREST

The authors declare that the research was conducted without any commercial or financial relationships that could be construed as a potential conflict of interest

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