Sustainable Agriculture Research Journal (SAR JOURNAL)

e-ISSN: 3109-3825
https://e-journal.tematikapertanusantara.sch.id/index.php/SAR-Journal
Vol.1 (No.2): 66-76, 2025

Analysis of Fresh Milk Raw Material Quality from Village Cooperative

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ABSTRACT

Fresh cow's milk has high nutritional and economic value, but is susceptible to counterfeiting. The purpose of this study was to determine the quality control system for fresh milk raw materials and the conformity of milk quality from partner KUDs to company standards. Testing was conducted using three main methods: physical and chemical testing, microbiological analysis, and adulteration. Physical and chemical testing included temperature, pH, fat, total solids (TS), non-fat solids (SNF), specific gravity, alcohol, and organoleptic tests. Microbiology testing included the Methylene Blue Reductase Test (MBRT) and resazurin, while adulteration testing included the detection of added glucose, vegetable fat, and peroxide. The test results showed that fresh milk from KUD C, KUD G, and KUD B met company standards. Although there were some variations between KUDs, the fresh milk received was generally suitable and safe for processing into final products.

Keywords: Quality, Fresh cow's milk, Physical chemical test, Microbiological test, Adulteration test

Introduction

Fresh cow's milk is one of the food ingredients of animal origin that has high nutritional value, including protein, fat, vitamins, and minerals, making it very important for supporting the health and growth of the community (Brilianty et al., 2022). Increasing public awareness of a healthy lifestyle has also encouraged the high demand for quality dairy products. This is a challenge as well as an opportunity for the dairy processing industry to ensure that the milk raw materials used meet the set quality standards.

However, the high demand and economic value of fresh milk are often taken advantage of by irresponsible parties by committing fraud, such as adulterating milk or adding certain substances to adjust to applicable quality standards. One of the critical points in the milk supply chain occurs at the distribution stage from farmers to Village Unit Cooperatives (KUD) to the processing industry. The variation in the quality of milk produced by farmers every day, coupled with the difference in standards between KUD and industry, makes quality control a very crucial aspect.

Quality control is very important because it determines the safety and competitiveness of the product. Fresh milk is easily damaged due to unstable temperatures, microbial contamination, and unhygienic handling and distribution practices. Therefore, strict quality control is required from the receipt of raw materials.

CV X is one of the milk processing industries that collaborates with several KUDs, such as KUD C, KUD G, and KUD B, implementing a quality control system to ensure that only the best quality milk is further processed. Therefore, an in-depth analysis of the quality control process of fresh milk raw materials carried out

e-ISSN: 3109-3825
https://e-journal.tematikapertanusantara.sch.id/index.php/SAR-Journal
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in this company is needed, starting from the acceptance stage, laboratory testing, and evaluation of results to ensure conformity with company standards.

Material and Methods

Material

The raw materials used are fresh cow's milk from KUD C, KUD G, and KUD B. Other supporting materials are sulfuric acid (H_2SO_4) 91%, amyl alcohol ($C_5H_{12}O$), 73% alcohol, solution Methylene Blue Reductase Test (MBRT), larutan resazurin, paper test special glucose, resorcinol, concentrated HCL, paper test special perokside, and P-resorcinol acid solution.

Tool

The equipment used is a 2-liter measuring cup, digital thermometer, pH meter, Gerber butyrometer, water hyacinth pipette, centrifuge, moisture analyzer, lactodensimeter, 1000 mL measuring cup, test tube, propipet, tip pipette, micropipette, waterbath, and stove.

Research Methods

This study employs a quantitative descriptive approach to assess the quality of fresh cow's milk based on laboratory test results of samples collected from three KUD partners of CV X. Sampling was conducted directly upon the arrival of raw materials at the company using a 2-liter measuring cup. The collected samples were subsequently analyzed in the laboratory, and the results were compared with the company's established quality standards to determine their suitability for use as raw materials.

Research Stages

1. Physical Chemical Test

Temperature

Temperature measurements in fresh milk are carried out by dipping the thermometer directly into the milk until the indicated number is stable. Based on the standards set by CV X, the maximum acceptable temperature of fresh milk is 8 °C. This cooling process aims to suppress the growth of destructive microorganisms in milk, so that it can extend its shelf life (Sutrisno et al., 2015).

PH

The pH check on fresh milk is carried out by dipping the pH meter in the milk until the displayed number is stable. CV X determines that the pH of acceptable fresh milk is in the range of 6.60 to 7.09, which is close to neutral. The purpose of this test is to determine the acidity level of milk, which plays a role in assessing the quality and feasibility of consuming the milk (Mutaqin et al., 2021).

Total fat

e-ISSN: 3109-3825
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Testing of total fat content was carried out using the Gerber method with a butyrometer. The test began by pouring 10 mL of a 91% solution of sulfuric acid (H_2SO_4) into a butyrometer tube, then adding 25 mL of the fresh milk samples using a water hyacinth pipette, as well as 1 mL of amyl alcohol ($C_5H_{12}O$). Next, the tube is covered with a rubber cover and gently shaken until homogeneous, characterized by a change in color to blackish-purple. The butyrometer is then inserted into the centrifuge and rotated for 5 minutes. Once the process is complete, the fat content is determined based on the scale (%) of the layer of clear fluid formed. CV X stipulates that fresh milk must have a fat content of at least 3.3%; If it is lower, then the sample will be rejected.

Solid Non-Fat (SNF)

The testing of the content of lean solids or Solid Non-Fat aims to find out the total amount of solid components in milk that do not contain fat. SNF values can be calculated using the following formula:

$$\% \text{ SNF} = \% \text{ TS} - \% \text{ Fat} \quad (1.1)$$

The percentage of SNFs indicates the content of solids other than fats in cow's milk, such as protein, carbohydrates, minerals, and ash. The higher the protein and lactose content in milk, the fat content of milk will also increase (Rohayati & Christi, 2017).

Total solid (TS)

The total solid content test was carried out with a moisture analyzer. First, it is put in a dry petri dish that has been placed on top of the moisture analyzer, then filled with 5 grams of fresh milk samples, and then the start button is pressed. An alarm will sound when the appliance has finished processing. The measurement results displayed are in the form of a percentage of moisture content, while the value of total solids is calculated using the following formula:

$$\% \text{ Total Solid} = 100\% - \% \text{ moisture} \quad (1.2)$$

CV X stipulates that the total solid content in fresh milk must be at least 10.5% if the value obtained is lower, then the sample is rejected and declared not to pass the quality test.

Specific gravity

Testing of the specific gravity of fresh milk was carried out using a lactodensimeter device. First, the fresh milk sample is put in a measuring cup of 1000 mL until full. Then a lactodensimeter was inserted and waited until the lactodensimeter was stable and not moving. It is ensured that there is no foam on the surface so as not to obstruct the reading of the appliance. Next, readings were made of the temperature scale (°C) and the density scale (g/mL). The specific gravity value is calculated using the following formula:

$$\text{Specific gravity} = ((20 - T) \times 0.0002) - d \quad (1.3)$$

CV X stipulates that the specific gravity of fresh milk must be at least 1.0250 at a temperature of 20 °C.

Alcohol

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Alcohol testing is carried out using a 73% alcohol solution. The test begins by inserting 2 mL of alcohol solution into the test tube, then 2 mL of the fresh milk sample is added. The mixture is homogenized, and the results of the emulsion formed are observed. If the emulsion remains stable and does not break, then the milk is declared in good condition (negative test). However, if the emulsion separates or clumps, it shows that the milk has been damaged (positive test). Based on the CV X standard, samples with positive alcohol test results must be rejected and cannot be used in the production process.

Organoleptics

Organoleptic testing is carried out by an experienced Quality Control officer. The testing procedure is carried out by gargling using milk samples, then assessing whether the taste, aroma, and texture are in accordance with the set quality standards. Based on the standards of CV X, fresh cow's milk is declared feasible if it passes the organoleptic test according to the criteria. These criteria include a yellowish-white color, a fresh aroma typical of cow's milk, as well as a savory and slightly sweet taste.

2. Microbiological Testing

Methylene blue reductase test (MBRT)

This test is carried out to determine the content of bacteria in milk by observing the ability of milk bacteria to grow using dissolved oxygen. A total of 10 mL of milk is mixed with 1 mL of methylene blue solution, then incubated in water at a temperature of 38 °C. Bacteria will reduce methylene blue until the color changes to white. The change is considered complete when 4/5 of the sample changes color, which is called the reduction time. The test lasts for 5–7 hours, and the faster the color changes, signaling a greater number of microbes, as more reducing compounds are produced by bacterial activity. Good milk generally has a reduction time of 5–7 hours, with a bacterial count of about 1–4 million/mL (Khoirul & Anggraeni, 2023). Based on the CV X standard, fresh cow's milk is declared feasible if the duration of the MBRT test time is at least 3 hours.

Resazurin testing

This resazurin test is carried out to determine the content of bacteria in the milk by observing the ability of bacteria to reduce the color of the resazurin solution. In this test, 10 mL of milk is mixed with 1 mL of resazurin solution, then put in a water bath and wait for 40 minutes. Every 10 minutes, it is observed to change color and homogenize, then return it to the waterbath. If, after the resazurin solution is added, the color of the milk does not change, then the quality is considered good. Instead, the change in color from blue to purple, pink, to white, indicates a high number of bacteria, low quality, and the possibility of mastitis in cattle (Arini & Ifalahma, 2021). Based on the CV X standard, fresh cow's milk is declared feasible if the resazurin test has a minimum score of 3.

3. Counterfeit Testing

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Glucose replenishment testing

This test aims to find out whether milk is added with glucose to increase sweetness, as well as Total Solid (TS) and Solid Non-Fat (SNF) levels. This glucose addition test was carried out using a special glucose paper test. The paper test is dipped in milk for a few seconds and observed to change its color within 30-60 seconds. If the color produced is dark brown, then the result is positive and contains glucose, but if the result is light blue, then the result is negative and does not contain glucose. As per the CV X standard, samples with positive results must be rejected.

Testing of vegetable fat supplements

This test aims to detect the addition of vegetable fats such as coconut milk to add savory taste and increase fat and Total Solid (TS) levels. A total of 0.1 grams of resorcinol is mixed with 25 mL of sample and 2.5 mL of concentrated HCl in a test tube, then whisked and heated to a boil. After sitting for 5 minutes, the color change is observed. If it does not change color, the result is negative. If it turns pink, the result is positive. Based on the CV X standard, samples with positive results must be rejected.

Peroxide addition testing

This test aims to detect the presence of peroxide additions in milk, which is often used to maintain the stability of the emulsion. The test of the addition of peroxide was carried out using a special peroxide paper test. The paper test is dipped in milk for a few seconds and observed to change its color within 30-60 seconds. If the color produced is blue and getting older, then the result is positive and contains peroxide, but if the result is light blue to white, then the result is negative and does not contain peroxide. Based on the CV X standard, if the sample has a positive result or exceeds +5, it must be rejected.

Carbonate addition testing

This test aims to detect the addition of carbonates used to preserve milk emulsions. A total of 2 mL of samples was mixed with 2 drops of p-resorcinol acid. If the mixture turns red then the result is positive. If the mixture turns orange, then the result is negative. The more intense the red color (more than +3), the higher the carbonate content added. Based on the CV X standard, samples with positive results or exceeding +2 should not be used.

Results and Discussion

Quality control is a sample testing activity that aims to ensure that the production process runs by the standards that have been determined by the company. Quality control of fresh cow's milk at CV X is carried out

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at the time of receipt of milk from KUD to determine good milk quality, then further testing is carried out in the laboratory to maintain milk quality before production. The quality control process at CV X is divided into three tests, namely physical, chemical, microbiological, and counterfeit testing. The raw material testing standards in CV X can be seen in Table 1.

Table 1. CV X Raw Material Testing Standards

Test Parameters	Quality Standards
Temperature Test	Max. 8 °C
Alcohol Test (71%)	Negative
Specific Gravity Test	Min. 1.0250
Fat Test	Min. 3.3%
pH Test	6.60 – 7.09
Total Solid Test	Min. 10.50%
Uji Organoleptik	Standard
MBRT Test	Min. 3 hours
Uji Resazurin	Min. score 3
Water Carbonate	Max. +2
Glucose Counterfeiting Test	Negative
Vegetable Fat Adulteration Test	Negative
Peroxide Test	Max. +5

Source: CV X, 2025

1. Physical Chemical Test

a. Organoleptic Test

The results of this test are not recorded quantitatively, but are only used as a reference that the sample meets organoleptic quality standards according to the company's SOPs. Although it includes subjective assessment, organoleptic tests are able to quickly identify any quality inconsistencies, such as sour aromas, unusual tastes, or discoloration.

Table 1. Results of Physical Testing of Fresh Milk Chemistry

KUD	TEST						
	TEMPERATURE	PH	FAT	SNF	TS	SPESIFIC GRAFITY	ALK
Company standards	Max. 8 °C	6.60-7.09	Min. 3,3 %	-	Min. 10.5 %	Min. 1.0250	(-)
KUD C	5 °C	6.78	3.63 %	6.73 %	11.57 %	1.0272	(-)
KUD G	4 °C	7	3.8 %	5.84 %	11 %	1.0257	(-)
KUD B	5 °C	6.84	3.39 %	5.86 %	10.55 %	1.0248	(-)

Source: Processed primary data, 2025

b. Temperature Test

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Based on Table 2, the results of the three KUDs are still below the maximum temperature limit set by the company, which is 8 °C. This means that the milk from the three KUDs has been stored properly so that it remains fresh and avoids microbial growth. This is also in line with the literature (Septiani et al., 2023), which states that if milk is not stored at a cold temperature (around 4 °C), then bacteria will develop faster and cause the milk to spoil quickly.

c. pH Test

Based on Table 1.2, the results of the three KUDs have met the company's standards because they have a pH between 6.60 and 7.09 or can be said to be in the neutral pH range. This indicates that the milk from the three KUDs does not experience an increase in the number of bacteria. The more bacteria in the milk, the more lactose content in the milk will be converted into lactic acid so that the milk will turn into acid (Pramesthi et al., 2015). Maintaining a neutral pH is important to prevent flavor changes and maintain the effectiveness of pasteurization.

d. Fat Test

Based on Table 2, the results of the three KUD have met the company's standards because the fat content obtained has exceeded 3.3%. This also indicates that KUD G has the best quality of the other two KUDs. The difference in fat content between KUDs can be caused by various factors, such as dairy cow genetics, type of feed, maintenance methods, climatic conditions, lactation period, and animal health status. According to (Widyawati et al., 2020), these factors greatly affect the synthesis of fat in milk, thus affecting the fat content produced.

e. Test Total Solid (TS)

Based on Table 2, the results of the three KUD have met the company's standard, which is at least 10.50%, so it can be concluded that the milk produced is still classified as good quality. KUD C has the highest TS value, which shows that the quality of milk is better than the other two KUDs. The difference in levels of total solid (TS) between these KUD is most likely influenced by the Solid Non-Fat (SNF), which is made up of components such as protein, lactose, and minerals. The higher the SNF content, the total solid value (TS) will also increase. This is by the opinion (Subagyo et al., 2023) that an increase in SNF will increase the total level of solids in milk. High TS values can affect the final product's results, such as the viscosity and taste of the milk. Other factors, such as the type of feed, the condition of dairy cows, and post-milking handling, can also affect the TS value between locations.

f. Test Solid Non-Fat (SNF)

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Although the company does not list the SNF standard, SNI 3141.1-2011 states that the minimum SNF value in fresh milk is 7.5% (Maryana et al., 2024). Based on Table 2, the SNF value results of the three KUDs have not met SNI standards. According to (Sari, 2021), SNF levels and total solids in milk are greatly influenced by the type of feed consumed by cows. This is because about 29% of the solid components in milk are synthesized from nutrients derived from feed. Therefore, a high-quality feed will contribute to an increase in the SNF content in milk. In line with that, according to (Subagyo et al., 2023), increasing SNF levels will have a direct impact on increasing the level of total solids in milk.

g. Specific Gravity Test

Based on Table 2, the results of the three KUDs are that KUD C and KUD G have met the company's standards, which are above 1.0250, while KUD B has not met the company's standards. Specific gravity below 1.0250 g/ml shows that the KUD adds a lot of water to its fresh milk with the aim of increasing the quantity (Gemechu et al., 2015). If milk is mixed with water, its specific gravity will decrease, while an increase in specific gravity can occur due to the release of carbon dioxide (CO_2) and nitrogen (N_2) contained in milk (Septiani et al., 2023). Although the average specific weight of milk from KUD B is not much different, the company can still accept it other words, the company will give a warning in the form of a letter to the KUD to reduce the addition of water to the milk. If the KUD cannot fix this, the company will stop receiving milk from the KUD.

h. Alcohol Test

Based on Table 2, it is known that fresh milk from the three KUDs produced negative values on the alcohol test. The results are by the company's negative standards. According to (Wiranti et al., 2022), Negative alcohol test results show that the water coat that covers proteins, especially casein, is still stable, so when alcohol is mixed, the protein does not clump and the milk remains stable. This means that milk is still suitable for consumption. Meanwhile (Wiranti et al., 2022), added that if there are clumps or milk granules attached to the walls of the test tube, then the alcohol test results are positive. On the other hand, the absence of a lump indicates a negative test result.

2. Microbiological Test

The following are the results of the microbiological testing of fresh milk raw materials along with the company's standards in CV X as stated in Table 3.

Table 3. Results of fresh milk microbiological testing

KUD	MBRT	REZ
Company standards	Min. 3 hours (180 minutes)	Min. score 3
KUD C	5 hours 31 minutes (331 minutes)	5
KUD G	6 hours 30 minutes (390 minutes)	5
KUD B	6 hours 30 minutes (390 minutes)	5

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Source: Processed primary data, 2025

a. Methylene Blue Reductase Time (MBRT)

Based on Table 3, it is known that on average, KUD C, KUD G, and KUD B have MBRT results that exceed the minimum company standard of 3 hours. This indicates that the milk from the three KUDs is of good quality and meets the company's standards because it can last up to more than 3 hours. According to (Khoirul & Anggraeni, 2023) the duration of the discoloration in the milk indicates the number of microorganisms present in it. The resulting MBRT shows more than 3 hours, which means that the microbes present in the milk are few because the lack of microbes makes the duration of the discoloration longer.

b. Resazurin Test

Based on Table 3, it is known that the average KUD C, KUD G, and KUD B have a score value of 5, which means that it exceeds the minimum standard of the company with a score of 3. Based on Table 4, it can be concluded that the three KUDs have very good quality and are by the company's standards. It also indicates that the milk quality is good and has a small number of bacteria that reduce resazurin.

Table 4. Resazurin Testing Color Standard

Color	Score	Result
Blue	5	Very good
Blue-pink	4	Good
Dark blue-pink	3	Neutral
Pink changes	2	Less good
White	1	Signs

Source: Arini & Ifalahma (2021)

3. Counterfeit Test

The following are the results of the counterfeiting test of fresh milk raw materials along with the company's standards in CV X as stated in Table 5.

Table 5. Raw Material Counterfeiting Test Results

KUD	Peroxida	Glucose	Vegetable fats
Company standards	Max. +5 or (-)	(-)	(-)
KUD C	(-)	(-)	(-)
KUD G	(-)	(-)	(-)
KUD B	(-)	(-)	(-)

Source: Processed primary data, 2025

a. Addition of peroxide

Based on Table 5, the values of the three KUD are by the company's standards. Scientifically, the addition of H_2O_2 can increase the activity of the lactoperoxidase system, which can inhibit the growth of

e-ISSN: 3109-3825
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microorganisms and slow down the pH drop, thus having an impact on the value of MBRT. However, use at high levels risks causing health impacts such as nausea, headaches, and cancer (Chou TC et al., 2018).

b. Added glucose

This glucose addition is used to add sweetness and increase the rate of Total Solid (TS) and Solid Non-Fat (SNF). Because the higher the % of total solids, the better the sample quality (Subagyo et al., 2023). The three KUDs had negative results, indicating that the milk did not contain added glucose. From the test results, KUD C, KUD G, and KUD B are in accordance with the company's standards.

c. Plant-based fat addition

Based on Table 5, it was found that the three KUDs had negative results, indicating that KUD C, KUD G, and KUD B had no addition of vegetable fats. This is by the company's negative standards.

d. Carbonate addition

The addition of carbonate in milk is indicated by a change in color, where the higher the carbonate content added, the more intense the red color that appears. This carbonate test is rarely carried out by CV X because the assessment of the quality of fresh milk can be determined through other test results, such as physical chemical and microbiological tests, which can also indirectly indicate the presence of counterfeiting or deterioration of milk quality.

Conclusion

CV X has implemented a comprehensive quality control system for fresh milk raw materials, starting from the acceptance stage to laboratory testing. The results of the chemical and physical tests showed that most of the fresh milk from the three KUDs met the company's standards, although there were minor differences in specific gravity and SNF parameters. The results of microbiological testing showed that the milk from the three KUDs was in the quality category with a reduction time and a minimum qualifying score, indicating a low number of microorganisms and the freshness of the milk that was maintained. The results of the counterfeit test showed that the samples contained illegal additives. This confirms that the milk received is clean from fraudulent practices that can harm consumers. Overall, fresh milk from the three partner KUDs was declared feasible and safe to be further processed into pasteurized milk products and yoghurt. The quality control system implemented by CV X has been effective in maintaining the consistency of the quality of fresh milk raw materials.

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