Research Article

Cilembu Sweet Potato (*Ipomoea batatas* L.) Puree as a Local Prebiotic Source to Enhance the Quality of Synbiotic Yogurt

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Abstract | Synbiotic yogurt formulations commonly rely on conventional or imported prebiotic ingredients, while the potential of locally available carbohydrate-rich crops in Indonesia remains underutilized. Cilembu sweet potato (*Ipomoea batatas* L.) is a traditional variety with documented nutritional properties and prebiotic-related characteristics, yet its application as a prebiotic source in fermented dairy products has not been comprehensively evaluated. This study evaluated the use of Cilembu sweet potato (*Ipomoea batatas* L.) puree as a local prebiotic source for synbiotic yogurt fortification. The effects of Cilembu puree incorporation on the yogurt's color attributes (L*, a*, b*), color spectrum, physicochemical characteristics (moisture, ash, water-holding capacity, total acidity, starch), rheology, texture, and lactic acid bacteria (LAB) viability were evaluated. A completely randomized design was applied with four treatments and five replications: T0 (0%), T1 (4%), T2 (6%), and T3 (8%) of Cilembu sweet potato puree addition. The addition of Cilembu sweet potato puree significantly affected ($P < 0.05$) on water-holding capacity, moisture, and ash content, alongside enhanced texture and rheological stability. The highest concentration (8%) produced yogurt that was more viscous, stable, and visually appealing, with a color shift toward a yellowish-red hue. These findings suggest that fortification with 8% Cilembu sweet potato puree effectively enhances the physical and functional qualities of synbiotic yogurt without compromising microbial viability, supporting the utilization of Cilembu as a promising local prebiotic ingredient in synbiotic yoghurt.

Keywords | Lactic acid bacteria (LAB), Local functional food, Prebiotic fortification, Physicochemical properties, Rheological characteristics

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INTRODUCTION

Along with the advancement of biotechnology in Indonesia, the consumption of fermented foods among Indonesians has been increasing. Yogurt is one of the fermented milk products that has gained popularity in recent years (Amelia *et al.*, 2022). According to data from the Indonesian Food and Drug Authority (BPOM) Regulation Number 30 of 2018, Indonesians consume approximately 155 grams of fermented milk products, including yogurt, per day, and this number continues to increase annually. Data from the Ministry of Industry

(2020) also reported that yogurt imports rose by 225.98% between 2012 and 2016. Yogurt is produced through the fermentation of milk by lactic acid bacteria (LAB), mainly *Lactobacillus bulgaricus* and *Streptococcus thermophilus* (Amelia *et al*., 2022). This process results in a semi-solid or compact texture with a smooth consistency and a distinctive flavor due to compounds such as diacetyl, acetaldehyde, and carbon dioxide (Yurliasni *et al*., 2020). As a fermented dairy matrix containing live lactic acid bacteria, yogurt acts as a functional carrier for probiotics, enabling the delivery of health-promoting microorganisms while maintaining desirable sensory and nutritional qualities (Ribeiro *et al*., 2019). Prebiotics, on the other hand, are food components that selectively stimulate the growth and activity of beneficial microorganisms, especially in the large intestine. Prebiotics must fulfill several criteria: They must be non-digestible, stimulate the growth of beneficial bacteria, and inhibit the proliferation of pathogenic microorganisms (Yurliasni *et al*., 2020; Anand *et al*., 2018; Suciati and Safitri, 2021). Common prebiotics include inulin, fructooligosaccharides (FOS), galactooligosaccharides (GOS), and resistant starch mostly derived from fruits, vegetables, and tubers (Delgado-Fernández, 2019). These prebiotic carbohydrates are resistant to digestion in the upper gastrointestinal tract and reach the intestine largely intact, where they can be selectively fermented by lactic acid bacteria. LAB possess specific transport systems and glycosidic enzymes that enable them to hydrolyze oligosaccharides and resistant starch fractions into fermentable sugars, which are further metabolized to produce lactic acid and other metabolites. This selective utilization supports the growth and metabolic activity of beneficial LAB while limiting substrate availability for potentially harmful microorganisms. Consequently, the addition of inulin or other prebiotic ingredients can enhance the viability and activity of probiotic bacteria during yogurt fermentation (Ehsani *et al*., 2018). Cilembu sweet potato (*Ipomoea batatas* L.) is a local Indonesian tuber known for its high starch and carbohydrate content (Setiawati *et al*., 2018). In addition to being rich in natural sugars such as fructose, sucrose, and glucose, it contains inulin, FOS, GOS, and resistant starch, all of which are potential prebiotic compounds. The puree of Cilembu sweet potato contains approximately 78.75% starch and 95.11% carbohydrates, which can serve as prebiotic substrates that support the growth of lactic acid bacteria during fermentation (Mahmudatussa'adah, 2014). Enhanced LAB activity leads to greater acid production, resulting in lower pH and higher total acidity in yogurt (Morady *et al*., 2023). A reduction in pH promotes protein aggregation, increasing viscosity and improving yogurt texture (Rohman and Maharani, 2020). However, studies evaluating the comprehensive effect of local prebiotics such as Cilembu sweet potato on yogurt color, rheology, texture, and microbial stability remain limited.

The yellow to orange pigmentation of Cilembu sweet potato puree, derived from its natural carotenoids such as beta-carotene, can also influence the appearance of yogurt, potentially producing a pale yellow hue (Marwani *et al*., 2023). Thus, the incorporation of Cilembu sweet potato puree into synbiotic yogurt may not only improve its nutritional and functional value but also affect its color, physicochemical, and microbiological characteristics. Therefore, this study aimed to evaluate the effects of adding Cilembu sweet potato puree (*Ipomoea batatas* L.) on the color attributes, color spectrum, physicochemical properties, and microbiological quality of synbiotic yogurt.

MATERIALS AND METHODS

Study design

This study was conducted using a Completely Randomized Design (CRD) with four treatments and five replications to evaluate the effects of Cilembu sweet potato (*Ipomoea batatas* L.) puree fortification on synbiotic yogurt. The treatments consisted of: T0= Control (without puree addition); T1= 4% Cilembu sweet potato puree; T2= 6% Cilembu sweet potato puree; T3= 8% Cilembu sweet potato puree. Parameters observed included color attributes (L, a, b*), color spectrum, physicochemical characteristics (moisture, ash, water-holding capacity, acidity, starch content), texture, rheology**, and total lactic acid bacteria (LAB) count.

Preparation of cilembu sweet potato puree

The preparation of Cilembu sweet potato puree with modifications (Suwannaphan, 2022). Fresh Cilembu sweet potatoes were obtained from local farmers in Cilembu, West Java, Indonesia. The tubers were selected based on uniformity in size and shape, absence of physical damage (cuts, bruises, and decay). Only visually healthy and intact tubers were used for puree preparation. Fresh Cilembu sweet potatoes were peeled, washed under running water, and steamed at 75 °C for 25–30 minutes until softened. The steamed sweet potatoes were blended with 30% (w/w) distilled water until smooth, producing the puree used for yogurt fortification.

Production of synbiotic yogurt

The production of synbiotic yogurt was carried out according to Adjei *et al*. (2024) with some modifications. Fresh cow's milk was mixed with Cilembu sweet potato puree at concentrations of 0%, 4%, 6%, and 8%. The mixture was homogenized for 5 minutes and pasteurized at 72 °C for 15 seconds. After cooling to 43 °C, the mixture was inoculated with 3% lactic acid bacteria starter (*Lactobacillus bulgaricus* and *Streptococcus thermophilus*) and incubated at room temperature (28-32°C) for 24 hours. The resulting yogurt was stored at 4 °C before analysis. The production process of synbiotic yogurt is illustrated in Figure 1.

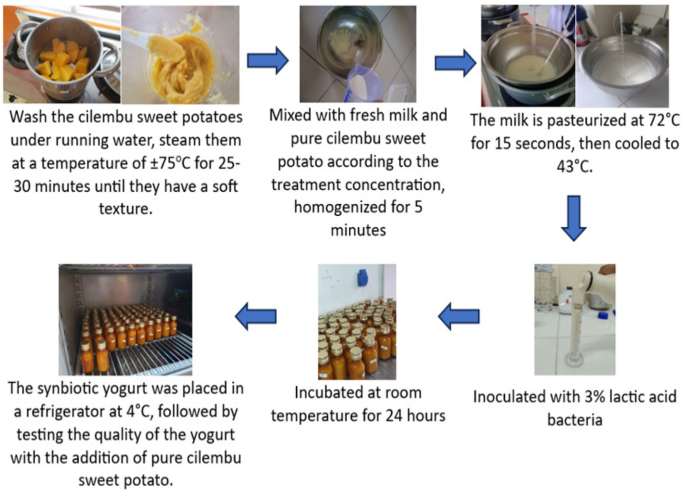

Figure 1: Production process of synbiotic yogurt.

L*a*b* color testing method

L*, a*, and b* color measurements were carried out using a color reader (Milovanovic *et al.*, 2020). In the CIELAB color space, each dimension has a specific meaning: The CIE L* value represents color brightness, where 0 corresponds to black and 100 corresponds to white; the CIE a* value indicates the green–red axis, with negative values representing green and positive values representing red; and the CIE b* value represents the blue–yellow axis, with negative values indicating blue and positive values indicating yellow.

Color spectrum testing method

Psychometric parameters were calculated from the color measurement results (L*, a*, and b* values) following Milovanovic *et al.* (2020), including chroma and hue angle. Chroma (C*) representing color saturation was calculated as:

$$C^* = (a^{*2} + b^{*2})^{1/2}$$

While the hue value (h*) was determined as:

$$h^* = \tan^{-1}(b^*/a^*)$$

And the hue angle was expressed in degrees by converting radians using:

$$\text{Hue angle} = h^* \times 180/\pi$$

Texture testing method

Texture was evaluated using a TAXT Texture Analyzer (Stable Micro Systems, Surrey, UK) with a back-extrusion cell attachment for yogurt (Terzioglu *et al.*, 2024). The maximum force (N) required to deform the sample was recorded to indicate firmness and consistency.

Rheological testing method

Rheological properties were analyzed using a cone-plate rheometer at 25 ˚C (Terzioglu *et al.*, 2024) with the following specifications: cone diameter: 40 mm, cone angle: 2˚, gap: 0.05 mm, strain sweep: 0.1%–10% to determine the linear viscoelastic region (LVR), frequency sweep: 0.1–10 Hz. The storage modulus (G') and loss modulus (G") were recorded to determine the viscoelastic behavior of yogurt.

Moisture content testing method

The moisture content of the yogurt samples was determined following the AOAC (2025) protocol. An empty aluminum moisture dish was first dried in a hot-air oven at 105 ˚C for 15 minutes and then cooled in a desiccator to room temperature before weighing. Approximately 5 g of yogurt sample was placed into the pre-weighed dish and dried in an oven at 105 ˚C for 6 hours, or until a constant weight was achieved. After drying, the dish was transferred to a desiccator for 30 minutes and subsequently reweighed. Moisture content was calculated using:

$$Moisture\ Content = \frac{Initial\ Sample\ Weight - Final\ Sample\ Weight}{Initial\ Sample\ Weight}\ x\ 100\%$$

Ash content testing method

Ash content was determined according to the AOAC (2005). A clean porcelain crucible was first heated in a muffle furnace at 400 ˚C for 1 hour, then removed using crucible tongs and cooled in a desiccator for 1 hour before weighing (A). Approximately 5 g of yogurt sample was placed into the pre-weighed crucible (B) and incinerated in the muffle furnace at 400 ˚C for 1 hour. The crucible was subsequently cooled in a desiccator and reweighed (C). Calculation of ash content can be calculated using the formula:

$$Ash\ Content\ (\%) = \frac{C - A}{B}\ x\ 100\%$$

Water holding capacity testing method

Water holding capacity was determined using a centrifugation method following Korkmaz *et al.* (2021). An empty centrifuge tube was weighed, after which 10 g of yogurt sample was added and recorded as W1. The tube was then centrifuged at 4000 rpm for 10 minutes. Following centrifugation, the separated supernatant was carefully decanted and weighed (W2). Water holding capacity was calculated using the following formula:

$$Water\ Holding\ Capacity\ (\%) = \left(1 - \frac{Supernatant\ weight}{initial\ weight\ of\ yogurt}\right) \times 100\%$$

Titratable acidity testing method

Titratable acidity of the yogurt samples was determined according to the method described by Melia *et al.* (2021). A volume of 10 mL of yogurt sample was transferred into an Erlenmeyer flask, followed by the addition of 2–3 drops of 1% phenolphthalein indicator. The sample was titrated with 0.1 N NaOH until a persistent pale pink endpoint was observed. The acidity test is calculated using the following formula:

$$Acidity\ (\%) = \frac{V1 \times N \times B}{v2} \times 100\%$$

Explanation; V1: Volume of NaOH (mL), V2: Volume of yogurt (mL), N: Normality of NaOH (0.1 N), B: Molecular Weight of Lactic Acid (90).

Lactic acid bacteria testing method

LAB counts were determined using the pour plate method on de Man, Rogosa, and Sharpe (MRS) agar (Melia *et al*., 2021). Serial dilutions (10^{-1}–10^{-8}) were prepared in sterile peptone water, and 1 mL of each dilution was plated. Plates were incubated at 37 °C for 48 hours. Colonies were counted using a Colony Counter, and results were expressed as log CFU/mL. Counts within 30–300 colonies per plate were considered valid according to ICMF (International Commission on Microbiology and Food) standards.

Statistical analysis

All data, except rheological and texture parameters, were analyzed using one-way ANOVA in a Completely Randomized Design (CRD) with four levels of Cilembu sweet potato puree (0%, 4%, 6%, and 8%) and five replications per treatment. Prior to ANOVA, data were checked for compliance with statistical assumptions. Normality of residuals was evaluated using the Shapiro Wilk test, and homogeneity of variances was assessed using Levene's test. When the assumptions were satisfied, treatment means were compared at a significance level of $P < 0.05$ using Duncan's multiple range test. The rheological and texture data were analyzed descriptively and interpreted by comparison with relevant published references. Statistical analyses were performed using SPSS version 26 (IBM Corp., Armonk, NY, USA).

RESULTS AND DISCUSSION

Characteristics of L*, a*, b* colors and the color spectrum

The effects of Cilembu sweet potato (*Ipomoea batatas* L.) puree addition on the L*, a*, and b* values and the color spectrum of synbiotic yogurt are presented in Table 1. Analysis of variance revealed that the addition of Cilembu puree significantly affected the L* and b* values ($P < 0.05$), but had no significant effect on the a* value ($P > 0.05$). Yogurt without puree (T0) exhibited the highest brightness (L* = 91.56 ± 0.28), while yogurt fortified with 8% puree (T3) showed the lowest brightness (L* = 90.53 ± 0.37). An increase in puree concentration led to higher b* values, indicating a transition in yogurt color from purple-red in T0 to yellowish-red in T3. The chroma and hue angle parameters confirmed this shift, with T0 having a chroma value of 75.25 and hue angle of 279.76°, while T3 exhibited 116.74 and 304.58°, respectively. These results suggest that β-carotene and xanthophyll pigments in Cilembu sweet potato contribute to the observed color enhancement. Visual appearance of yogurt samples at different puree concentrations is shown in Figure 2, while the color distribution is represented in Figure 3. The L* value represents lightness, ranging from 0 (black) to 100 (white). In this study, yogurt without Cilembu puree (T0) had the highest L* value, while yogurt with 8% puree (T3) exhibited the lowest brightness (90.53). The gradual decrease in brightness was associated with the

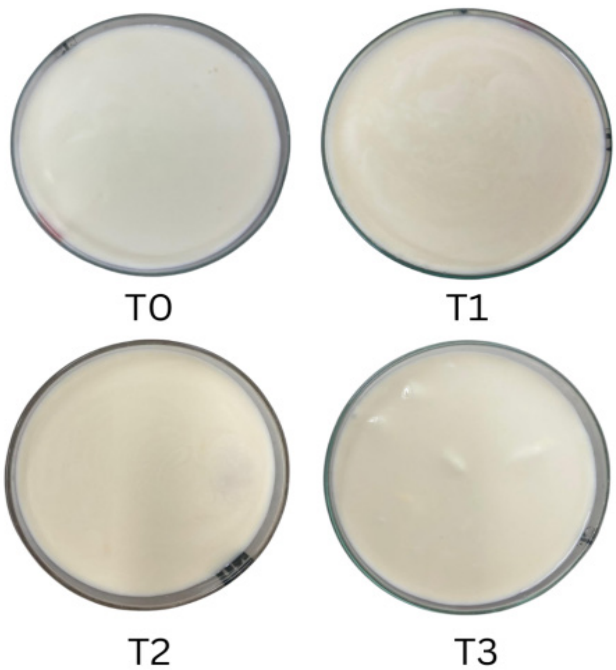

Figure 2: Visualization of synbiotic yogurt samples.

Table 1: L*, a*, and b* color attributes and color spectrum of synbiotic yogurt fortified with cilembu sweet potato puree.

Treatments	Colour			Colour spectrum	
	L*	a*	b*	Chroma (C)	Hue Angle (h°)
T0 (0%)	91.56 ±0.28^{a}	-2.08± 0.23	12.09 ±0.71^{b}	75.25	279.76
T1 (4%)	91.09 ±0.65^{a}	-1.82 ± 0.25	14.28 ±1.39^{a}	103.28	304.46
T2 (6%)	90.58 ±0.71^{ab}	-1.81±0.34	14.87 ±1.10^{a}	112.24	304.59
T3 (8%)	90.53±0.37^{b}	-1.63±0.41	15.17 ±1.71^{a}	116.74	304.58

Description: different superscripts, ^{a,b} in the same column indicated significant differences.

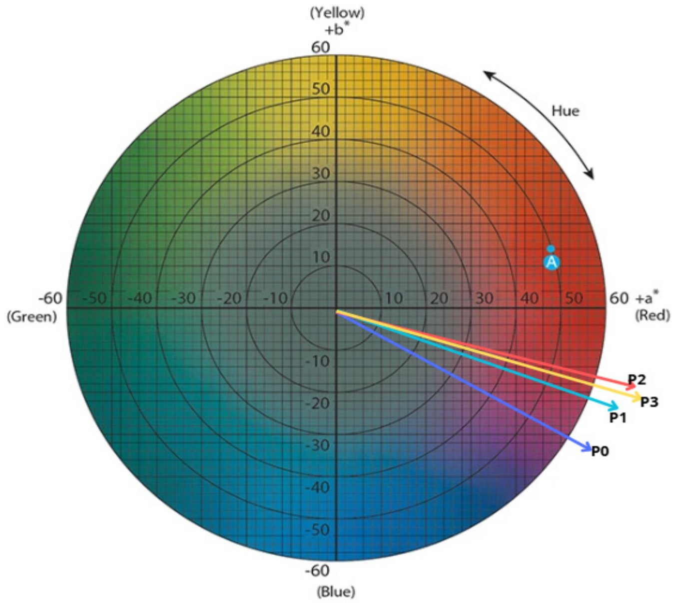

Figure 3: Color spectrum diagram of synbiotic yoghurt with the addition of Cilembu sweet potato puree.

increasing concentration of β-carotene in Cilembu sweet potato, which imparts a deeper yellow–orange hue and lowers light reflectance. Similar findings were reported, who observed that the β-carotene content of Cilembu sweet potato increased color intensity as the concentration of puree rose (Almadania, 2019). Positive a* values indicate redness, while negative values represent greenness. The addition of Cilembu puree shifted the yogurt color from greenish (T0, −2.08) toward reddish (T3, −1.63). This transformation is linked to the presence of carotenoid pigments such as xanthophylls and lycopene, which are responsible for the red-to-yellow shades observed in plant-derived colorants. The addition of tomato juice enhanced yogurt redness due to its lycopene content (Savitry *et al.*, 2018; Blassy *et al.*, 2019).

The b* value (yellowness) increased significantly with higher Cilembu puree concentrations, reflecting the influence of xanthophylls, particularly lutein and zeaxanthin, known for imparting yellow to orange hues (Mulyani *et al.*, 2021). The positive b* values obtained in this study indicate a dominant yellow hue, especially in the T3 treatment (b* = 15.17). The color spectrum analysis further confirmed these findings (Halimah and Issutarti, 2021). The chroma and hue angle values revealed a shift from purple-red in the control sample to yellowish-red with higher puree concentrations. This color change is consistent with the presence of β-carotene and other carotenoids. The overall color enhancement suggests that Cilembu sweet potato contributes both nutritional value and visual appeal to synbiotic yogurt (Gavril *et al.*, 2024). The color spectrum of synbiotic yoghurt is represented or visualized in a color diagram to show a more objective color which is presented in Figure 3.

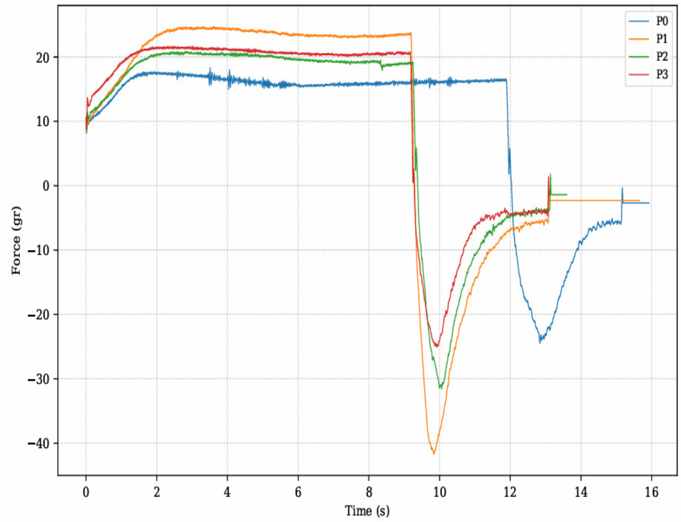

Figure 4: Texture analysis results of symbiotic yogurt.

Texture and rheological characteristics

The addition of Cilembu sweet potato puree improved the firmness and structural stability of yogurt (Figure 4). Yogurt containing 8% puree (T3) exhibited the greatest resistance to deformation, indicating a denser and more cohesive gel network. This improvement is largely attributed to the high starch and carbohydrate content of Cilembu sweet potato, which increases total solids and enhances casein starch interactions during fermentation. Such interactions strengthen the gel matrix, reduce syneresis, and improve firmness, consistent with previous findings on tuber-based starch fortification in yogurt (Gahruie *et al.*, 2015; Hernandez *et al.*, 2019; Prayitno *et al.*, 2022). The rheological analysis Figure 5. demonstrated that both storage modulus (G') and loss modulus (G") increased with the puree concentration, suggesting improved viscoelastic behavior. The highest G" value was recorded in T3, indicating more pronounced viscous properties. Descriptive interpretation confirmed that the starch and carbohydrate contents of Cilembu puree acted as natural thickeners and prebiotic substrates, promoting LAB activity that further enhanced gel strength and viscosity. The rheological behavior Figure 5. confirmed that both the storage modulus (G') and loss modulus (G") increased with puree concentration. A higher G" value indicates stronger viscous properties, while an increase in G' reflects enhanced elasticity. This finding suggests that the yogurt became more viscous and cohesive as the puree level increased. The fiber fortification improved yogurt rheology by increasing total solids and stabilizing the gel matrix (Sah *et al.*, 2016). The increase in viscosity and elasticity is also supported by the carbohydrate and dietary fiber composition of Cilembu sweet potato (Venica *et al.*, 2015). These components promote network reinforcement within the yogurt matrix, resulting in higher gel strength and stability (Sah *et al.*, 2016; Ng *et al.*, 2017). Overall, the incorporation of Cilembu puree at 8% produced yogurt with optimal textural and rheological qualities suitable for functional dairy applications.

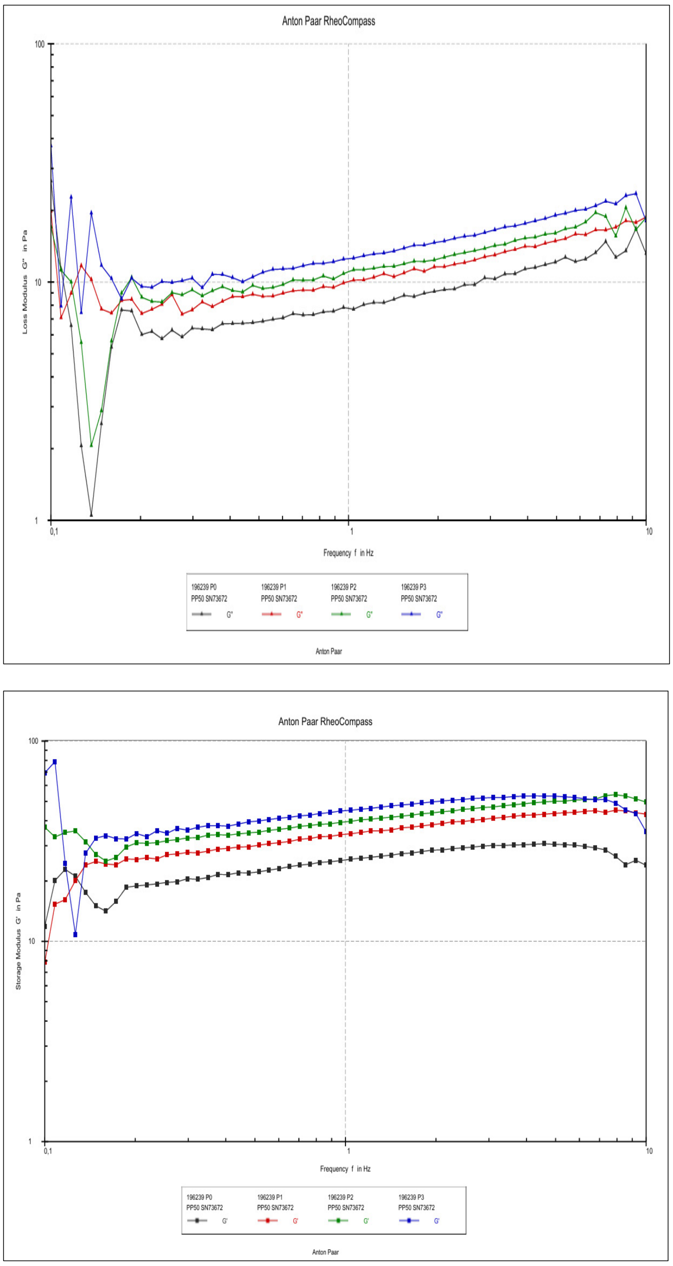

Figure 5: Rheology test results of synbiotic yogurt.

Physicochemical characteristics of water holding capacity, moisture content, ash content and total acid

The physicochemical parameters of synbiotic yogurt, including water-holding capacity (WHC), moisture, ash, total acidity, and starch content, are summarized in Table 2. ANOVA results indicated significant differences ($P < 0.05$) in WHC, moisture, and ash contents while total acidity content showed no significant differences ($P > 0.05$) among treatments. The WHC increased progressively from 56.45% in T0 to 63.85% in T3, reflecting the hydrophilic nature of starch and amylopectin in the Cilembu puree. These components enhanced the yogurt's ability to bind water and maintain a stable gel matrix. Conversely, moisture content slightly decreased from 87.04% (T0) to 85.37% (T3), likely due to higher total solids reducing free water availability. The ash content decreased significantly ($P < 0.05$) with increasing puree concentration, from 1.02% in T0 to 0.95% in T3, which may be due to the lower mineral composition of Cilembu puree compared with milk. Nonetheless, all treatments complied with the Indonesian National Standard (SNI 2981:2009) for yogurt (<1%). Meanwhile, total acidity remained stable across treatments (3.21–3.48%), indicating consistent fermentation and microbial activity.

Table 2: Water-holding capacity, moisture, ash, total acidity, and starch content of synbiotic yogurt fortified with cilembu sweet potato puree.

Treat-ments	Water holding capacity (%)	Ash con-tent (%)	Moisture content (%)	Total acids (%)
T0 (0%)	56.45 ±1.90^{b}	1.02 ± 0.02^{a}	87.04 ±0.30^{a}	3.21±0.49
T1 (4%)	60.61 ±6.41^{a}	0.99 ±0.02^{a}	86.61 ±0.47^{a}	3.28±0.29
T2 (6%)	61.91 ±1.53^{a}	0.96 ±0.02^{b}	85.95 ±0.32^{b}	3.38±0.53
T3 (8%)	63.85 ± 2.40^{a}	0.95 ±0.04^{b}	85.37 ±1.44^{b}	3.48±3.47

Description: different superscripts ^{a,b} in the same column indicated significant differences.

The addition of Cilembu puree significantly influenced the water holding capacity (WHC), moisture, and ash content of synbiotic yogurt, while total acidity and starch content remained stable. The WHC increased from 56.45% in T0 to 63.85% in T3, likely due to the high starch and amylopectin content of Cilembu sweet potato, which enhances water absorption and gel formation. Starch concentration improved yogurt's WHC by strengthening proteinstarch interactions (Tania and Parhusip, 2022). The mechanism underlying WHC enhancement involves starch gelatinization during fermentation, which increases the hydrophilic properties of the gel network and reduces syneresis. The presence of amylopectin also contributes to greater water entrapment, resulting in a stable structure with minimal whey separation (Tania and Parhusip, 2022).

In contrast, moisture content showed a slight decline with higher puree addition, due to increased total solids and reduced free water availability. Although the average moisture values (85.3%–87.0%) slightly exceeded the SNI standard (83%–85%), they were comparable to those observed in yogurt enriched with purple sweet potato (Fitriyah *et al*., 2025). The ash content decreased from 1.02% in T0 to 0.95% in T3, likely because of the lower mineral concentration in Cilembu puree compared with milk (Tari *et al*., 2018; Sari *et al*., 2024). Nevertheless, all samples met the SNI requirement for yogurt ash content (<1%). When Cilembu puree was incorporated, the increase in total solids was mainly attributable to carbohydrate and starch based components rather than minerals. Consequently, the higher load of non-mineral solids diluted the relative proportion of minerals per 100 g of product, so that ash content decreased even though total solids increased (Tari *et al*., 2018).

The total titratable acidity ranged from 3.21% to 3.48% lactic acid, which is higher than the typical range specified in SNI 2981:2009 for yogurt. This elevated acidity may be associated with the extended fermentation period and the combined availability of lactose and Cilembu derived carbohydrates as substrates for LAB. Instead, the carbohydrate and starch content served as fermentable substrates that supported lactic acid production. Acidity stability in synbiotic yogurt fortified with various prebiotic sources (Mukhoiyaroh *et al*., 2022). The consistent acidity across treatments suggests that Cilembu sweet potato puree maintained balanced fermentation activity and LAB metabolism.

Total lactic acid bacteria (LAB)

The results of the analysis of the addition of Cilembu sweet potato puree (*Ipomoea batatas L.*) to the total lactic acid bacteria (LAB) are presented in Table 3. Data and analysis of variance showed that synbiotic yoghurt with the addition of Cilembu sweet potato puree was not significantly different from the total lactic acid bacteria (LAB) ($P>0.05$). Complete data are presented in Table 3. The total LAB count ranged from 9.63 to 10.00 log CFU/mL, with the highest value observed in the 8% puree treatment (T3). Although statistical differences were not significant ($P > 0.05$), the trend indicates that increasing Cilembu puree concentration slightly enhanced LAB growth. This improvement can be attributed to the high carbohydrate (95.11%) and starch (78.75%) content of Cilembu sweet potato, which provides fermentable substrates for LAB metabolism and lactic acid production. Higher puree levels supply more available sugars such as glucose, fructose, and sucrose, stimulating microbial activity and cell proliferation (Mahmudatussa'adah, 2014). These results therefore likely reflect the combined contribution of milk lactose and Cilembu derived carbohydrates as carbon sources for LAB, rather than the effect of Cilembu starch alone. Potential competition or shifts in substrate preference between lactose and Cilembu derived carbohydrates cannot be ruled out; however, this mechanism was not specifically investigated in the present study and should be clarified in future work.

Cilembu sweet potato extract enhanced the growth of *Lactobacillus paracasei* and lactic acid yield during fermentation (Setiarto *et al*., 2017; Swithenia *et al*., 2021). Moreover, the final LAB counts in all treatments exceeded 10^7 CFU/mL, the threshold recommended by the International Dairy Federation for probiotic functionality. This confirms that fortification with Cilembu puree does not impair microbial viability but instead supports synbiotic interactions between probiotics and natural prebiotic compounds. It should be noted that LAB enumeration in this study was limited to total LAB counts (log CFU/mL), and individual starter or probiotic species were not differentiated. This lack of species-level resolution is a limitation of the microbiological analysis and should be addressed in future studies.

Table 3: Total lactic acid bacteria (LAB) of synbiotic yogurt fortified with Cilembu sweet potato puree.

Treatments	LAB (Log CFU/mL) ± SD
T0	9.63±0.08
T1	9.64±0.46
T2	9.94±0.21
T3	10.00±0.19

Figure 2, illustrates the visual appearance of the yogurt, showing a progressive change in color intensity and viscosity with increasing puree levels. The fortified samples exhibited a thicker consistency and more appealing yellowish-red color, demonstrating both aesthetic and functional enhancement in product quality. The incorporation of Cilembu sweet potato puree at concentrations up to 8% effectively improved yogurt's color, texture, WHC, and rheological properties, without compromising acidity or microbial viability. The starch and fiber in Cilembu functioned as prebiotic materials, promoting LAB growth and contributing to stable fermentation. These outcomes align with previous studies reporting that tuber-based prebiotics can enhance both physical stability and probiotic survival in fermented dairy products (Gahruie *et al*., 2015; Sah *et al*., 2016; Swithenia *et al*., 2021). The findings highlight the potential of Cilembu sweet potato as a local prebiotic source to support Indonesia's functional food innovation. Its utilization in synbiotic yogurt improved product quality in terms of color, texture, and water-holding capacity and may offer a culturally relevant alternative to imported prebiotics such as inulin or FOS, with potential benefits for local value chains and economic sustainability that should be explored in future studies.

CONCLUSION

Fortification of synbiotic yogurt with Cilembu sweet potato (*Ipomoea batatas L.*) puree enhanced its color, texture, rheological stability, and water-holding capacity without affecting acidity, starch content, or LAB viability. The 8% addition (T3) yielded the best overall quality, confirming Cilembu sweet potato's potential as a local prebiotic source for developing functional synbiotic dairy products.

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NOVELTY STATEMENT

The novelty of this study is the use of Cilembu sweet potato (Ipomoea batatas L.) puree as a local prebiotic source to fortify synbiotic yogurt in Indonesia. This is in contrast with traditional products that are enriched with imported prebiotics such as, for example, inulin or FOS and provides a full evaluation of the effect of Cilembu puree addition on yogurt color characteristics, physicochemical parameters, texture profile, rheological stability and LAB survival. Results show an effective improvement of functional and physical quality with the addition of 8% puree, without negatively affecting microbial survival, to develop local sustainable functional dairy products.

AUTHOR'S CONTRIBUTION

Conceptualization: Zahrotur Rozana and Premy Puspitawati Rahayu
Methodology: Zahrotur Rozana and Lukman Hakim
Data curation: Zahrotur Rozana and Agus Bahar Rachman
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For this work, the authors employed Consensus for search of literature. The content was then edited manually and the authors are responsible for all the aspects of an article.

Conflict of interest

The authors have declared no conflict of interest.

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