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Quality Control and Quality Testing of Final Product of Chocolate-Flavored Pasteurized Milk at CV Cita Nasional

Salmah Zakiroh Al-Hamdani[1], Aprilia Fitriani[2]*
Food Technology, Faculty of Industrial Technology, Universitas Ahmad Dahlan
South Ringroad Street, Tamanan, Bantul, Yogyakarta 55164
*Correspondence Email: aprilia.fitriani@tp.uad.ac.id

ABSTRACT

CV Cita Nasional is a dairy processing company that produces pasteurized milk and yogurt in various flavors, with chocolate being one of its flagship products. Pasteurized milk has a relatively short shelf life because the heating process does not completely sterilize the milk, making quality control of the final product essential. The purpose of this quality control is to ensure that each final product of pasteurized milk meets both the company's internal quality standards and the national regulations SNI 01-3591-1995. Quality control is carried out by monitoring physicochemical parameters, including pH, fat content, total solids, and sweetness level (Brix). Testing was conducted routinely for 23 consecutive days on the final product of chocolate-flavored pasteurized milk. The test data were then analyzed using statistical control methods to evaluate the stability of the quality system and identify deviations from established standards. The results of quality control and quality testing indicated that there was one pH sample, all fat content values, and Brix values that did not comply with the internal standards. Statistical control analysis showed that the product quality was relatively stable; however, improvements are still needed because some values were below the company's internal quality standards.

Keywords: *quality control, fat content, pasteurized milk, quality control, statistical analysis, CV Cita Nasional*

Introduction

Milk is a highly nutritious food consumed by people from various walks of life. However, fresh milk is highly perishable because it serves as an ideal medium for the growth of microorganisms, especially psychrotrophic bacteria and pathogens such as *Escherichia coli* and *Listeria monocytogenes*, which can proliferate rapidly if the milk is not immediately chilled and processed (Kaskous *et al*., 2022). Therefore, milk requires special handling through processing methods such as pasteurization to ensure its safety. The purpose of pasteurization is to inactivate pathogenic microorganisms and extend the shelf life of milk without significantly reducing its nutritional value (Jamal *et al*., 2018). This process generally uses High Temperature Short Time (HTST) technology, which heats milk to 72–75°C for 15–20 seconds, followed by rapid cooling using a Plate Heat Exchanger (PHE) to maintain the physicochemical stability of the product (Indumathy *et al*., 2022).

One of the most popular processed milk products is chocolate-flavored pasteurized milk, which is favored for its taste and freshness. However, during production, the quality of pasteurized milk can be affected by many factors, such as raw material quality, heating temperature, method of mixing additives, and sanitation of production equipment (Azarpazhooh *et al*., 2021). Therefore, a strict and consistent quality control system is required to ensure that the products produced meet the established quality standards, both physicochemically

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and sensorially. Quality control is important not only to ensure food safety but also to maintain consumer trust and prevent production losses due to defective products (Mahato *et al*., 2022).

Quality control of the final product is a crucial form of quality assurance. This includes testing parameters such as pH, fat content, total solids, and Brix, each with specific standard limits (Azami *et al*., 2018). The minimum fat content for flavored pasteurized milk is set at 2.0% in SNI 01-3951-1995, but many products have fat content below the standard due to the use of skim milk or excessive dilution (Mancebo *et al*., 2023). Low fat content and changes in pH can also affect taste, emulsion stability, and shelf life. If not promptly identified and controlled, these issues can impact taste, texture, and shelf life, and even pose health risks to consumers. Therefore, quality control of the final product is essential to ensure that the final products meet both internal company quality standards and applicable national standards.

Materials and Methods

Materials

The main raw materials used in the production of chocolate-flavored pasteurized milk at CV Cita Nasional include fresh milk as the primary source of protein, fat, and essential nutrients; skim milk to reduce fat content according to the formulation; granulated sugar as a sweetener; potable water serving as a solvent and volume enhancer; flavor agents to provide the distinctive chocolate taste; CMC (Carboxymethyl Cellulose) as a stabilizer to maintain product consistency and texture; and food coloring to achieve an attractive and uniform brown color.

Equipment

The equipment used for quality control and testing of chocolate-flavored pasteurized milk at CV Cita Nasional includes a pH meter, refractometer, butyrometer, moisture analyzer, digital scale, thermometer, measuring cylinder, micropipette, and test tubes.

Methods

Data were obtained through direct observation of the production process, interviews with laboratory personnel, and documentation of final product quality testing. Quality control was carried out for 23 consecutive days on chocolate-flavored pasteurized milk after pasteurization and before packaging.

Analysis

Analysis was performed using descriptive methods and statistical control ($\bar{x}$-chart). Control limits were calculated based on the mean (μ) and standard deviation (σ) of each parameter. The $\bar{x}$-chart in food quality control aims to monitor the average of critical parameters, such as weight, moisture content, or active ingredient content during processing. The basic formulas used are:

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$$UCL = \mu + 3\sigma \quad (1)$$

$$LCL = \mu - 3\sigma \quad (2)$$

Where:

μ: mean of the test parameter values

σ: standard deviation

These formulas are based on the assumption of normal distribution, with control limits of ±3 standard deviations to accommodate 99.73% of normal process variation. Recent studies by Gunasekaran *et al*. (2019) and Lim & Antony (2016) confirm that Statistical Process Control (SPC) using $\bar{x}$-charts effectively improves efficiency and safety in food production systems by enabling early detection of process deviations.

Results and Discussion

Process of Quality Control and Testing of Final Products

Quality control and testing of final products at CV Cita Nasional are conducted as part of product quality documentation for all goods leaving the factory. The aim is to ensure that products distributed to the market have undergone appropriate control processes and can serve as a verification basis in the event of consumer complaints. The quality parameters for final product testing include organoleptic testing (color, taste, aroma) performed by trained quality control personnel; alcohol test; temperature; pH; sweetness level; fat content; total solids; and product volume. Samples for organoleptic, alcohol, pH, fat, sweetness, and total solids testing are taken after production but before packaging to ensure that only products meeting the quality standards proceed to packaging.

1. Organoleptic Test

   The organoleptic test is conducted by trained quality control staff through visual inspection, tasting, and smelling of final product samples to ensure that the color, taste, and aroma match the intended product variant and are not contaminated with characteristics of other variants. According to Civille and Carr (2015), organoleptic testing is an important descriptive sensory evaluation in food quality control because color, taste, and aroma are the main parameters determining consumer acceptance.

2. Alcohol Test

   The alcohol test is performed using a 73% alcohol solution by mixing 2 ml of sample and 2 ml of alcohol solution in a test tube, shaking the tube, then inverting it while closing the mouth of the tube with the thumb. The milk emulsion is then observed—if it remains intact, the sample is in good condition and the test result is considered negative and safe to use. If the emulsion breaks, the sample is deemed damaged, and the

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result is positive and unsuitable for use. According to McSweeney and Fox (2013), alcohol instability may indicate protein degradation or changes in mineral composition due to suboptimal storage conditions.

3. pH Test

   The pH of the pasteurized milk final product is measured using a pH meter. The electrode of the pH meter, standardized with distilled water, is immersed into the milk sample until the reading stabilizes. According to Dash *et al*. (2022), pH is used to ensure that heat treatments such as pasteurization do not cause protein denaturation or casein precipitation.

4. Sweetness Level Test

   The sweetness level is measured using a Brix refractometer. The refractometer's prism is rinsed with water, dried with tissue, and then a drop of sample is placed on the prism until the scale shows a certain sweetness level. Sari *et al*. (2023) noted that this method uses the principle of total internal reflection in geometrical optics, widely accepted as a standard for determining the refractive index of transparent and semi-transparent liquids.

5. Total Fat Content Test

   Total fat content is measured using a butyrometer. First, 10 ml of 91% H_2SO_4 is poured into the butyrometer, followed by 25 ml of the milk sample down the inner wall of the butyrometer, and then 1 ml of amyl alcohol or pentanol is added. The butyrometer is sealed, gently shaken, and centrifuged for 5 minutes. The clear layer's scale reading represents the percentage of total fat content. According to Nyandey and Jakubczyk (2023), fat content is crucial in milk quality assurance systems, as the concentration and distribution of fat globules greatly influence sensory perception and industrial applications of milk. McSweeney *et al*. (2020) added that volatile compounds from lipids provide characteristic flavor to dairy products.

6. Total Solids Content Test

   Total solids content is measured using a moisture analyzer and a dry petri dish placed on it. The device is tared to zero, 5 g of sample is placed on the dish, and heated at 140°C for approximately 45 minutes or until the alarm sounds. According to Maywald and Vimalajeewa (2023), total solids analysis is an important part of milk spectroscopy data processing for quality assurance in the dairy industry.

7. Temperature Test

   Temperature during packaging is measured with a digital thermometer inserted into the milk until a stable reading is obtained. Dewi *et al*. (2019) found that waiting time and process temperature before packaging affect the quality of commercially sterilized flavored milk.

8. Volume Test

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Volume is checked by pouring three unpackaged filled cups into a measuring cylinder. Inconsistent volume can cause consumer dissatisfaction, regulatory violations, and economic losses. Khairunnisa and Sirajuddin (2023) highlight that packaging defects, such as volume deviations, significantly affect the quality of pasteurized milk.

Results of Monitoring and Quality Assessment of Chocolate-Flavored Pasteurized Milk

The product quality evaluation process at CV Cita Nasional uses SNI 01-3951-1995 as a reference in establishing internal quality standards. The SNI 01-3951-1995 standard for pasteurized milk with added flavorings and the internal quality standards set by CV Cita Nasional are presented in Tables 1 and 2 below.

Table 1. Indonesian National Standard (SNI) 01-2951-1995

Characteristic	Requirement	Testing Method
Odor, taste, color	Characteristic	Organoleptic
Fat content, % (w/w) min.	1.50	SP-SMP-248-1980
Non-fat solids, % (w/w) min.	7.5	SP-SMP-249-1980
Reductase test with methylene blue	0	SP-SMP-251-1980
Protein content, % (w/w) min.	2.5	SP-SMP-79-1975
Phosphatase test	0	SP-SMP-250-1980
Total Plate Count (TPC), ml, max.	3×10^4	SP-SMP-93-1975
Coliform presumptive MPH/ml, max.	10	SP-SMP-94-1975
As (ppm) max.	1	SP-SMP-193-1977, Ministry of Health S.I. 7
Pb (ppm) max.	1	SP-SMP-197-1977, Ministry of Health S.I. 7
Cu (ppm) max.	2	SP-SMP-247-1980
Zn (ppm) max.	5	SP-SMP-190-1980, AOAC 25136-25142
Preservatives	In accordance with Ministry of Health Regulation No. 235/Men.Kes/Per/IV/79	

Table 1. Quality Standards for Chocolate-Flavored Pasteurized Milk at CV Cita Nasional

Characteristic	**Requirement**	
pH	6.7 – 7.1	
Temperature	7 – 8°C	
Sweetness Level	14 – 15	
Fat Content	2.5 – 2.7%	
Alcohol Test	Negative	
Total Solids	Minimum 10.5%	

Several parameters are not explicitly stated in SNI 01-3951-1995, such as pH, Brix, and total solids standards. Based on the study by Mugozin & Husni (2019), the pH of pasteurized milk with added extracts remains within the normal range. Meanwhile, Dewi *et al*. (2019) found that the pH of commercial flavored liquid

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milk after heat treatment remains stable at 6.4–6.7. Studies by Dogan *et al*. (2017) and Della Lucia *et al*. (2016) showed that flavored milk, such as chocolate milk, generally has a Brix value between 16–18°Brix, depending on the formulation. The total solids value is also not explicitly stated in SNI 01-3951-1995, but it can be calculated by adding the fat content value to the non-fat solids content value. The fat content is at least 1.50% and the non-fat solids content is at least 7.5%, so it can be concluded that the total solids value for flavored pasteurized milk is a minimum of 9%.

Monitoring Results for pH Value

By comparing the pH values obtained from testing with the standards based on the literature and the company's internal standards, the monitoring results are shown in Table 3 below.

Table 3. Monitoring Results for pH of Chocolate-Flavored Pasteurized Milk

No	Date	pH	Literature (6.4–6.8)	Internal Standard (6.7–7.1)
1	02/03/2025	7.11	Not compliant	Compliant
2	03/03/2025	6.97	Not compliant	Compliant
3	04/03/2025	6.72	Compliant	Compliant
4	05/03/2025	6.94	Not compliant	Compliant
5	06/03/2025	7.02	Not compliant	Compliant
6	07/03/2025	7.02	Not compliant	Compliant
7	08/03/2025	7.00	Not compliant	Compliant
8	09/03/2025	7.03	Not compliant	Compliant
9	10/03/2025	7.01	Not compliant	Compliant
10	11/03/2025	7.00	Not compliant	Compliant
11	12/03/2025	7.01	Not compliant	Compliant
12	13/03/2025	7.08	Not compliant	Compliant
13	14/03/2025	7.06	Not compliant	Compliant
14	15/03/2025	7.03	Not compliant	Compliant
15	16/03/2025	7.05	Not compliant	Compliant
16	17/03/2025	7.03	Not compliant	Compliant
17	18/03/2025	7.05	Not compliant	Compliant
18	19/03/2025	7.14	Not compliant	Compliant
19	20/03/2025	7.06	Not compliant	Compliant
20	21/03/2025	7.03	Not compliant	Compliant
21	22/03/2025	7.11	Not compliant	Compliant
22	23/03/2025	7.05	Not compliant	Compliant
23	24/03/2025	7.20	Not compliant	Not compliant

Source: Processed primary data, 2025

Based on Table 3, monitoring of the pH value of chocolate-flavored pasteurized milk from March 2 to March 24, 2025, shows that most samples had pH values outside the literature standard range (6.4–6.8), but still complied with the company's internal standard range (6.7–7.1). Only one sample, on March 4, 2025, met

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both standards, and one sample, on March 24, 2025, failed to meet either standard, with a pH value of 7.20. According to Nielsen *et al*. (2022), significant pH changes after pasteurization may indicate protein denaturation or nutrient degradation due to suboptimal heat treatment. However, a pH range of 7.00–7.14 is generally considered safe for consumption as long as there is no microbiological contamination and other quality parameters, such as odor, taste, and total microbial count, meet food safety standards.

Monitoring Results for Fat Content

By comparing the fat content obtained from testing with the SNI 01-3951-1995 standard and the company's internal standard, the monitoring results are shown in Table 4 below.

Table 4. Monitoring Results for Fat Content of Chocolate-Flavored Pasteurized Milk

No	Date	Fat%	SNI 01-3951-1995 (min 1.50%)	Internal Standard (2.5–2.7%)
1	02/03/2025	1.50	Compliant	Not compliant
2	03/03/2025	1.50	Compliant	Not compliant
3	04/03/2025	1.20	Not compliant	Not compliant
4	05/03/2025	1.20	Not compliant	Not compliant
5	06/03/2025	1.60	Compliant	Not compliant
6	07/03/2025	1.40	Not compliant	Not compliant
7	08/03/2025	1.00	Not compliant	Not compliant
8	09/03/2025	1.00	Not compliant	Not compliant
9	10/03/2025	1.20	Not compliant	Not compliant
10	11/03/2025	1.30	Not compliant	Not compliant
11	12/03/2025	1.20	Not compliant	Not compliant
12	13/03/2025	1.40	Not compliant	Not compliant
13	14/03/2025	1.20	Not compliant	Not compliant
14	15/03/2025	1.10	Not compliant	Not compliant
15	16/03/2025	1.40	Not compliant	Not compliant
16	17/03/2025	1.30	Not compliant	Not compliant
17	18/03/2025	1.00	Not compliant	Not compliant
18	19/03/2025	1.40	Not compliant	Not compliant
19	20/03/2025	1.40	Not compliant	Not compliant
20	21/03/2025	1.20	Not compliant	Not compliant
21	22/03/2025	1.30	Not compliant	Not compliant
22	23/03/2025	1.20	Not compliant	Not compliant
23	24/03/2025	1.00	Not compliant	Not compliant

Source: Processed primary data, 2025

Based on Table 4, monitoring of fat content (Fat %) in chocolate-flavored pasteurized milk from March 2 to March 24, 2025, shows that most samples did not meet either the SNI 01-3951-1995 standard or the company's internal standard. Only two samples, on March 2 and 3, 2025, met the SNI standard but still did not meet the internal standard. The remaining 21 samples showed fat content below 1.40%, with the lowest recorded at 1.00%. Low fat content may indicate issues with formulation or processing, such as excessive dilution or

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improper mixing of raw materials. Achaw and Danso-Boateng (2021) noted that the direct addition of water and non-fat milk powder reduces the fat content in the final product.

Monitoring Results for Total Solids

By comparing the total solids obtained from testing with the SNI 01-3951-1995 standard and the company's internal standard, the monitoring results are shown in Table 5 below.

Table 5. Monitoring Results for Total Solids of Chocolate-Flavored Pasteurized Milk

No	Date	TS %	SNI 01-3951-1995 (min. 9%)	Internal Standard (min. 10.5%)
1	02/03/2025	13.66	Compliant	Compliant
2	03/03/2025	12.26	Compliant	Compliant
3	04/03/2025	12.89	Compliant	Compliant
4	05/03/2025	13.15	Compliant	Compliant
5	06/03/2025	12.34	Compliant	Compliant
6	07/03/2025	13.11	Compliant	Compliant
7	08/03/2025	13.62	Compliant	Compliant
8	09/03/2025	14.31	Compliant	Compliant
9	10/03/2025	13.22	Compliant	Compliant
10	11/03/2025	12.82	Compliant	Compliant
11	12/03/2025	12.83	Compliant	Compliant
12	13/03/2025	13.51	Compliant	Compliant
13	14/03/2025	12.72	Compliant	Compliant
14	15/03/2025	12.93	Compliant	Compliant
15	16/03/2025	13.01	Compliant	Compliant
16	17/03/2025	12.71	Compliant	Compliant
17	18/03/2025	12.44	Compliant	Compliant
18	19/03/2025	13.47	Compliant	Compliant
19	20/03/2025	12.75	Compliant	Compliant
20	21/03/2025	13.75	Compliant	Compliant
21	22/03/2025	13.17	Compliant	Compliant
22	23/03/2025	12.49	Compliant	Compliant
23	24/03/2025	12.84	Compliant	Compliant

Source: Processed primary data, 2025

The total solids parameter shows very good results, with all values above the minimum quality standard of 10.5%. During the monitoring period, TS% ranged from 12.26% to 14.31%, indicating that the solids content in the product is sufficiently high and stable. Juvinal *et al*. (2023) noted that total solids directly affect the viscosity, physical stability, and consumer sensory preference of chocolate milk.

Monitoring Results for Brix Value

By comparing the Brix values obtained from testing with the literature and internal standards, the monitoring results are shown in Table 6 below.

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Table 6. Monitoring Results for Brix of Chocolate-Flavored Pasteurized Milk

No	Date	Brix	Literatur (12–17°Brix)	Internal Standard (14-15°Brix)
1	02-24/03/2025	16	Compliant	Not Compliant

Source: Processed primary data, 2025

During the monitoring period, the Brix value was consistently 16 every day. This slightly exceeds the company's internal standard (14–15°Brix), but the difference is small and still acceptable for consumers, especially considering subjective sweetness preference. Consistent Brix values indicate stable and controlled sugar or sweetener addition. Aribah *et al*. (2020) stated that total soluble solids (measured as Brix) correlate with increased sweetness and physical stability in chocolate beverages, especially in low-fat formulations. The constant Brix value reflects effective quality control in the formulation process.

Stability of Final Product Quality Monitoring

Based on data obtained from March 2 to March 24, 2025, and the calculation of UCL and LCL values for each parameter, the analysis using control charts for pH, fat, and total solids is shown in Figures 1, 2, and 3.

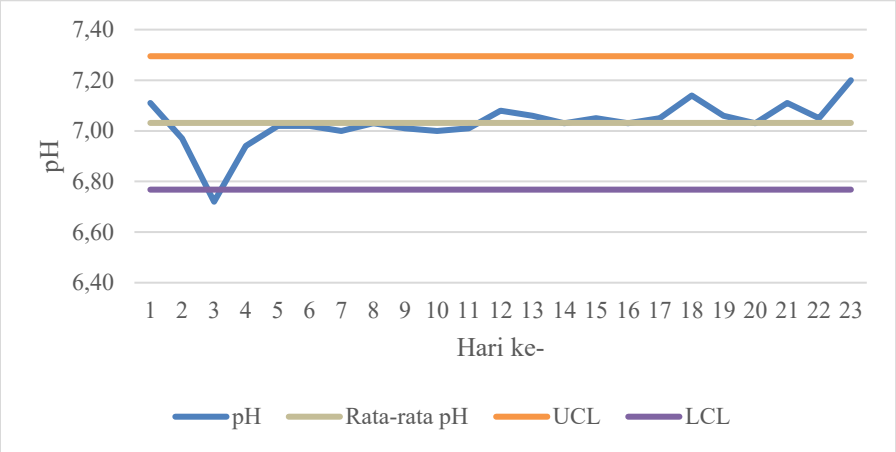

Figure 1. Control Chart of pH Parameter for Chocolate-Flavored Pasteurized Milk
Source: Processed primary data, 2025

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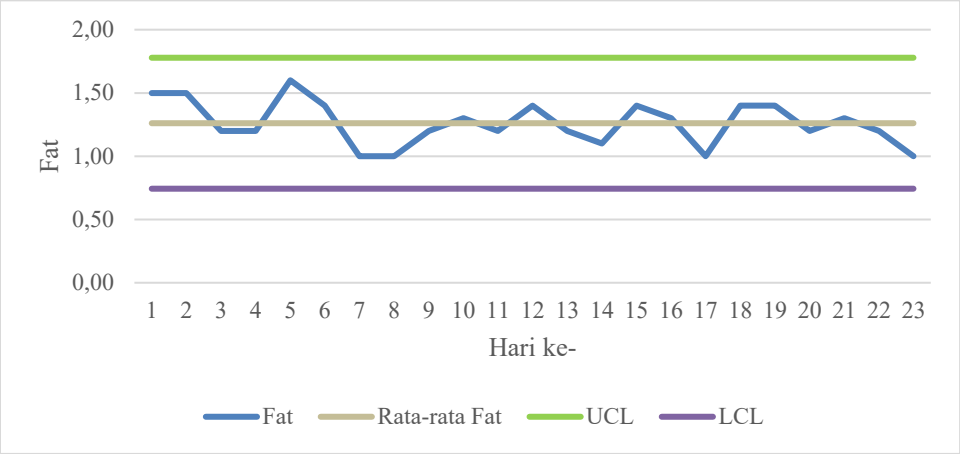

Figure 2. Control Chart of Fat Parameter for Chocolate-Flavored Pasteurized Milk
Source: Processed primary data, 2025

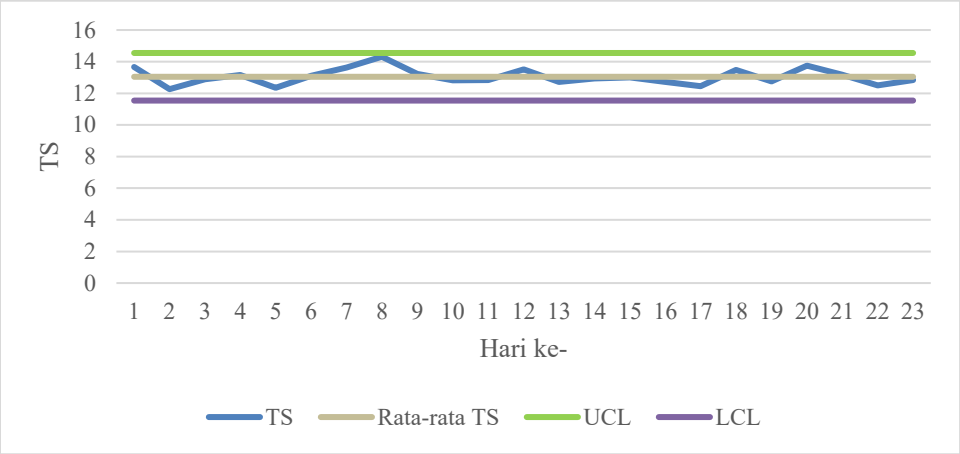

Figure 3. Control Chart of Total Solids Parameter for Chocolate-Flavored Pasteurized Milk
Source: Processed primary data, 2025

The control chart for pH shows that all pH values are within control limits (between LCL and UCL), although there is some fluctuation at the beginning of the observation (sample 3 shows the lowest point close to LCL). No points exceed the upper or lower limits, indicating that the production process is statistically under control. Stability of pH in chocolate milk is important to prevent coagulation and flavor degradation due to enzymatic or microbial activity (Öztürk *et al*., 2025).

The control chart analysis for fat shows fluctuating fat content, but still within control limits. Although some points are close to the lower limit (LCL), none exceed it, indicating that fat content remains stable despite minor variations, which is acceptable in normal production. Fat is important for flavor and viscosity of chocolate-flavored milk, making its stability critical (de Pádua Gandra *et al*., 2016).

The control chart for total solids shows very stable values, with nearly all points close to the average line. No extreme fluctuations are observed, and all TS values are comfortably within control limits. This indicates

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high stability in total solids composition, including sugar, protein, minerals, and fat. Stability of total solids contributes to physical and sensory stability of chocolate milk during storage (Aji *et al*., 2023).

Conclusion

Based on the practical work conducted from February 24 to March 24, 2025, at CV Cita Nasional, it can be concluded that the monitoring and testing of chocolate-flavored pasteurized milk were carried out according to procedures to ensure compliance with applicable standards. The results show that most quality parameters meet SNI 01-3951-1995, literature references, and the company's internal standards. However, some samples had fat content below the limits of SNI and internal standards, which could affect taste and product stability, although other parameters still met the requirements. Control chart analysis ($\bar{x}$-chart) indicated that all quality parameters were within control limits (UCL and LCL), showing that product quality remained relatively stable during the observation period and consistently met the established standards.

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