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Storage Temperature on the Product Quality of Several Pro Coffee Variants That Contain (*Bacillus cereus* SN7)

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ABSTRACT

This study aims to analyze the effect of storage temperature on microbial growth in several pro coffee variants and to investigate the impact of storage temperature on the quality of pro coffee containing *B. cereus* SN7. The coffee variants used were original, latte, original jelly, and latte jelly at temperatures of 10, 25, and 37°C for 7 days of storage. Microbial growth was observed using the total plate count method, while the pro coffee quality was analysed using the organoleptic test. The results showed that low storage temperatures can inhibit microbial growth and maintain the quality of pro coffee. The lowest total number of microbes was found in the original variant with a storage temperature of 10°C, with a value of 0.11×10^3 CFU/mL, and the highest total number of microbes was found in the latte jelly variant with a storage temperature of 25°C, with a value of 3.476×10^3 CFU/mL. In the organoleptic test, the highest value was found in the latte variant coffee at a storage temperature of 10°C, categorized as 'very like', with a value of 35% for taste, 30% for aroma, and 30% for colour. The effect of temperature on the product quality of several probiotic coffee variants containing *B. cereus* SN7 showed a significant difference ($p < 0.05$) in microbial growth and the quality value of the probiotic coffee. Statistical analysis showed the effect of temperature on the product quality of several pro coffee variants containing *B. cereus* SN7.

Keywords: Microbes, Organoleptic test, Shelf life, Single cell protein, Total plate count.

1. INTRODUCTION

Coffee is one of the drinks of choice to accompany your busy activities. This results in an increase in the number of coffee consumers (Nasution, 2018). Coffee has its appeal in various circles, so it is necessary to increase the added value of coffee commodities. The application of technology to improve coffee quality can be achieved through multiple processes, including the plantation stage, processing, and storage. At the processing stage, the fermentation process using microorganisms has become a subject of study by various researchers (Sridevi et al., 2019).

Single-cell protein (SCP) is a high-protein biomass product derived from microbes. Bacillus cereus is one of the bacteria from the genus Bacillus that may be a source of protein production. Bacillus cereus is one of the bacteria from the genus Bacillus that may be a source of protein production. This is evident from several previous studies, which state that B. cereus is a probiotic that can inhibit several pathogenic bacteria and is also a heterotrophic bacterium capable of degrading toxic organic matter in the environment, particularly in water. One of the bacteria that has the potential to be developed as a Single-Cell Protein agent is *B. cereus,* which is classified as a heterotrophic bacterium (Feliatra et al., 2018).

Storage of food or beverages is a process undertaken to ensure a long shelf life and prevent spoilage, as each food ingredient requires different treatments, one of which is temperature control within a specific range to prevent damage (Karlida et al., 2017). Controlling the room temperature during storage is one of the factors that needs to be considered in preventing decay, as decay can be caused by various factors, including temperature, humidity, dryness, air and oxygen, light, and time (Sari et al., 2013).

TPC testing is followed by product shelf life. Product shelf-life testing helps monitor the development of microbes in the product during storage treatment. Samples will be tested hourly, daily, or weekly, depending on the type of product the researcher produces (Wati, 2018).

Organoleptic testing is a method that utilizes human senses as the primary tool to

evaluate the quality of a product, encompassing its appearance, smell, taste, and consistency/texture, which are essential for assessing the product's quality. According to Afrianti (2008), sensory properties, or organoleptics, are properties that can be assessed by the five senses, including taste (sour, salty, bitter) and flavour (aroma and taste).

2. RESEARCH METHOD

Time and Place

This research was conducted from October to December 2024. Inoculation of pro coffee-making bacteria was carried out at the Marine Microbiology Laboratory, Department of Marine Sciences, Faculty of Fisheries and Marine Sciences, Universitas Riau.

Procedures

Starter Preparation and Analysis

The first step is to make NA media in a petri dish aseptically. Then sterilise it with an autoclave. After sterilization, the NA media is transferred aseptically into a petri dish. Then, after the NA media is solid, *B. cereus* bacteria from the old media are inoculated into the new media using a sterile needle. Furthermore, the bacteria are incubated for 24 hours at 37°C in an incubator.

The growth media used in this study were milk and granulated sugar, which function as sources of carbohydrates and protein. Growth media were produced in sterile Erlenmeyer flasks. The production procedure involved adding or homogenising water and sugar on a hotplate for ± 20 minutes at a temperature of 47°C. Meanwhile, milk and other micronutrients, such as multivitamins, were pasteurised separately.

The *B.cereus* SN7 suspension was prepared by comparing its turbidity with that of the McFarland 10^5 solution. After the 100 mL sample bottle containing 10 mL of distilled water was sterilised by autoclaving, the incubated bacteria were then suspended in the bottle aseptically using an aseptic needle. Then, it was homogenized using a vortex until the turbidity of the suspension was equivalent to that of the McFarland solution that had been prepared. Coffee was made into four variants: original, latte, original jelly, and latte jelly, with the addition of a 5% bacterial suspension.

Pro coffee is packed into 250 mL plastic bottles and stored at temperatures of 10 °C, 25 °C, and 37°C. To analyse the shelf life of pro coffee, a survey method needs to be conducted by observing the comparison based on the shape, taste, and aroma of coffee at different storage temperatures on the 7th day. This analysis aims to assist in assessing and determining the best temperature to maintain the quality of pro coffee.

Next, the colony count was carried out on the coffee. The technique used in the TPC method in this test is the spread plate technique. Where to make a physiological solution as a media dilution solution, namely 10^{-1} to 10^{-5}. Then each sample of coffee product at different storage temperatures was put into a 10^{-1} dilution solution as much as 1 ml up to a dilution of 10^{-5}, then 0,1 ml of the suspension from the 10^{-5} dilution was put into a petri dish that already contained solid PCA (Plate Count Agar) media. The media mixed with the sample was leveled using an L-rod. The samples were incubated at 37°C for 6 hours. The results of colony growth on the media were calculated using a colony counter, and then the TPC results were obtained. The results of the number of colonies obtained were then entered into the bacterial calculation formula (Mardalisa et al., 2021).

Data analysis

The research data, including the total plate count and organoleptic tests, are presented in table form. Then, the data are analyzed using the ANOVA test, and the Duncan test is discussed descriptively, linking it to the literature related to the research results and data.

3. RESULT AND DISCUSSION

The Effect of Storage Temperature on the Shelf Life of Pro Coffee

Temperature affects bacterial growth, which can damage product quality standards. As bacterial growth increases, it can cause microbial contamination in products to exceed the microbial contamination limit, rendering them unsuitable for consumption. This is in accordance with BPOM Regulation No. 13 of 2019, which sets the maximum limit of microbial contamination in coffee drinks. Microbial contamination can be calculated using the Total Plate Count method. TPC calculations are performed to determine the number of bacterial colonies present in coffee with a suspension of *B. cereus* SN7 bacteria. The following are the results of the TPC value

analysis in Arabica coffee at different temperatures.

According to BPOM Regulation No. 13 of 2019, the limit for the number of microbes in coffee is 1 × 10^3 CFU/mL. In the TPC results graph above, several coffee variants with treatment A (10°C) do not exceed the microbial limit set by BPOM No. 13 of 2019, so the coffee is suitable for consumption. In several coffee variants with treatments B (25°C) and C (37°C), the number of microbes exceeds the standard set by BPOM No. 13 of 2019, which is likely contaminated with pathogenic bacteria and damages the product's composition. This renders the coffee in treatments B and C unfit for consumption.

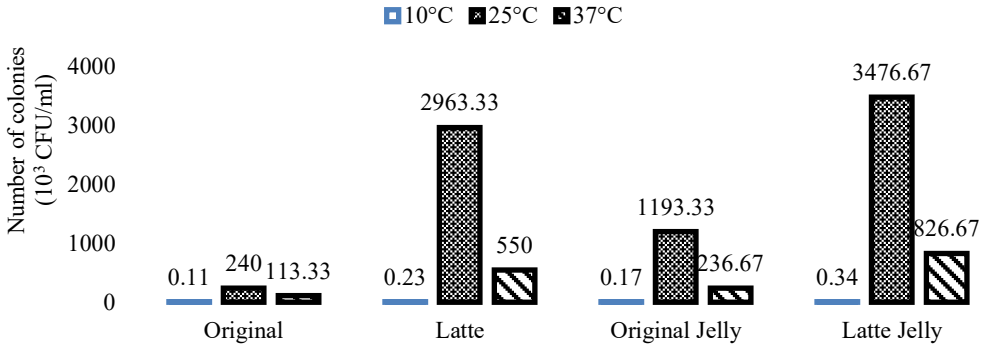

Figure 1. TPC graph at different storage temperatures

The Effect of Storage Temperature on Coffee Quality Pro

The quality of pro coffee products can be assessed through organoleptic tests to determine the suitability of the product for consumer consumption and to evaluate the quality of coffee based on sensory values. Organoleptic tests are also commonly referred to as sense tests or sensory tests. This test is carried out using human senses as the primary tool for measuring product acceptance.

Table 1. Percentage of organoleptic test of product taste

Product	Really dislike (%)	Do not like (%)	Neutral (%)	Like (%)	Really like (%)	Total %
Original A (10°C)	00	00	45	45	10	100
Original B (25°C)	100	00	00	00	00	100
Original C (37°C)	100	00	00	00	00	100
Latte A (10°C)	00	00	20	45	35	100
Latte B (25°C)	100	00	00	00	00	100
Latte C (37°C)	100	00	00	00	00	100
Original Jelly A (10°C)	00	35	50	15	00	100
Original Jelly B (25°C)	100	00	00	00	00	100
Original Jelly C (37°C)	100	00	00	00	00	100
Latte Jelly A (10°C)	00	15	50	35	00	100
Latte Jelly B (25°C)	100	00	00	00	00	100
Latte Jelly C (37°C)	100	00	00	00	00	100

The average organoleptic test conducted on the panellists regarding the taste of coffee with different storage temperatures showed the highest score results in treatment A, which corresponded to the lowest storage temperature. This is because storing pro coffee at the lowest temperature can maintain the original taste of the coffee, so the panellists prefer treatment A. The variant that the panellists like the most is the latte variant, with the highest 'very like' score of 35%, because the combination of milk and coffee creates a softer and creamier taste than black coffee.

The average organoleptic test results conducted on panellists regarding the aroma of coffee with different storage temperatures showed the highest scores in treatment A, or the lowest temperature storage (Table 2). Storing pro coffee at low temperatures can help maintain the original aroma of the coffee, which is why

panellists prefer coffee stored at low temperatures. The variant most preferred by panellists is the latte variant, with the highest 'very like' score of 30%, as the combination of coffee and milk aromas produces a softer and sweeter aroma.

Table 2. Percentage of organoleptic test of product aroma

Product	Really dislike (%)	Do not like (%)	Neutral (%)	Like (%)	Really like (%)	Total %
Original A (10°C)	00	00	45	40	15	100
Original B (25°C)	100	00	00	00	00	100
Original C (37°C)	100	00	00	00	00	100
Latte A (10°C)	00	00	25	45	30	100
Latte B (25°C)	100	00	00	00	00	100
Latte C (37°C)	100	00	00	00	00	100
Original Jelly A (10°C)	00	30	55	15	00	100
Original Jelly B (25°C)	100	00	00	00	00	100
Original Jelly C (37°C)	100	00	00	00	00	100
Latte Jelly A (10°C)	00	25	55	20	00	100
Latte Jelly B (25°C)	100	00	00	00	00	100
Latte Jelly C (37°C)	100	00	00	00	00	100

Table 3. Percentage of organoleptic test of product color

Product	Really dislike (%)	Do not like (%)	Neutral (%)	Like (%)	Really like (%)	Total %
Original A (10°C)	00	00	40	40	20	100
Original B (25°C)	100	00	00	00	00	100
Original C (37°C)	100	00	00	00	00	100
Latte A (10°C)	00	00	20	50	30	100
Latte B (25°C)	100	00	00	00	00	100
Latte C (37°C)	100	00	00	00	00	100
Original Jelly A (10°C)	00	30	50	20	00	100
Original Jelly B (25°C)	100	00	00	00	00	100
Original Jelly C (37°C)	100	00	00	00	00	100
Latte Jelly A (10°C)	00	30	50	20	00	100
Latte Jelly B (25°C)	100	00	00	00	00	100
Latte Jelly C (37°C)	100	00	00	00	00	100

The average test conducted on the panellists regarding the colour of coffee with different storage temperatures showed the highest score results in treatment A, or the lowest temperature storage. Storing pro coffee at low temperatures can maintain the original colour of the coffee, so panellists prefer coffee stored at low temperatures. The variant most preferred by panellists is the latte variant, with the highest 'very like' score of 30%, because the combination of coffee and milk produces a light brown colour that gives a beautiful and elegant impression.

4. CONCLUSION

The study's results, which analyzed the impact of storage temperature on the product quality of several pro coffee variants containing *B. cereus* SN7, show that temperature significantly affects the quality and shelf life of pro coffee products.

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