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ANALYSIS OF WATER CONTENT, FIBER, ANTHOCIANIN AND ORGANOLEPTIC ACCEPTANCE OF BUTTERFLY PEA JELLY POWDER (GATELA) AT VARIOUS DRYING TEMPERATURES OF SEAWEED

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ABSTRACT

Jelly is a kind of food that consumers typically of all ages like. Food additive ingredients can increase the nutritional content while providing an attractive color to the food. Butterfly pea flowers have the potential to be developed as a local natural food colorant while providing antioxidant effects. This research aims to determine the organoleptic profile, water content, fiber and anthocyanin content of butterfly pea flower (Gatela) gelatin powder at various seaweed drying temperatures, carried out in February-March 2023. The treatments in the research were seaweed drying temperatures which were divided into 3, namely temperature 50°C, 60°C and 70°C. The initial stage is the preparation of the ingredients, then continued with making butterfly pea flower (Gatela) agar powder, as well as organoleptic testing. The best formulation is followed by analysis of water, fiber and anthocyanin content. This research involved 30 students as panelists with the parameters tested, namely color, aroma, texture and taste. The results of the organoleptic test showed that the selected butterfly pea flower (Gatela) agar powder was the most preferred, namely with a drying temperature of 50ºC in terms of aroma and texture. The results of the analysis on butterfly pea flower agar powder (Gatela) with a drying temperature of 50ºC were a water content of 12.18%, a fiber content of 4.93% and anthocyanin content of 154.84 ppm. This butterfly pea flower gelatin powder (Gatela) can be accepted and is used as a local food-based preparation. In further research, we can increase the level of preference for the four indicators and the content of butterfly pea flower agar powder.

Keywords: *Jelly, butterfly pea flower, seaweed, drying temperature*

INTRODUCTION

Indonesia is famously known as an archipelago country that has a high variety of marine resources. This country is located right below the equator line, making the area exposed to the sun more throughout the year which is known to be beneficial for seaweed growth (Firdaus, 2019). A known species of seaweed called *Eucheuma cottonii* is one of the most popular seaweed that is sold in the market of Bengkulu. It is famously made for a special dessert *dawet*, which is a mix of coconut milk, ice cubes and palm sugar syrup (Sholiha, 2020). Moreover, *Eucheuma cottonii* can be used for jelly, which is an already famous dessert among the people, so the value of the seaweed can be more excelled (Juarsa, 2019).

The appeal of food can be evaluated from four aspects: color, taste, aroma and texture. An addition of food ingredients can raise its nutritional value while giving the food a better color (Gracelia et al, 2022). Butterfly flea flowers can be used as a local natural coloring agent while also acting as an antioxidant (Handito et al, 2022). However, a lot of people overlook the benefit, and only see it as ordinary wild vine (Charolina et al, 2022).

Food processing method like the desiccation procedure determines the quality and quantity of the food products (Nurhayati et al, 2022). Using oven for the drying process can be an alternative, as it's easy to adjust the temperature, and unlike the conventional drying method, it's not depending on the weather (Orilda et al, 2021). The drying process can alter the food quality in sensory aspects of color, aroma, texture and taste (Asiah et al, 2021).

The temperature in the drying process affects the color of the seaweed (Orilda et al, 2021). Apart of the sensory aspects, the quality change also occurs in chemical aspects, whether it's an increase or decrease in its chemical activities (Asiah et al,

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2021). The high temperature in the drying process can decrease the water content. Meanwhile, a high level of water content in the seaweed affects the texture or the gel strengths. Jelly powders with low-level of water content are less likely to be damaged than the high-level one (Yolanda et al, 2020).

Furthermore, the food water content determines its shelf life (Herliyana et al, 2022). Diminished water content has the potential to deactivate enzymes, impede chemical reactions, and suppress microbial growth, ultimately leading to a deterioration in food quality. According to SNI 2802:2015 standards, jelly powder is expected to adhere to a maximum water content of 22% to meet quality criteria. Consequently, a thorough examination of the water content was conducted at the drying temperature of seaweed in butterfly pea flower (*Gatela*) jelly powder, focusing on the treatment that garnered the highest preference.

Elevated drying temperatures pose a notable risk to the degradation or impairment of anthocyanin content within butterfly pea flowers. Substantial reduction in anthocyanin observed at drying temperatures surpassing 60ºC, as documented by Martini *et al*. (2020). The diminution of anthocyanin content significantly contributes to an intensified and darkened coloration. Consequently, the inclusion of butterfly pea flower emerges as a pivotal determinant influencing the coloration of agar. The hue of the gelatin matrix assumes paramount importance as a primary factor shaping consumer appeal. The resultant color spectrum is contingent upon the amalgamation of seaweed flower powder with agar powder, considering diverse temperatures utilized in the drying process of distinct seaweed specimens.

The impact of drying temperature on seaweed has been elucidated in studies, demonstrating an augmentation in the fiber content of the material (Kusuma et al., 2019). In light of the foregoing discussion, the incorporation of butterfly pea flowers, serving as a local natural coloring agent, stands as a deliberate endeavor aimed at enhancing the nutritional profile of gelatin. This augmentation aligns with the preferences of consumers, thereby rendering it more palatable for consumption. The primary objective of this investigation was to ascertain the optimal drying temperature for seaweed, employing a comprehensive evaluation conducted by panelists. This evaluation encompassed an organoleptic assessment, incorporating indicators such as color, taste, texture, and aroma. Furthermore, a quantitative analysis of water, fiber, and anthocyanin content was executed to provide a nuanced understanding of the compositional attributes of butterfly pea flower jelly powder (Gatela).

METHODS

The investigation was conducted in the months of February and March 2023, involving the production of items at the Food Technology Science Laboratory within the Nutrition Department at Bengkulu Health Polytechnic. Subsequent to the manufacturing phase, organoleptic evaluations were performed at the Organoleptic Assessment Laboratory affiliated with the Health Polytechnic under the Ministry of Health, Bengkulu. Following the organoleptic assessments, the quantitative analysis of water, fiber, and anthocyanin content was executed at the laboratory facilities of Bengkulu University.

The essential materials employed in this study included *Eucheuma cottonii* seaweed, procured from Pasar Minggu. Stringent criteria for selecting the seaweed necessitated specimens with unblemished thalli and a yellowish-white hue. Butterfly pea flowers, sourced from the environs of Lempuing and Berkas Beach, were meticulously chosen based on their vibrant blue petals, undamaged and fully bloomed characteristics. The instrumental apparatus employed throughout the product manufacturing process comprised a gas oven, a "TANITA 2 kg" scale, a precision 0.01 g MH-Series pocket scale, an oven pan, a basin, an 80-mesh sieve, and a ZT-300 FOMAC grinder.

The compositional analysis entailed the examination of water content (per AOAC, 2005, and corroborated by Orilda et al., 2021), crude fiber (as per AOAC, 1995, also substantiated by Orilda et al., 2021), and anthocyanin levels (determined differentially based on pH, following the method proposed by Purwaniati et al., 2020). The reagents employed in these analyses included 0.3 N acid sulfate (H2SO4), ethanol, distilled water, n-hexane,

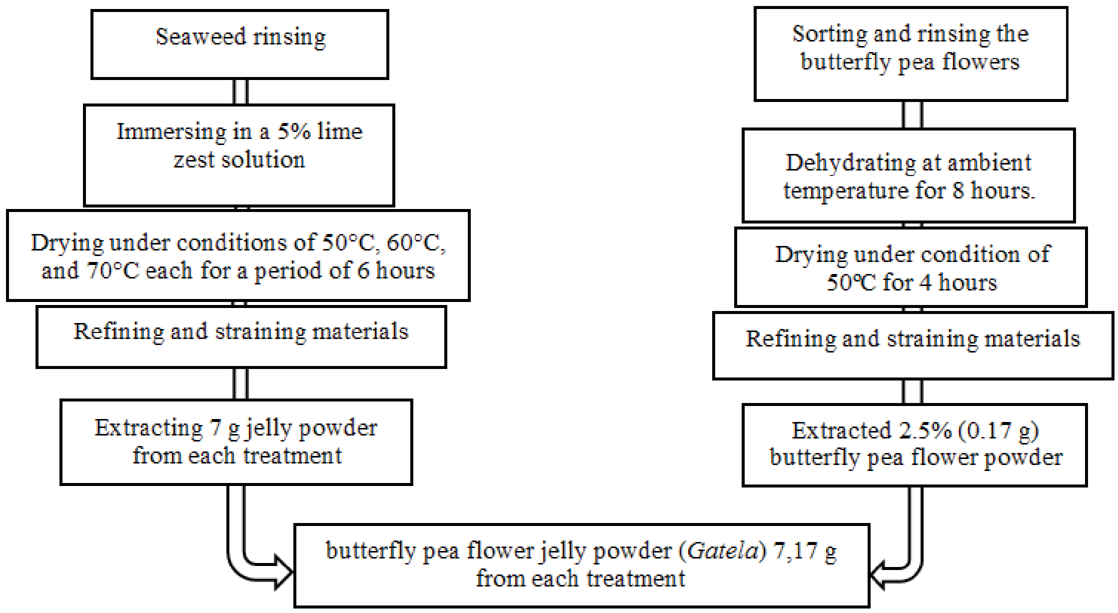

Chart 1. Process of Creating Butterfly Pea Flower Gelatin Powder

methanol, 15 N NaOH, HCI 1%, KCI pH 1.0, and sodium acetate pH 4.5. The requisite apparatus encompassed a cup, desiccator, reflux tube, beaker, filter paper, oven, furnace, and vial.

Ethical approval for this investigation was obtained from the Ethics Commission of Bengkulu Ministry of Health Polytechnic under Reference No. KEPK.BKL/139/04/2023. The research design employed is experimental, specifically characterized as experiment research, with the primary objective of evaluating a treatment pertaining to variations in seaweed drying temperatures—specifically, at 50°C, 60°C, and 70°C, as detailed in the work by Orilda et al. (2021). The overarching aim of this study is to discern the outcomes of analytical tests on water content, fiber content, and anthocyanin content within butterfly pea flower (Gatela) agar powder, the organoleptic qualities of which have been rigorously examined. The experimental treatments were systematically administered through the application of diverse seaweed drying temperatures, namely 50ºC, 60ºC, and 70ºC.

The organoleptic assessment involved 30 semi-trained panelists, selected based on specific criteria encompassing satiety, willingness, absence of color blindness, overall health, and absence of illness. Evaluations transpired at the Food Laboratory of Poltekkes Kemenkes Bengkulu. Each distinct jelly sample was presented in coded cups, with predetermined codes corresponding to the seaweed drying temperatures employed, namely 50ºC (coded as 159), 60ºC (coded as 274), and 70ºC (coded as 315). Panelists independently assess the provided samples, responding to a questionnaire based on personal judgment devoid of external influences. Prior to tasting successive samples, panelists cleanse their palate with supplied water. Organoleptic evaluations encompass assessment of color, aroma, taste, and texture. The ordinal ranking sequence employed for organoleptic test evaluations of the four parameters is as follows: 1 = strongly dislike, 2 = dislike, 3 = somewhat like, 4 = like, and 5 = strongly like. Subsequently, the organoleptic test outcomes for the identified products are subjected to analysis, focusing on water, crude fiber, and anthocyanin content, within the laboratory facilities of Bengkulu University (UNIB).

The analytical scrutiny of data derived from organoleptic assessments was employed Kruskal-Wallis test. In the event that the initial analysis yields a significance level (p-value) below 0.05, further examination will be undertaken utilizing the Mann-Whitney test for more nuanced insights.

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RESULTS AND DISCUSSION

Color

Upon scrutinizing the evaluations provided by the 30 panelists, it was discerned that 17 individuals exhibited a preference for the coloration of butterfly pea flower jelly (Gatela) subjected to a seaweed drying temperature of 70ºC. The outcomes of the Kruskal-Wallis test, conducted to appraise the treatments, revealed no statistically significant impact on the organoleptic attributes related to the color of butterfly pea flower (Gatela) jelly (p-value = 0.143, $p > 0.05$). Consequently, the execution of the Mann-Whitney test was deemed unnecessary. The empirical findings indicate that, at a seaweed drying temperature of 70ºC, the average assessment value from the panelists who expressed a preference for the color of butterfly pea flower jelly (Gatela) stands at 3.83.

The present investigation delves into the discernible impact of seaweed drying temperatures on the chromatic manifestation of butterfly pea flower jelly, known as “Gatela.” The alterations in coloration are inherently linked to the elevated drying temperatures, a phenomenon elucidated by the degradation of chlorophyll within the seaweed matrix, resulting in a concomitant diminution in luminosity (Widyastuti, et al., 2021). Furthermore, the infusion of butterfly pea flowers, replete with anthocyanin content, into the seaweed jelly substrate precipitates an additional transformative effect, ultimately inducing a discernible shift towards a purplish hue.

Noteworthy is the absence of statistically significant disparities in the coloration of the butterfly pea flower seaweed jelly powder (Gatela) across varied drying temperatures. Although perceptible distinctions in color intensity were observed upon visual inspection—manifesting as a slightly deepened purple hue at 50°C, a characteristic purple hue at 60°C, and a marginally brighter purple hue at 70°C—these distinctions failed to attain statistical significance.

Aroma

Upon scrutiny of evaluations provided by 30 panelists, it was ascertained that 18 individuals expressed a favorable disposition toward the aroma of butterfly pea flower jelly (Gatela) when subjected to a seaweed drying temperature of 50ºC. Employing the Kruskal-Wallis test to scrutinize treatment effects on the organoleptic attributes of the aroma, a calculated p-value of 0.397 ($p > 0.05$) was derived, signifying a lack of statistical significance. Consequently, the Mann-Whitney test, which would have further interrogated potential distinctions, was deemed unnecessary. The research findings elucidate that, at a seaweed drying temperature of 50ºC, the average panelist score for aroma preference stood at 3.60, underscoring a noteworthy predilection for the olfactory characteristics of butterfly pea flower jelly (Gatela).

The findings of the investigation indicate a lack of discernible disparity in the organoleptic aroma preferences among the panelists, notwithstanding variations in seaweed drying temperature. *Eucheuma cottonii*, the seaweed under examination, is acknowledged for its intrinsic alkaline nature and characteristic piscine odor owing to the presence of ammonia. Intriguingly, alterations in seaweed drying temperatures did not yield concomitant changes in the aromatic profile exhibited by the butterfly pea flower agar (Gatela). This resilience in aroma consistency is attributed to the mitigating influence of a lime-infused

Table 1. Mean Organoleptic Evaluation of Butterfly Pea Flower Jelly Powder (Gatela) under Varied Drying Temperatures of Seaweed Substrates

No	Organoleptic Criteria	Temperature			p-value
		50ºC (159)	60ºC (274)	70ºC (315)	
1	Color	3.47	3.73	3.83	0.143
2	Aroma	3.60	3.43	3.47	0.397
3	Texture	3.80	3.03	1.53	<0.001
4	Taste	3.30	3.60	2.73	<0.001

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soaking process, as elucidated by Rosalita et al. (2018), the amalgamation of acidic compounds resulting from lime soaking serves to neutralize the inherently fishy aroma, effecting a diminution or even complete elimination thereof.

Texture

Upon analysis of evaluations provided by 30 panelists, a noteworthy observation emerged, indicating that 18 individuals expressed a favorable inclination towards the gelatinous texture of butterfly pea flowers (Gatela) when subjected to a seaweed drying temperature of 50ºC. Employing the Kruskal-Wallis test to scrutinize treatment effects on the organoleptic attributes of the texture yielded a strikingly significant outcome, as evidenced by a p-value of <0.001 ($p < 0.05$). Consequently, a subsequent Mann-Whitney test was executed to delve deeper into the nuances of observed distinctions. The research outcomes elucidate that, at a seaweed drying temperature of 50ºC, the average panelist rating for texture preference stood at 3.80, affirming a discernible proclivity for the gelatinous quality of butterfly pea flower jelly (Gatela).

The outcomes of the investigation revealed a discernible influence of diverse seaweed drying temperatures on texture characteristics. Comparative analysis of textures arising from three distinct seaweed drying temperatures applied to Telang flower jelly (Gatela) unveiled a statistically significant impact on agar texture ($p < 0.001$). Intriguingly, higher drying temperatures yielded a gelatinous texture characterized by reduced density and chewiness. This observed phenomenon is attributed to the consequential degradation of carrageenan polymer chains within the seaweed matrix at elevated drying temperatures, leading to a decline in viscosity and subsequently impacting gel formation. The attenuated durability or strength of carrageenan, stemming from its diminished viscosity, is countered by higher carrageenan content, imparting greater repulsion and fortitude to the resulting gel, as expounded by Pratiwi et al. (2022). Complementing these findings, Uju et al. (2018) reported the highest viscosity value at a seaweed drying temperature of 50ºC.

Upon the continuation of the Mann-Whitney test for butterfly pea flower seaweed jelly powder (Gatela) at varying seaweed drying temperatures, specifically 50ºC (159) versus 60ºC (274), a discernible difference in texture was uncovered, evidenced by a statistically significant p-value of <0.001 ($p < 0.05$). Similarly, a distinct textural contrast emerged between butterfly pea flower seaweed jelly powder (Gatela) subjected to seaweed drying temperatures of 50ºC (159) and 70ºC (315), substantiated by a p-value of <0.001 ($p < 0.05$). Further, the examination of textures in butterfly pea flower seaweed jelly powder (Gatela) under drying temperatures of 60ºC (274) versus 70ºC (315) elucidated a significant difference, as indicated by a p-value of <0.001 ($p < 0.05$). This observed textural variability is intricately linked to carrageenan, a polysaccharide inherent to seaweed, renowned for its utility as a thickening and gelling agent. Carrageenan's distinctive capacity to bind and retain water imparts a robust texture to food products, as underscored by Yudiastuti et al. (2023).

Taste

Following the evaluation conducted with a sample of 30 panelists, it was revealed that 18 individuals exhibited a preference for the flavor profile of butterfly pea flower jelly (Gatela) when subject to a seaweed drying temperature of 60ºC. The application of the Kruskal-Wallis test yielded a statistically significant impact on the organoleptic attributes of taste in butterfly pea flower (Gatela) jelly, with a calculated p-value of <0.001 ($p < 0.05$). Subsequent to this observation, the Mann-Whitney test was executed to further elucidate the nature of the identified distinctions. The research findings underscore that, at a seaweed drying temperature of 60ºC, the average rating assigned by panelists who favored the taste was 3.60, indicating a discernible inclination toward the flavor profile of butterfly pea flower jelly (Gatela).

Elevated drying temperatures exert a discernible influence on the firmness of the resulting gel, a phenomenon attributable to the presence of carrageenan within the seaweed matrix. Carrageenan, renowned for its water-binding capacity (hydrocolloids), plays a pivotal role in the gel formation process by effectively binding water-soluble sugars. This intrinsic property of carrageenan is expounded upon in the study by

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Stevani et al. (2019), elucidating its capability to bind and retain water. Aligning with the findings of Fajarini et al. (2018), it is established that increased carrageenan content contributes to a discernible sweetness in black grape skin jelly candy (*Vitis vinifera*).

As elucidated in the exposition by Vania (2017), the augmentation of double helix polymer chains is notably pronounced in response to elevated concentrations of carrageenan. This heightened concentration imparts increased strength and robustness to the polymer structure. The substantial binding of water molecules, facilitated by carrageenan, further contributes to the fortification of the gel matrix, rendering it firmer and more resilient. Noteworthy, however, is the tasteless nature of carrageenan, as expounded upon in the literature, indicating its lack of influence on taste parameters.

Upon the continuation of the Mann-Whitney test for butterfly pea flower jelly powder (Gatela) at distinct seaweed drying temperatures—specifically, 50ºC (159) versus 60ºC (274)—discernible taste disparities were unveiled. The calculated p-value of 0.048 ($p < 0.05$) attests to the statistical significance of the identified taste differences at these temperatures. Similarly, the exploration of taste nuances in butterfly pea flower jelly powder (Gatela) subjected to seaweed drying temperatures of 50ºC (159) versus 70ºC (315) revealed significant taste distinctions, as indicated by a p-value of 0.004 ($p < 0.05$). Furthermore, the assessment of taste variances in butterfly pea flower jelly powder (Gatela) exposed to seaweed drying temperatures of 60ºC (274) versus 70ºC (315) confirmed a pronounced taste disparity, underscored by a p-value of 0.000 ($p < 0.05$).

Water content

The analysis of water content in butterfly pea flower jelly powder (Gatela) at a drying temperature of 50ºC revealed a content of 12.18%. In alignment with the findings of Orilda (2021), there was an observed reduction in water content in dried *Eucheuma cottonii* seaweed across a range of drying temperatures (50°C - 70°C), registering at 15.87% - 10.69%. A comparative examination with the water content of butterfly pea flower herbal tea, dried at 50ºC for 4 hours, disclosed a content of 10.18% (Martini et al., 2020). Notably, despite the incorporation of butterfly pea flower, the water content in butterfly pea flower jelly powder (Gatela) adheres to established quality standards for water content in flour gelatin, as stipulated by SNI 2802:2015, which prescribes a maximum threshold of 22%.

The desiccation procedure applied to a material inherently leads to a reduction in water content. This reduction holds paramount significance, as higher water content in food renders it more susceptible to deleterious consequences such as microbial growth, biological activity, and the infiltration of detrimental bacteria, thereby exacerbating the risk of spoilage or deterioration (Herliyana et al., 2022). The inverse correlation between water content and the longevity of food underscores the pivotal role of the drying process in fortifying the stability and shelf-life of consumable products.

Crude Fiber Content

The analysis of crude fiber content in butterfly pea flower jelly powder (Gatela) subjected to a seaweed drying temperature of 50ºC revealed a content of 4.95%, demonstrating a notable increase compared to the crude fiber content in fresh *Eucheuma cottonii* seaweed, which ranged from 2.25% to 2.82% (Safia et al., 2020). This finding aligns closely with the results of research by Khotijah et al. (2020), indicating a comparable crude fiber content of 3% in fresh *Eucheuma cottonii* seaweed. Additionally, insights from Kusuma et al. (2019) underscore the correlation between drying temperature and crude fiber content, elucidating a progressive increase in crude fiber levels with escalating drying temperatures.

The evaluation of crude fiber content in seaweed subjected to drying temperatures of 50°C, 60°C, and 70°C for a duration of 6 hours yielded values of 1.15%, 1.25%, and 1.4%, respectively (Orilda et al., 2021). This indicates a considerable deviation of 49.5% from the baseline research result of 1.15% (Orilda et al., 2021). Beyond the impact of drying temperature, the incorporation of crude fiber content from butterfly pea flowers introduces an additional dimension. According to research by Handito et al. (2022), fresh butterfly pea flowers boast a crude fiber

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content of 5.5%. Consequently, the calculated crude fiber ratio is 3.8% higher than the findings of Orilda et al. (2021) at an equivalent seaweed drying temperature of 50°C.

The elevated crude fiber content within this jelly formulation holds promise in mitigating obesity and heart disease. The presence of fiber accelerates the expulsion of food waste through the digestive tract, contributing to overall digestive health. Furthermore, fiber exerts regulatory effects on blood glucose and blood cholesterol levels, thereby playing a pivotal role in metabolic control. Additionally, the inclusion of fiber has been associated with a reduction in the risk of cancer, as highlighted by Damayanti et al. (2020).

Anthocyanin Level

The analysis of anthocyanin content in butterfly pea flower jelly powder (Gatela) at a seaweed drying temperature of 50ºC revealed a concentration of 154.84 ppm or 15.484 mg/100g. These findings, however, indicate a lower anthocyanin level compared to fresh butterfly pea flowers, which boasts a concentration of approximately 22.74 mg/100g (Kiranawati et al., 2022). This discrepancy is primarily attributed to the preservation of anthocyanins in fresh butterfly pea flowers, as they have not undergone processes such as drying or heating that may compromise or degrade these compounds, as elucidated by Purwaniati et al. (2020).

In contrast to the findings presented by Martini et al. (2020), the crude anthocyanin content in butterfly pea flower tea powder subjected to a drying temperature of 50ºC for 4 hours reached 249.7 mg/100g. This discrepancy becomes more pronounced when considering that the study incorporated only 2.5% (0.17g) of butterfly pea flower tea powder, while Martini et al. utilized 1g. The observed lower anthocyanin content in butterfly pea flower (Gatela) agar powder at a drying temperature of 50ºC is attributed to the natural degradation of anthocyanins during the storage process.

Elevated storage temperatures have been identified as a catalyst for anthocyanin degradation, leading to a consequential reduction in anthocyanin concentration. This phenomenon is underscored by the research findings of Permatasari (2021), wherein buni fruit coloring powder stored at 55°C exhibited a more substantial decline in anthocyanin levels compared to storage at temperatures of 28°C and 35°C. While the current study did not explicitly manipulate storage temperature as a variable, the butterfly pea flower (Gatela) agar powder under investigation was stored at room temperature. It is noteworthy that room temperature can induce anthocyanin damage through oxidation, resulting in a subsequent decline in anthocyanin content, as elucidated by Nalawati et al. (2022).

Additives incorporating anthocyanins serve a dual purpose as natural food coloring agents, imparting vibrant colors to a spectrum of food and beverage products. Beyond their aesthetic contribution, anthocyanins play a crucial role in averting degenerative diseases. This is exemplified in their ability to combat cardiovascular diseases by mitigating and inhibiting cholesterol levels in the bloodstream, stemming from the oxidation of low-density lipoproteins (LDL), as evidenced by Priska et al. (2018).

CONCLUSION

The optimal choice for butterfly pea flower (Gatela) jelly powder is discerned at a seaweed drying temperature of 50ºC. This preference aligns with the SNI standards, as the analysis indicates a water content of 12.18%, falling within the specified range for jelly flour. Further scrutiny reveals a crude fiber content of 4.95% and an anthocyanin content of 154.84 ppm.

To enhance product development, it is advisable to delve deeper into preferences, explore additional macro and micro-nutrient compositions, and meticulously examine the impact of varying temperatures and storage durations. A comprehensive comparative analysis between treatments and control variables will shed light on the nuanced intricacies influencing the overall quality of butterfly pea flower (Gatela) jelly, facilitating a more nuanced and informed approach to formulation.

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