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Chemical And Microbiological Properties Of Fermented Dragon Fruit Peel Beverages

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ABSTRAK

Dragon fruit peel is rich in bioactive compounds such as betacyanin, betasianidin, polyphenols, and dietary fiber, which can potentially provide health benefits and added value to food products. This research aimed to determine the best formulation of fermented dragon fruit peel beverages based on chemical and microbiology characteristics. The fermentation process is a method for increasing the availability of nutrients in food, as well as creating new compounds that are beneficial for human health. Currently, there is a growing demand for fermented products originating from non-dairy sources, so research on fermented beverages from dragon fruit peel could be an interesting and sustainable solution in the functional food and beverage industry. Chemical analysis in the research conducted includes analysis of reducing sugar, total titratable acidity, and pH, while microbiological analysis was in the form of total lactic acid bacteria. The factor used in this research was the concentration of dragon fruit peel (20%, 40%, 60% and 80%). The results showed that the best formulation was 40% sugar concentration based on reducing sugar (2,92±0,023%,) total titratable acidity (0,27±0,015%), pH (3,53±0,025), and total lactic acid bacteria (4.8 x 109 CFU/ml)

Kata kunci — dragon fruit peel, fermented beverages, lactic acid bacteria

1. Introduction

Dragon fruit peel (Hylocereus spp.) is a waste that contains bioactive compounds such as betasianin, flavonoids, and polyphenols, which have potential as antioxidants, antimicrobials, and anticancer. This potential makes dragon fruit peels a valuable material for applications in various industries, including food, cosmetics, and pharmaceuticals. Studies have shown that dragon fruit peel extract can be used as an environmentally friendly natural colorant in food and cosmetic products, replacing synthetic colorants that can be harmful to human health (Enjelina et al., 2019). In addition, the high fiber content in dragon fruit peels can be utilized in the development of functional products and foods that are good for digestive health (Bethany et al., 2024).

One of the functional food products from dragon fruit peel is fermented beverages. Fermented beverages are products resulting from the fermentation process of food ingredients with the help of microorganisms such as lactic acid bacteria, yeast, or mold. This process converts components in the raw materials, such as sugars and carbohydrates, into alcohol, organic acids, or gases, resulting in specific flavors, textures, and functional properties. In addition to increasing shelf life, fermentation can also increase the nutrient content and biological activity of the base material, such as antioxidants, probiotics, and enzymes that are beneficial to health (Gänzle et al., 2015).

Several studies related to dragon fruit peel fermented products include dragon fruit peel fermented juice using lactic acid bacteria such as Lactobacillus sp., which produces a drink rich in probiotics and antioxidants, and helps improve digestive health (Saraswati et al., 2023). In addition, dragon fruit peel kombucha has also been produced by adding dragon fruit peel extract to kombucha tea fermented by a symbiosis of bacteria and yeast (SCOBY), resulting in a drink with high polyphenol content that functions as a natural antioxidant (Naufal et al., 2023). Dragon fruit peel vinegar is another innovation, where dragon fruit peels are naturally fermented to produce acetic acid which functions as a probiotic and flavor enhancer in food (Sari et al., 2013). These beverages utilize the potential of dragon fruit peels as a source of nutrients and bioactive compounds, while reducing food waste. The dragon fruit peel fermented beverage conducted in this study aims to determine the best concentration of dragon fruit peel based on chemical and microbiological characteristics.

2. Methodology

Materials

The materials used are dragon fruit peel, palm sugar, distilled water, luff reagent, KI 20%, H2SO4 26.5%, anhydrous Na2S2O3, amylum 1%, and MRSA media. The tools used are glass jars, stoves, pans, erlenmeyers, beaker glass, measuring pipettes, micro pipettes, burettes, petri dishes, autoclaves, hot plates, stirrers, and Laminar Air Flow (LAF).

Methods

The production process of the fermented beverage was based on a modified method of Sagita (2023). The dragon fruits were washed to remove impurities and residues. The dragon fruit was peeled and the pulp and peel were separated. The container to be used was sterilised with hot water, and palm sugar was boiled with water and poured into the container at a temperature of 37°C. The peel was then treated with 20%, 40%, 60% and 80% and incubated for 2 days at room temperature.

The concentration of dragon fruit peel used is

K1 : 20% dragon fruit peel
K2 : 40% dragon fruit peel
K3 : 60% dragon fruit peel
K4 : 80% dragon fruit peel

Chemical Analysis

Measurement of reducing sugar content using the Luff Schoorl method based on AOAC (1995), Measurement of total acid content using the total acid titrated method based on AOAC (2000) , and Total LAB testing was carried out using the pour plate method with MRSA media based on Ginting (2019).

Data Analysis

The data result was analyzed using SPSS, one way ANOVA (Analysis of Variance). Then followed by Duncan's multiple range test (DMRT) with a significant level of 5%.

3. Discussion

3.1. Chemical Analysis

Chemical analysis carried out, namely reducing sugar content, total acid content and pH, is shown in Table 1. Reducing sugar is formed as a result of sugar hydrolysis and serves as a carbon source in the fermentation process. Microorganisms further degrade reducing sugars to produce alcohol. A higher alcohol concentration in fermented products suggests a lower level of reducing sugars in the final product (Kim et al., 2018). Based on the analysis of variance, the addition of peel had a significant effect on the content of reducing sugar. In table 1, the highest reducing sugar content in treatment K2 is the concentration of sugar and peel in the same amount so that microbes are optimal in breaking down sugar into ethanol. Meanwhile, the higher the peel concentration, the number of microbes will increase because the peel contains microbes. The higher the number of microbes in the fermentation medium, the lower the reducing sugar content and the higher the ethanol produced. The content of reducing sugar decreases during the fermentation process, this is because the sugar contained in the fermentation medium will continuously be utilized by microbes for growth and ethanol formation (Putri et al., 2016).

Table 1. Chemical analysis of dragon fruit peel fermented drinks

Treatment	reducing sugar content (%)	total acid content (%)	pH
K1	1,66±0,021 b	0,19±0,012 a	3,58±0,006 b
K2	2,92±0,023 d	0,27±0,015 b	3,53±0,025 a
K3	1,98±0,017 c	0,18±0,025 a	3,71±0,021 c
K4	0,46±0,012 a	0,18±0,006 a	3,67±0,029 c

Note: value presented by different letters in the row indicated a significantly different (P<0.05) analyzed by DMRT test

Total acid is the amount of acid formed due to the fermentation process. Based on the analysis of variance, the addition of dragon fruit peel had a significant effect on the total acid content and pH. In table 1, the total acid content increased in proportion to the smaller pH value. The total acid content increases due to the increasing number of microbes converting sugar into ethanol and organic acids. This is in line with the research of Budiari et al (2023), which shows that the higher the concentration of kombucha culture used in the manufacture of fermented beverages of red ginger extract produces more organic acids so that the pH value is lower and the total acid is higher.

3.2. Microbiology Analysis

The microbiological analysis carried out is the analysis of the growth of lactic acid bacteria on MRSA media shown in table 2.

Table 2. Microbiology analysis of dragon fruit peel fermented drinks

Treatment	Total LAB (CFU/ml)
K1	$3{,}26 \times 10^{8} \pm 0{,}01^{a}$
K2	$4{,}8 \times 10^{9} \pm 1{,}00^{c}$
K3	$6{,}94 \times 10^{8} \pm 0{,}07^{b}$
K4	$1{,}69 \times 10^{10} \pm 1{,}00^{d}$

Note: value presented by different letters in the row indicated a significantly different (P<0.05) analyzed by DMRT test

Based on the analysis of variance, the addition of dragon fruit peel has a significant effect on the number of lactic acid bacteria. The more the amount of dragon fruit peel added, the more the number of lactic acid bacteria that grow. The increase in the number of lactic acid bacteria is thought to be caused by glucose as a source of nutrients (carbon source) for growth. This is in line with the research of Rizal et al (2013), stated that glucose in sufficient quantities can stimulate the growth of L. casei bacteria.

4. Conclusion

Based on data analyzed result, it is known that the concentration of dragon fruit peel has a significant different effect ($p<0,05$) on reducing sugar content, total titratable acidity content, pH, and total lactic acid bacteria. The results showed that the best formulation was 40% sugar concentration based on reducing sugar (2,92±0,023%,) total titratable acidity (0,27±0,015%), pH (3,53±0,025), and total lactic acid bacteria (4.8 x 109 CFU/ml)

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