Robusta and Arabica Coffee Effects on Yoghurt's Physical, Chemical, Sensory, and Microbiological Quality

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ABSTRACT

This study entitled robusta and arabica coffee effects on yoghurt's physical, chemical, sensory, and microbiological quality. Aimed to investigate the impact of adding Robusta coffee, Arabica coffee, and their combination on the physicochemical properties and sensory acceptance of yoghurt. The research was structured using a Completely Randomized Design, analyzing six distinct formulations, including a control (A), pure coffees (B, C), and combinations (D, E, F). Data analysis utilized ANOVA followed by the Honestly Significant Difference test. Sensory evaluation identified treatment E as the most preferred overall (score 4.00), owing to its strong, yet well-balanced, coffee flavor and aroma. Further analysis focused on treatment E, assessing viscosity, color, and total Lactic Acid Bacteria count. Results indicated that coffee inclusion significantly influenced all parameters. Treatment E exhibited the highest pH (4.85) and showed a dramatic viscosity decrease from 727.5 (control) to 37.5 cP. Color analysis revealed a darker product (L 63.93), with increases in a*, b*, C*, and H* values, attributed to coffee's melanoidin content. Importantly, the total LAB count for treatment E (4.5×10^7 CFU/ml) was statistically similar to the control and met the minimum national standard (SNI 01-2981-2009). In conclusion, Formulation E successfully yielded a functional coffee yoghurt product with excellent organoleptic characteristics and preserved the viability of Lactic Acid Bacteria.*

Keywords: *Arabica Coffee; Lactid Acid Bacteria; Robusta Coffee; Yoghurt*

ABSTRAK

Penelitian ini berjudul pengaruh kopi robusta dan arabika terhadap kualitas fisik, kimia, sensoris, dan mikrobiologis yoghurt. Bertujuan untuk menentukan pengaruh penambahan kopi robusta, kopi arabika, dan kombinasi keduanya terhadap sifat fisikokimia dan penerimaan sensoris yoghurt. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan formulasi kopi yang berbeda, meliputi robusta (B), arabika (C), kombinasi (D, E, F), dan kontrol (A). Analisis data dilakukan menggunakan ANOVA, dilanjutkan dengan uji *Honestly Significant Difference* (HSD). Hasil penelitian menunjukkan bahwa, dalam hal atribut sensoris, perlakuan E paling disukai secara keseluruhan (4,00) karena rasa dan aroma kopi yang kuat dan seimbang. Oleh karena itu, analisis lebih lanjut dilakukan untuk viskositas, warna, dan total Bakteri Asam Laktat (BAL). Hasil analisis menunjukkan bahwa penambahan kopi memengaruhi semua parameter kualitas. Nilai pH perlakuan E adalah 4,85, tertinggi di antara semua perlakuan. Penambahan kopi juga secara signifikan menurunkan viskositas dari 727,5 (kontrol) menjadi 37,5 (E). Analisis warna menunjukkan bahwa perlakuan E menghasilkan produk yang lebih gelap L* 63,93, dan menunjukkan peningkatan pada a* 7,99, b* 14,85, C* 16,86, dan H* 61,2, karena kandungan melanoidin kopi. Jumlah total BAL untuk perlakuan E adalah $4.5x10^7$ CFU/ml, yang tidak berbeda signifikan dengan kontrol dan memenuhi standar yoghurt SNI 01-2981-2009. Formulasi E berhasil menciptakan produk kopi yoghurt fungsional dengan karakteristik organoleptik yang sangat baik dan melindungi viabilitas BAL.

Kata kunci: Bakteri Asam Laktat; Kopi Arabika; Kopi Robusta; Yoghurt

INTRODUCTION

Yoghurt is a dairy product resulting from fermentation using lactic acid bacteria. The primary bacterial strains utilized in yoghurt fermentation are *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* (Savaiano & Hutkins, 2021). During fermentation, the lactose present in the milk is converted into lactic acid and acetaldehyde, which imparts the characteristic sour taste, aroma, and texture associated with yoghurt. Furthermore, this process results in a decrease in pH, thus facilitating increased calcium absorption by the body (Shkembi & Huppertz, 2022). Fermented products are recognized as having a superior nutritional profile compared to non-fermented counterparts (Hossain et al., 2025). Yoghurt positively contributes to digestive health (Sarıtaş, Mondragon Portocarrero, Miranda, Witkowska, & Karav, 2024), enhances immunological responses (Li et al., 2025), serves as a source of protein, and is highly beneficial for individuals with lactose intolerance (Beret et al., 2025), thereby increasing its consumer appeal. The popularity of this product has surged concurrent with increasing public awareness regarding the importance of nutritious and functional foods (Bintsis & Papademas, 2022). The presence of probiotic bacteria in yoghurt promotes gastrointestinal health and may reduce the likelihood of digestive disorders (Hadjimbei, Botsaris, & Chrysostomou, 2022). Various flavor variants of yoghurt have been innovatively developed through the enhancement or incorporation of additional flavorings to meet diverse consumer preferences. Widely circulated flavor variants include fruit flavors, while research has also explored variants such as soybean flavor (Zhang et al., 2025) and corn yoghurt (Wijayanti, Khusania, Safitri, Rizqiati, & Pramono, 2024). However, it has been found that the utilization of flavor enhancers sometimes involves the use of original fruit, but often employs synthetic flavorings, which may pose health risks. Synthetic flavorings, including colorants and taste enhancers, present significant health hazards to consumers (Chen & Xia, 2024). Therefore, there is a need for innovative yoghurt formulations that do not rely on synthetic flavorings and can still be accepted by consumers.

Coffee is a highly favored beverage among consumers. Coffee consumption, whether served hot or cold, has shown an increase across various regions (Soares et al., 2025). A significant portion of the community strives to create new innovations in coffee enjoyment and coffee-based products, such as the research conducted on cold-brew probiotic coffee (Jannah, Rahayu, Yanti, Suroto, & Wikandari, 2022). Coffee is renowned as a beverage rich in bioactive compounds (Nugroho et al., 2025), particularly polyphenols (Hu et al., 2023). The polyphenolic components of coffee, including caffeine and chlorogenic acids (Badmos & Kuhnert, 2025), exhibit considerable functional properties, primarily serving as antioxidants (Jannah, Verawati, Manurung, & Ichsan, 2025). In Indonesia, coffee cultivation is widespread, especially in high-altitude areas such as the Pagar Alam region of South Sumatra. According to 2024 statistical data, the Pagar Alam area has 8,074 hectares of coffee land, and coffee production in Pagar Alam reached 19,268.3 tons in 2024, according to the Central Bureau of Statistics. In this region, Robusta and Arabica are the dominant coffee varieties cultivated by farmers. Therefore, there is a need for an innovative application of coffee to integrate coffee as a local product with yoghurt. Coffee yoghurt offers a unique and novel flavor profile, can replace the use of synthetic flavorings in yoghurt products, and yields a dual advantage: the digestive health benefits provided by yoghurt and the antioxidant characteristics found in coffee (Santoso et al., 2022). Previous research has indicated that the incorporation of coffee extract into yoghurt can enhance its antioxidant capacity and confer unique sensory attributes (Mbae, Koskei, & Mugendi, 2023). Variations in coffee concentration may lead to significant changes in pH, viscosity, and consumer acceptance (Kayaputri, Amalia, & Khairunnisa, 2022). The inclusion of coffee extract in yoghurt has been proven to affect various factors, such as the physicochemical properties that determine quality and sensory acceptance (taste, aroma, mouthfeel) among consumers (Mbae et al., 2023).

Although previous research on coffee yoghurt has been conducted generally, studies specifically comparing the impact of using robusta and arabica coffee, or their combination, on yoghurt characteristics remain very limited. Different coffee types exhibit variations in their chemical composition, including antioxidants (chlorogenic acids) and caffeine levels. To date, no study clearly elucidates how the incorporation of robusta (characterized by high chlorogenic acid content), arabica (noted for its high acidity), or their combination affects the antioxidant properties, bacterial viability within the yoghurt, or its physicochemical attributes. Robusta coffee is characterized by a bitter taste resulting from its higher caffeine and chlorogenic acid content compared to arabica coffee (Caracostea, Sîrbu, & Busuricu, 2021) (Badmos, Lee, & Kuhnert, 2019), whereas arabica coffee demonstrates a more complex aroma profile, a less bitter taste, and higher acidity (Priyanto, Hintono, & Dwiloka, 2022). These distinctions will significantly influence the sensory attributes, aroma, acidity, and even the color of the resulting yoghurt. This research will clarify how the different properties of each coffee type, or their combined interaction, influence the final product. Accordingly, this study aims to observe the effect of adding robusta coffee, arabica coffee, and a combination of both on the physicochemical and sensory properties of yoghurt, thereby providing crucial information for the development of innovative and consumer-acceptable functional yoghurt products. This research is expected to pave the way for the development of functional coffee yoghurt customized to market needs.

RESEARCH METHOD

Materials

The materials used in this study were robusta coffee powder and arabica coffee powder obtained from HSS store, Pagar Alam City, Indonesia; full cream UHT fresh milk (Frisian Flag brand, PT. Frisian Flag Indonesia, Bekasi, Indonesia); a lactic acid bacteria starter culture (Heavenly Blush Greek Yoghurt brand) containing *Streptococcus thermophilus*, *Lactobacillus delbrueckii* subsp. *bulgaricus*, *Lactobacillus acidophilus*, and *Bifidobacterium* (PT. Heavenly Nutrition Indonesia, Bogor, Indonesia); mineral water; and sucrose (Gulaku brand, PT. Sweet Indolampung, Lampung, Indonesia).

The materials used for analysis were aquadest, buffer solutions (pH 4 and 6), and MRSA Medium (KGaA, Darmstadt, Germany). The analytical instruments employed in this study were a digital pH meter, an NDJ-8S viscometer (China), a color reader (Konica Minolta, Japan), petri dishes, a 1000 ml micropipette, micropipette tips, an autoclave (All American, USA), an incubator (Memmert, Germany), and glassware.

Experimental Design

The treatments involved the formulation factor of coffee powder and fresh milk (w/v). The coffees used were robusta and arabica coffee, as well as a combination of the two (robusta 50% : arabica 50%). Each treatment was performed according to Table 1.

Table 1. Coffee Yoghurt Treatments with The Ratio of Robusta and Arabica Coffee

Treatment	Fresh Milk (ml)	Robusta (g)	Arabica (g)	Sucrose (g)
A	1000	-	-	70
B	1000	10	-	70
C	1000	-	10	70
D	1000	5	5	70
E	1000	10	10	70
F	1000	15	15	70

Research Procedure

Preparation of Coffee Yoghurt

The coffee yoghurt production process followed the modified methods of (Mbae et al., 2023) (Kayaputri et al., 2022). It began with the preparation and first pasteurization of fresh milk with the addition of sugar according to treatment specifications, heated at 90° C for 30 minutes with occasional stirring. Subsequently, the coffee powder was added according to the treatment, stirred, cooled for 5 minutes, and filtered. The milk-coffee mixture was filtered and pasteurized again at 80° C for 15 minutes, then cooled to reach 40° C - 45° C. Inoculation was then performed using a yoghurt starter culture containing *S. thermophilus*, *L. bulgaricus*, *L. acidophilus*, and *Bifidobacterium* at 30% v/v of the total milk. The final stage was incubation at 45° C for 4 hours.

After incubation, the samples were stored in a refrigerator to halt fermentation until they were used for analysis.

Analysis Method

pH Measurement of Coffee Yoghurt

The pH measurement was performed using a digital pH meter according to (Kim, Lim, Kim, & Kim, 2024). pH measurement began with the rinsing and calibration of the pH using 4 and 6 buffers. Subsequently, the pH meter probe was immersed in the sample to measure the pH until a stable value was obtained.

Sensory Evaluation of Coffee Yoghurt

Sensory evaluation was conducted using both hedonic (liking) and scoring methods (Jannah et al., 2022) (Rahayu et al., 2022). The sensory evaluation involved 31 panelists consisting of lecturers and students from the Department of Agricultural Technology and Business Engineering, Sriwijaya State Polytechnic. The attributes observed included liking with a scale of 1 (strongly dislike) to 5 (strongly like), and the intensity of aroma, taste, homogeneity, mouthfeel, color, and viscosity using a scale of 1 to 5. The sample yielding the best results from the sensory evaluation was subsequently subjected to testing for viscosity, color, and total lactic acid bacteria.

Color Profile Determination of Coffee Yoghurt

The color profile determination of the observed yoghurt coffee samples, which included L*, a*, b*, C*, and H* values, was carried out following the method described by (Zulaikhah & Karseno, 2024). A 50 ml sample was prepared and tested using a color reader (Konica Minolta, Japan). The reading mode was set to measure L*(*lightness*), a* (*redness*), b* (*yellowness*), C* (*Chroma*), and H* (*Hue*), and the target button was pressed. The results obtained from the instrument reading were then recorded.

Viscosity Determination of Coffee Yoghurt

The determination of viscosity was conducted using the method described by (Arifani, Zulaikhah, & Luthfi, 2023). A 100 ml sample of the yoghurt coffee was measured using an NDJ-8S viscometer (China).

Determination of Total Lactic Acid Bacteria in Coffee Yoghurt

The determination of the Total Lactic Acid Bacteria (LAB) followed the method described by (Jannah et al., 2022) (Novelina, Syukri, & Khairani, 2025). The determination of the total lactic acid bacteria in the yoghurt coffee sample was carried out using the Total Plate Count (TPC) method. The procedure began by dissolving 1 mL of the sample into 9 mL of aquadest (resulting in a 10^{-1} dilution), followed by a series of further dilutions until the desired concentration was reached. Subsequently, 1 mL from the three final dilutions was inoculated onto MRS Agar media in Petri dishes and incubated for 48 hours at a temperature of 37 °C. The colonies were counted using a Quebec Colony Counter, and the results were expressed in log CFU/mL. Valid colonies for counting were those within the range of 25 to 250 cells. Counts below 25 were designated as EAPC (Estimated Aerobic Plate Count), and counts exceeding 250 were designated as TNTC (Too

Numerous To Count). The calculation of the colony count followed the formula from (Zhang Guodong, Frguson Martine, & Blodgett Robert J, 2025):

$$S.I = \frac{\Sigma C}{(1Xn1) + (0{,}1xn2)} xd \quad (1)$$

ΣC is the total number of colonies on all counted plates, n_1 dan n_2 are the number of plates counted at the first and second dilutions, respectively, and d is the dilution factor of the first counted dilution.

Statistical Analysis

Each treatment was conducted in three replicates. The treatments were arranged in a Completely Randomized Design (CRD). The results obtained were analyzed using Analysis of Variance (ANOVA) and the T-test. Treatments showing a significant effect were further tested using Tukey's Honestly Significant Difference (HSD) test at a 5% significance level. Data processing was performed using IBM SPSS Statistics 26.

RESULTS AND DISCUSSION

pH Measurement of Coffee Yoghurt

The results of the pH measurement are presented in Figure 1.

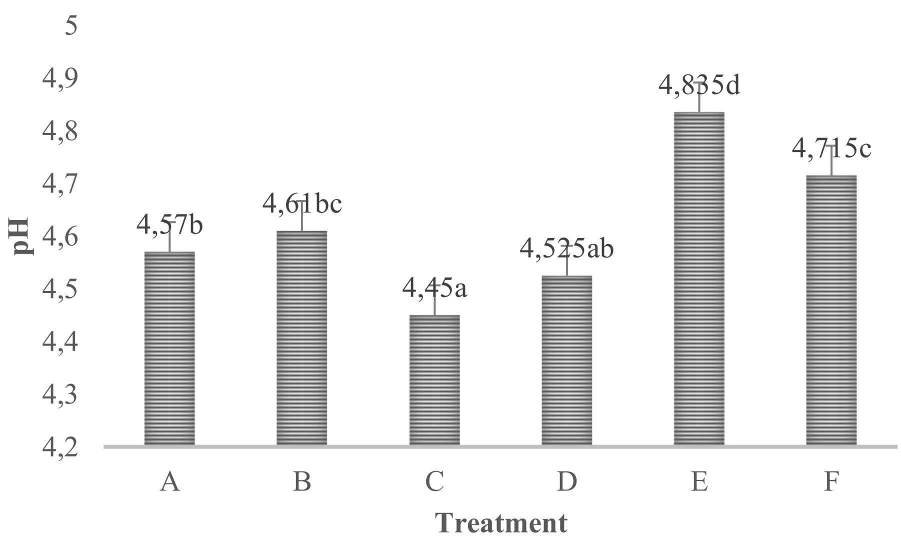

Figure 1. The pH Measurement Results of Coffee Yoghurt

Description: A (control), B (Robusta 10g), C (Arabica 10g), D (Robusta 5g and Arabica 5g), E (Robusta 10g and Arabica 10g), and F (Robusta 15g and Arabica 15g).

Statistical analysis using Analysis of Variance (ANOVA) revealed that the treatments had a significant effect on the pH values. The pH measurement results, shown in Figure 1, indicate that all treatments exhibited values within the acidic range (below 7), with values ranging from 4.45 to 4.83. This pH range is consistent with the natural characteristics of yoghurt products, which tend to be acidic (Adrianto, Wiraputra, Jyoti, & Andaningrum, 2020). Specifically, treatment C yielded the lowest pH 4.45, indicating the strongest level of acidity, although it did not differ significantly from treatment D. Conversely, treatment E resulted in the highest pH 4.85, signifying the lowest acidity, and was significantly different from treatments C and D. Meanwhile, treatments A 4.57 and B 4.61 showed no apparent difference. The pH in treatment F indicated lower acidity compared to treatment E and was significantly different.

Sensory Evaluation of Coffee Yoghurt

The results of the sensory evaluation are presented in Figure 2.

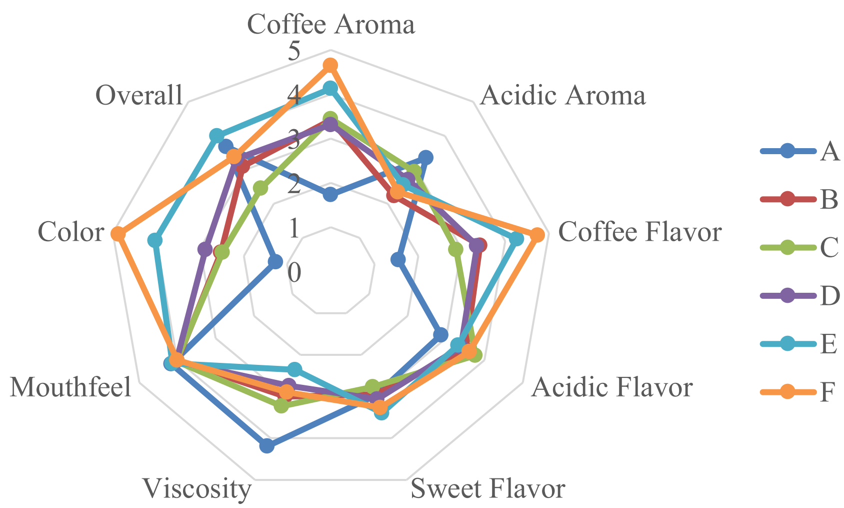

Figure 2. The Sensory Evaluation Results of Coffee Yoghurt

Description: A (control), B (Robusta 10g), C (Arabica 10g), D (Robusta 5g and Arabica 5g), E (Robusta 10g and Arabica 10g), and F (Robusta 15g and Arabica 15g).

The sensory evaluation results, shown in Figure 2, indicate that the intensity of coffee aroma and flavor in the yoghurt followed a similar pattern across treatments. Treatment F exhibited the strongest intensity of both coffee aroma (4.65) and coffee flavor (4.74) and was significantly different from all other treatments. Meanwhile, treatment A had the lowest intensity of coffee aroma (1.75) and coffee flavor (1.55). Treatment E also showed high intensity for coffee aroma (4.13) and coffee flavor (4.26), where both aspects were significantly different from the other treatments (except F, although the coffee aroma in E was lower than F). This aligns with the research by (Mbae et al., 2023), stating that coffee influences the flavor, creating a distinct coffee taste. Overall, the intensity of coffee aroma increased from A to F. However, treatments B, C, and D showed relatively similar coffee aroma intensities and did not differ significantly from one another. Treatments F and E were rated as the most effective in enhancing the desired intensity of coffee flavor. This is because coffee contains melanoidin compounds, which impart a characteristic coffee aroma (Cordoba, Fernandez-Alduenda, Moreno, & Ruiz, 2020).

The intensity of the sour aroma in treatment A was the most dominant (3.35) and differed significantly from all other treatments. This indicates that the A composition resulted in the strongest acidic aroma. Previous research has shown that the presence of compounds such as acetaldehyde and butanedione contributes to the sour flavor and aroma in yoghurt (Liu, Yang, Wang, & Song, 2022). Conversely, treatments B, D, E, and F had acid aroma intensities that did not differ significantly. This suggests that the acidic aroma was not influenced by the coffee, or perhaps the coffee even masked the acidic aroma of the yoghurt, introducing a coffee aroma instead. Meanwhile, treatment C was rated as having the strongest sour flavor (3.77), yet it did not differ significantly from treatments B and F. This suggests that the intensity of the sour flavor was enhanced by the use of coffee, particularly arabica coffee. Arabica coffee inherently possesses a higher level of acidity compared to robusta (Zainuri et al., 2023). The presence of chlorogenic acid compounds within the melanoidin structure can contribute to the coffee's sour flavor (Cordoba et al., 2020). Furthermore, the inherent sour flavor of yoghurt itself contributes to the overall high acidity of the product. Consequently, treatment A exhibited the lowest sour flavor (2.87) and was significantly different from treatments B, C, and F.

Based on the test results, there were significant differences among treatments for the attributes of sweetness and consistency (viscosity). Treatment E showed the highest sweetness intensity (3.39), while treatment C had the lowest sweetness (2.77), and both differed significantly from the other treatments. Despite these variations, the applied treatments generally did not cause a drastic change in sweetness intensity. Regarding consistency (viscosity) intensity, treatment A yielded samples with the highest consistency (4.19), which was significantly different from all treatments except B and C. Conversely, treatment E resulted in the product with the lowest consistency (2.35).

The Mouthfeel intensity across all treatments showed similar results, ranging from 4.00 to 4.16, and did not show a significant difference. This explains that the treatment formulation did not affect the mouthfeel sensation (Mbae et al., 2023). In contrast, the color attribute showed significant differences. Treatment F had the highest color intensity (darkest) (4.87) and differed significantly from all other treatments. The product color intensity gradually increased from treatment A (lightest) (1.26) to treatment F, and almost all treatments were significantly different, except B and C. This indicates that the coffee-added treatments influenced the color change in the yoghurt. The more coffee added, the more melanoidin compounds are present, which cause the dark color (Iriondo-DeHond, Rodríguez Casas, & del Castillo, 2021).

The overall acceptance of the sample was highest for treatment E (4.00), possibly due to the characteristic coffee flavor being well-balanced. Conversely, the least-liked sample was treatment C (2.45), perhaps due to its high sour flavor. Therefore, the best treatment to be used for further analysis, namely color, viscosity, and total lactic acid bacteria, is A as the control and E as the best treatment.

Color Profile Determination of Coffee Yoghurt

The results of the color profile are presented in Table 2.

Table 2. The Color Profile Determination Results of Coffee Yoghurt

Color	Treatment	Results
L*	A	69.53±9.66
	E	63.93±4.53
a*	A	1.96±1.02*
	E	7.99±0.69*

b*	A	9.91±0.33*
	E	14.85±0.75*
C*	A	10.91±1.23
	E	16.86±0.33
H*	A	78.48±5.63
	E	61.2±2.65

Description: A (control) and E (Robusta 10g and Arabica 10g). Statistical analysis using the Independent T-test showed that parameters marked with an asterisk (*) are significantly different ($p < 0.05$).

The results of the color profile determination, which include the values for Lightness (L*), Redness (a*), Yellowness (b*), Chroma (C*), and Hue (H*), are presented in Table 2. Analysis using the Independent T-Test was conducted on the following parameters. The table indicates that the lightness value for treatment A (69.53) was higher than that of E (63.93), meaning A was brighter or whiter and E was darker (Zulaikhah & Karseno, 2024), yet the difference between the two was not significant. In contrast, for the redness a* and yellowness b* attributes, treatment E (7.99 and 14.85) showed significantly higher values than A (1.96 and 9.91). This suggests that the addition of coffee to the yoghurt influenced the redness and yellowness in treatment E. This aligns with previous research (Yanti & Utami, 2022) showing that adding coffee to cookies can cause the color to become darker. Overall, although the lightness levels of A and E were similar, treatment E visually exhibited a much more dominant intensity of redness and yellowness compared to A. The Chroma C* and Hue H* analyses revealed that treatment E was not significantly different from treatment A. This indicates that the color intensity and saturation between the two treatments were relatively similar, with no substantial variation in paleness or depth. In the Hue analysis, both treatments exhibited a comparable color profile, showing that the addition of coffee in treatment E did not significantly shift the hue from yellow toward orange. Consequently, the concentration of coffee used in treatment E was insufficient to produce a distinct increase in dark compounds such as melanoidins (Antonietti et al., 2022). This align with findings suggesting that while chlorogenic acid and melanoidins can cause dark pigments, their impact may be negligible depending on the concentration and heat processing conditions (Portillo & Arévalo, 2022).

Determination of Viscosity and Total Lactic Acid Bacteria of Coffee Yoghurt

The results of the viscosity and total Lactic Acid Bacteria determination are presented in Table 3.

Table 2. The Color Profile Determination Results of Coffee Yoghurt

Treatment	Viscosity	Total LAB
A	720±27.13*	4.8×10^7±20.78
E	37.2±1.15*	4.5×10^7±18.00

Description: A (control) and E (Robusta 10g and Arabica 10g). Statistical analysis using the Independent T-test showed that parameters marked with an asterisk (*) are significantly different ($p < 0.05$).

The results of the viscosity determination for the coffee yoghurt are presented in Table 3, which shows a significant difference in viscosity between treatment A (727.5) and treatment E (37.5). The high viscosity in A is a natural characteristic of yoghurt, caused by the formation of a gel matrix during fermentation (Zhou et al., 2024). Conversely, the decrease in yoghurt viscosity in treatment E, with the higher coffee addition, may limit the formation of casein aggregates

(Gnanarathna et al., 2022). Phenolic compounds from the coffee extract can interact with milk proteins, preventing optimal casein aggregation, thereby disrupting the matrix structure and resulting in a much more fluid product. Similar studies also report that the interaction of phenolic compounds (such as chlorogenic acid) in coffee has a strong affinity for milk casein (Han et al., 2019). Therefore, it can be stated that the increased interaction between phenolic compounds and milk proteins during storage indirectly supports a strong interaction between coffee components and yoghurt protein, which causes the yoghurt product to be more fluid. Consumer acceptance of the product is closely related to viscosity (Salgado et al., 2021). The results of the consistency attribute in the sensory test correlate with the results obtained from the viscosity test, showing that treatment A had the highest consistency value and was significantly different from treatment E.

The results of the total Lactic Acid Bacteria (LAB) determination, presented in Table 3, indicate that both the control yoghurt (A) and the coffee-added yoghurt (E) maintained a high LAB count, specifically 4.8 x 10^7 CFU/ml and 4.5 x 10^7 CFU/ml, respectively. Statistically, there was no significant difference between the two treatments. This demonstrates that the addition of coffee had no notable effect on the LAB count. Both treatments satisfy the Indonesian National Standard (SNI 01-2981-2009) for yoghurt products, issued by the National Standardization Agency of Indonesia (BSN), which requires a minimum of 10^7 CFU/mL. This finding is supported by other research reporting that the addition of coffee extract to yoghurt at concentrations ranging from 0.1% to 0.3% still maintained LAB counts between 3.7 x 10^7 CFU/ml and 1.09 x 10^8 CFU/ml CFU/ml (Mbae et al., 2023). This confirms that the fermentation process was successful in both products, and both possess good microbiological quality and are safe for consumption. Furthermore, other studies explain that the antimicrobial properties of coffee, derived from polyphenol compounds, can still preserve LAB in yoghurt (Toalá-Gómez et al., 2025). Although coffee extract contains bioactive compounds like polyphenols and caffeine that potentially inhibit microorganism growth, these results indicate that the concentration of coffee used was tolerant or non-toxic to the yoghurt starter bacteria. The preserved LAB viability in treatment E suggests that the yoghurt matrix (fermented milk) might provide an effective protective effect for the LAB, neutralizing the potential inhibitory effects of the coffee. This is supported by research identifying that milk protein and fat components can reduce the bioavailability of coffee's phenolic compounds, thereby protecting the LAB cells from its antimicrobial properties (Helal, Cattivelli, Conte, & Tagliazucchi, 2022). Thus, the addition of coffee successfully enriched the yoghurt without compromising its primary functional quality as a fermented product, making coffee a promising functional ingredient in yoghurt formulation.

CONCLUSION

The conclusion of this research indicates that yoghurt with the combined addition of robusta and arabica coffee (Treatment E) is the best formulation and the most preferred overall, due to its suitable intensity of coffee aroma and flavor, as well as having the highest sweetness, all while maintaining the product's primary functional quality. Microbiologically, the Lactic Acid Bacteria (LAB) count in the best treatment, 4.5 x 10^7 CFU/ml, remained high and met the yoghurt standard SNI 01-2981-2009 by the National Standardization Agency of Indonesia (BSN), suggesting that the yoghurt matrix provided an effective protective effect for the LAB against the potential inhibitory compounds of coffee. Although the addition of coffee significantly reduced viscosity due to the interaction of coffee's phenolic compounds with milk protein, this innovation successfully yielded a unique functional product with superior organoleptic properties and preserved LAB viability.

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