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FORMULATION OF RED DRAGON FRUIT (*HYLOCEREUS COSTARICENSIS*) BASED ON PORANG TUBER FLOUR (*AMORPHOPHALLUS ONCOPPHYLLUS* BLUME.) AND SAGU (*METROXYLON SAGU* ROTTB.) : ANALYSIS OF PHYSICOCHEMICAL CHARACTERISTICS AND ORGANOLEPTIC TESTING OF DODOL AS A SUSTAINABLE HEALTHY FOOD

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Abstrak

Dragon fruit, commonly known as Hylocereus costaricensis, has many benefits in its flesh, while its skin is discarded and unused. The skin of Hylocereus costaricensis fruit has many benefits. Dodol is made from Hylocereus costaricensis fruit with the aim of obtaining a more appealing taste, colour and texture, as well as a delicious and chewy flavour that is widely enjoyed. The comparison between porang tuber flour (Amorphophallus oncopphyllus Blume.) and sagu flour (Metroxylon sagu Rottb.) shows that each has its own characteristics. This results in different physicochemical and organoleptic characteristics after being mixed with Hylocereus costaricensis fruit. Porang tuber flour (Amorphophallus oncopphyllus Blume.) functions as a thickener and gel former, giving dodol a chewy and fibre-rich texture, while sagu flour (Metroxylon sagu Rottb.) is rich in fibre and antioxidants. It gives the dodol a chewy, sticky, and dense texture when eaten and also thickens when the sagu flour (Metroxylon sagu Rottb.) is cooked with coconut milk and dodol from Hylocereus costaricensis fruit, giving it a thick consistency.

INTRODUCTION

Dodol snacks are a type of food or snack that is widely produced and enjoyed by many people. The mixture used in dodol snacks creates a variety of textures, so that sometimes dodol can be hard, dense and chewy, soft, or even very soft and not chewy at all. According to Vitriasari & Sunyanto (2021), the main ingredient in the production process of dodol snacks is glutinous rice flour, which is rich in amylopectin and can affect the elasticity of the final product.

Meanwhile, according to Agung (2021), with the increasingly advanced developments in technology and knowledge about food technology in the manufacture of snacks, namely dodol, which is varied with ingredients from tubers or fruits that make dodol taste sweeter and more appealing.

Dodol is a processed food product that is a snack with a moderate water content, giving it a dense texture and allowing it to be preserved without heating or cooling. This makes dodol a popular snack because it is made from ingredients such as glutinous rice flour, coconut milk, sugar, salt, and other ingredients that are processed or cooked for a long time to produce a chewy texture and a long shelf life (Faridah & Ananda, 2020 in Putri *et al*., 2023).

According to Fatma (2015) in Alhafiz & Suprapto (2025), dodol snacks are usually made from glutinous rice flour and often contain additives such as essence, which is a colouring agent added to the glutinous rice flour base. This is in line with the opinion of Wulansari *et al*. (2023) that dodol made from fruits is generally not given additives such as colouring or flavouring to sweeten the dodol snack.

An innovation aimed at creating a more appealing appearance and chewier texture was achieved by adding dragon fruit (*Hylocereus costaricensis*). Dragon fruit (*Hylocereus costaricensis*) is used as an ingredient in dodol and can increase the *antioxidant* content of this traditional Indonesian sweet treat.

Dragon fruit, commonly known as dragon fruit with the scientific name *Hylocereus undatus* (L.), is a fruit that has an exotic appearance, a sweet taste, and health benefits. Dragon fruit is a highly sought-after commodity with a delicious taste ranging from sweet to sweet-sour (Riato *et al*., 2021 in Wulansari *et al*., 2023).

Red dragon fruit, also known as super sweet red dragon fruit, with the scientific name *Hylocereus costaricensis*, is consumed and processed into various products to facilitate processing and consumption. This is because red dragon fruit is a fruit with a high water content, making it prone to spoilage. Therefore, some entrepreneurs have created processed red dragon fruit products, such as snacks, to avoid significant losses, including processed products such as dodol, syrup, and even chips from the dragon fruit (Wahyuni, 2012; Rudianto *et al*., 2019 in Engelen, 2021).

The production of dodol from red dragon fruit (*Hylocereus costaricensis*) formulated with Sagu flour (*Metroxylon sagu* Rottb.) is an innovative product in sustainable food management that utilises the natural *antioxidants* in dragon fruit and takes advantage of the chewy texture of Sagu flour.

In this addition, the use of dragon fruit (*Hylocereus costaricensis*) will give a natural colour to the dodol snack, while Sagu flour (*Metroxylon sagu* Rottb.) provides a chewy texture that is liked by many people.

Meanwhile, flour from Porang tubers (*Amorphophallus oncopphyllus* Blume.) provides a chewy texture through its hydrocolloid properties, and Porang tubers (*Amorphophallus oncopphyllus* Blume.) contain *glucomannan*, which functions in gel formation or as a substitute for glutinous rice flour (Mareta, 2015 in Putri *et al*., 2023).

RESEARCH METHODS

a. Research Location

This research was conducted independently at the Food Laboratory of the University of Sumatra Utara (USU) in Medan, North Sumatra. The experimental trials were conducted over a

period of three months, from May 2025 to August 2025. The panel of observers consisted of 30 people.

b. Research Design

This study is an experimental study using a completely randomized design (CRD) consisting of 3 treatments and 3 replicates, resulting in 9 experiments.

The design used in this study was a non-factorial completely randomised design (CRD) with 3 treatments and 3 replicates, including:

1. D_1 = Red Dragon Fruit (*Hylocereus costaricensis*) + Rice Flour
2. D_2 = Red Dragon Fruit (*Hylocereus costaricensis*) + Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.)
3. D_3 = Red Dragon Fruit (*Hylocereus costaricensis*) + Sagu Flour (*Metroxylon sagu* Rottb.)

Other ingredients such as margarine, coconut water, coconut milk, salt, sugar and others that support the making of dodol were not included in the observation variables but were applied evenly in all experimental observation variables.

c. Observation Variables

Data analysis was continued with experimental data from research indicators, including testing of color, aroma, texture, and taste. The data analysis used was ANOVA (Analysis of Variance) at a significance level of 5%.

Observation of variable scores by looking at physicochemical characteristics and organoleptic tests, which are scored from 1 to 5, with the criterion that the higher the score, the better and tastier the product, consisting of the following assessments:

1. The texture of the product consists of 1. Very Soft, 2. Soft, 3. Hard, 4. Somewhat Chewy, 5. Chewy.
2. The aroma of the product consists of 1. No aroma of red dragon fruit, 2. No aroma of red dragon fruit, 3. Slight aroma of red dragon fruit, 4. Aroma of red dragon fruit, 5. Strong aroma of red dragon fruit
3. Colour consists of 1. Very Little Red Colour, 2. Less Red Colour, 3. Medium Red Colour, 4. Red Colour, 5. Deep Red Colour
4. Taste consists of 1. Very Unsweet, 2. Unsweet, 3. Slightly Sweet, 4. Sweet, 5. Very Sweet

RESULTS AND DISCUSSION

From the results of research that has been conducted and observations of the production of Dodol from Red Dragon Fruit (*Hylocereus costaricensis*) formulated with the addition of Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.) and Sagu Flour (*Metroxylon sagu* Rottb.), the following can be observed:

1. Texture of Dodol *Hylocereus costaricensis*

From the observations made on the panelists, the results of the analysis of dodol snacks made from Red Dragon Fruit (*Hylocereus costaricensis*) formulated with Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.) and Sagu Flour (*Metroxylon sagu* Rottb.) can be seen in Table 1 as follows:

Table 1. Physicochemical Characteristics and Organoleptic Test of Dodol Texture

Texture		
Product	**Average**	**Score**
Red Dragon Fruit (*Hylocereus costaricensis*) + Rice Flour	7,12	4
Red Dragon Fruit (*Hylocereus costaricensis*) + Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.)	8,43	5

Red Dragon Fruit (*Hylocereus costaricensis*) + Sagu Flour (*Metroxylon sagu* Rottb.)	8,51	5

The results of the observations presented in Table 1 show that the physicochemical characteristics and organoleptic tests on Dodol snacks gave good average scores from the panelists in the trials adding flour from Porang tubers (*Amorphophallus oncopphyllus* Blume.) and flour from Sagu (*Metroxylon sagu* Rottb.). The average of the experiments yielded no significant differences, and even the organoleptic test treatment on Red Dragon fruit (*Hylocereus costaricensis*) showed the lowest average value of 7.12.

According to Rizqullah & Elida (2022), the texture of food can be determined by its dryness, moisture content, chewiness or softness, and hardness.

Based on the results of research conducted, the texture quality of dragon fruit dodol (*Hylocereus costaricensis*) produced from glutinous rice flour with the addition of other ingredients provides a slightly chewy texture that is not hard, or what could be called springy.

According to Lubis (2026), testing the texture of food and beverages is carried out simultaneously, but the treatment given in food and beverage experiments will have a major impact on quality and produce an unsuitable texture, even causing the texture of dodol to become semi-wet.

2. Colour of Dodol *Hylocereus costaricensis*

From the observations made on the panelists, the results of the analysis of dodol snacks made from Red Dragon Fruit (*Hylocereus costaricensis*) formulated with Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.) and Sagu Flour (*Metroxylon sagu* Rottb.) can be seen in Table 2 as follows:

Table 2.Physicochemical Characteristics and Organoleptic Testing of Dodol Colour

Colour		
Product	**Average**	**Score**
Red Dragon Fruit (*Hylocereus costaricensis*) + Rice Flour	6,11	3
Red Dragon Fruit (*Hylocereus costaricensis*) + Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.)	9,24	4
Red Dragon Fruit (*Hylocereus costaricensis*) + Sagu Flour (*Metroxylon sagu* Rottb.)	9,13	4

The results of the observations presented in Table 2 show that the physicochemical characteristics and organoleptic tests on Dodol snacks gave good average scores from the panelists in the trials adding flour from Porang tubers (*Amorphophallus oncopphyllus* Blume.) and flour from Sagu (*Metroxylon sagu* Rottb.). The average of the experiments yielded no significant differences, and even the organoleptic test treatment on Red Dragon fruit (*Hylocereus costaricensis*) showed the lowest average value of 6.11.

Essentially, aroma is one of the indicators of food quality, and it is the aroma that makes a food product appealing to everyone through their sense of smell.

According to Wati & Holinesti (2019) in Salsabella (2023), the quality of dodol from an experiment using red dragon fruit is a reddish-brown colour because it is obtained from pure dragon fruit extract. This is achieved through the processing of dodol snacks using low heat and continuous, even stirring until the desired colour is obtained from stirring the red dragon fruit in the dodol-making process.

Meanwhile, according to Ayuni *et al*. (2017) in Palupi *et al*. (2021); Alhafiz & Suprapto (2025), the red colour in dodol with red dragon fruit extract is due to the anthocyanin content in red dragon fruit, which causes a natural red colour. Anthocyanins are natural colouring agents that give dodol a bright natural red colour. Therefore, the higher the amount of dodol extract used, the brighter the red colour of the dodol will be. Conversely, if the dragon fruit does not contain high levels of anthocyanins, which cause the bright red colour, then the colour of the dodol snack will not be as bright.

3. The aroma of Dodol *Hylocereus costaricensis*

From the observations made on the panelists, the results of the analysis of dodol snacks made from Red Dragon Fruit (*Hylocereus costaricensis*) formulated with Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.) and Sagu Flour (*Metroxylon sagu* Rottb.) can be seen in Table 3 as follows:

Table 3. Physicochemical Characteristics and Organoleptic Testing of Dodol Aroma

Aroma		
Product	**Average**	**Score**
Red Dragon Fruit (*Hylocereus costaricensis*) + Rice Flour	6,88	3
Red Dragon Fruit (*Hylocereus costaricensis*) + Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.)	8,37	4
Red Dragon Fruit (*Hylocereus costaricensis*) + Sagu Flour (*Metroxylon sagu* Rottb.)	8,51	4

The results of the observations presented in Table 3 show that the physicochemical characteristics and organoleptic tests on Dodol snacks gave good average scores from the panelists in the trials adding flour from Porang tubers (*Amorphophallus oncopphyllus* Blume.) and flour from Sagu (*Metroxylon sagu* Rottb.). The average of the experiments yielded no significant differences, and even the organoleptic test treatment on Red Dragon fruit (*Hylocereus costaricensis*) showed the lowest average value of 6.88.

Aroma is a key indicator in attracting consumers to a food product. The panelists were presented with dodol containing red dragon fruit (*Hylocereus costaricensis*) + sagu flour (*Metroxylon sagu* Rottb.), which received an average aroma rating of 8.51, while dodol containing red dragon fruit (*Hylocereus costaricensis*) + porang tuber flour *(Amorphophallus oncopphyllus* Blume.) produced an average aroma of 8.37. However, in this case, there was no significant difference.

In this case, the production of dodol from Red Dragon Fruit (*Hylocereus costaricensis*) with a formulation of Porang Tuber Flour (*Amorphophallus oncopphyl*lus Blume.) and Sagu (*Metroxylon sagu* Rottb.) is not too significant, indicating that dodol made from Red Dragon Fruit still retains its distinctive aroma.

In this case, according to Lukito *et al*. (2017) in Faridah & Ananda (2020); Hasanah *et al*. (2021), this is because in the dodol-making process, many ingredients are used, such as glutinous rice flour, which can reduce the aroma of dodol, while the use of fruit as the base flour for making dodol does not reduce the aroma of dodol.

4. The taste of Dodol *Hylocereus costaricensis*

From the observations made on the panelists, the results of the analysis of dodol snacks made from Red Dragon Fruit (*Hylocereus costaricensis*) formulated with Porang Tuber Flour

(*Amorphophallus oncopphyllus* Blume.) and Sagu Flour (*Metroxylon sagu* Rottb.) can be seen in Table 4 as follows:

Table 4. Physicochemical Characteristics and Organoleptic of Dodol Taste

The Taste		
Product	**Average**	**Score**
Red Dragon Fruit (*Hylocereus costaricensis*) + Rice Flour	8,45	5
Red Dragon Fruit (*Hylocereus costaricensis*) + Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.)	8,90	5
Red Dragon Fruit (*Hylocereus costaricensis*) + Sagu Flour (*Metroxylon sagu* Rottb.)	8,89	5

The results of the observations presented in Table 4 show that the physicochemical characteristics and organoleptic tests on Dodol snacks gave good average scores from the panelists in the trials adding flour from Porang tubers (*Amorphophallus oncopphyllus* Blume.) and flour from Sagu (*Metroxylon sagu* Rottb.). The average of the experiments yielded no significant differences, and even the organoleptic test treatment on Red Dragon fruit (*Hylocereus costaricensis*) showed the lowest average value of 8.45.

Flavour is a quality of a product that is produced from the ingredients used and can be tasted in the food processing (Lestari & Yusuf, 2019).

The results of physicochemical and organoleptic tests conducted in the taste analysis showed that the panelists preferred dodol made from dragon fruit (*Hylocereus costaricensis*) with the addition of flour from porang tubers (*Amorphophallus oncopphyllus* Blume.) and sagu (*Metroxylon sagu* Rottb.). However, the panelists also liked the taste without the addition of Porang tuber and Sagu flour, such as glutinous rice flour. According to Julianti *et al*. (2018), taste is an important factor in evaluating food products, even though taste is the main standard for assessing food product quality.

The flavour created from dodol by mixing red dragon fruit (*Hylocereus costaricensis*) with a formulation of Porang tuber flour (*Amorphophallus oncopphyllus* Blume.) and Sagu flour (*Metroxylon sagu* Rottb.) is very sweet, so that the resulting components give the dodol its distinctive flavour.

CONCLUSION

In conclusion, it can be concluded that processed dodol products from Red Dragon Fruit (*Hylocereus costaricensis*) formulated with Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.) and Sagu Flour (*Metroxylon sagu* Rottb.) show a significant effect on all variable parameters, including texture, aroma, taste, and colour. The panelists' assessment also showed that they liked and enjoyed the dodol made from a mixture of red dragon fruit (*Hylocereus costaricensis*) and a formulation of Porang tuber flour (*Amorphophallus oncopphyllus* Blume) and Sagu flour (*Metroxylon sagu* Rottb).

For this study, it is expected to use White Dragon Fruit (*Hylocereus undatus*) extract mixed with Porang Tuber Flour (*Amorphophallus oncopphyllus* Blume.) and Sagu Flour (*Metroxylon sagu* Rottb.).

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