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Original Article

Milk quality test using lactose, specific gravity and fat test approaches at the Kertajaya Village Cooperative Unit, Kediri

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ABSTRACT

The quality of fresh milk based on SNI 2011 regarding fresh milk requirements includes physical, chemical and the number of microorganisms. One of the physical properties of milk can be seen from the density test. The chemical properties of milk can be seen from the lactose and fat rate. The lactose test is by means of titration of the filtrate resulting from filtering milk which is free from any content other than lactose. Density test using a lactodensimeter. Fat test using the Gerber method. From the results of research on the quality of cow's milk which was carried out using the lactose test approach, density and fat obtain average results of 3.98% of lactose rate, 1.0259 g/ml of density and 2.7% of the at rate in VUC Kertajaya is good and close to the criteria according to SNI 2011. This can affect the selling price of milk from farmers in VUC Kertajaya.

Keywords: Milk, lactose, density, fat, VUC

Introduction

Based on data from the Food Security Agency in 2021, the level of milk consumption in Indonesia increased in 2018 to 3.1 kg/capita/year, which was previously only 2.8 kg/capita/year in 2017. In 2020, the average milk consumption was 3.0 kg/capita/year. Milk is a fluid produced by the mammary glands of mammals and humans whose components are not reduced and other ingredients are not added. The main components consist of water, protein, fat, minerals, carbohydrates, minerals and vitamins (Rahmawati *et al*., 2020).

The average composition of cow's milk consists of: Water 83.8%, protein 3.2%, fat 4.3%, carbohydrates 3.5%, potassium 4.3 mg/100 g, calcium 143.3 mg/100 g, phosphorus 60 mg/100 g, iron 1.7 mg/100 g, vitamin A, SI 130, vitamin B1 0.3 mg/100 g and vitamin C 1 mg/100 g (Suhendar, 2008). Milk contains substances needed by the body, all nutrients contained in milk can be absorbed by the blood and utilized by the body. Animals that produce milk are goats, buffaloes, sheep, camels, horses also produce milk although in limited quantities. The milk that is mostly consumed by humans is dairy cow's milk, namely cow's milk, because this type of livestock is a potential milk producer (Arin, 2020).

Currently, almost 95% of fresh milk produced by dairy farmers is marketed to the Milk Processing Industry. Farmers who have dairy cattle can market their milk through cooperatives. Village Unit Cooperatives (VUC) have an important role in supporting the

development of milk (Puspasari, 2017). The Kertajaya Village Unit Cooperative is a cooperative that houses dairy farmers in Medowo Village, Kandangan District, Kediri Regency. The requirements and quality testing of milk carried out at the Kertajaya VUC are lactose content testing, specific gravity testing and fat content testing. The characteristics of milk are important to know because these qualities determine the selling price. The higher the quality of the milk, the higher the price. Low milk quality also affects the results of milk processing (Christi *et al*., 2022).

Lactose in milk gives milk a sweet taste, so the higher the lactose content, the sweeter the milk tastes. Lactose levels are also correlated with the specific gravity of milk. The higher the lactose content, the higher the specific gravity of milk. The specific gravity of milk is influenced by the fat content of milk. The higher the milk fat, the lower the specific gravity of milk and vice versa. Milk fat has been used as a requirement to determine the quality of milk and the price of milk. If the milk fat produced is high, the price of milk offered is higher. Several Milk Processing Industries apply a price bonus for farmers who submit milk with fat and lactose levels above the standard (Prasetyo *et al*., 2023).

There are two types of milk quality assessment, namely physical and chemical. The physical properties of milk can reflect the quality of each component of milk. The physical properties of milk can be seen from the results of the specific gravity test, organoleptic test (color, aroma, taste and viscosity), acidity, pH, and alcohol test (Shodiq *et al*., 2023). The chemical properties of milk are related to the acidity level of milk (Wahyuningsih, 2022). Based on the background of the problems that have been described, this study aims to see the quality of fresh milk at VUC Kertajaya with a lactose, specific gravity and fat test approach.

Materials and methods

Research design

Sampling was carried out at the Kertajaya Village Unit Cooperative, Sidomulyo Hamlet, Medowo Village, Kandangan District, Kediri Regency which was carried out on April 8, 2023. The research was conducted at the Public Health Laboratory, Public Health Division, Faculty of Veterinary Medicine, Airlangga University which was carried out on April 11 - April 17, 2023.

Sampling

Milk sampling was carried out aseptically from the cow's udder by first cleaning it with clean water and drying it. Milking was carried out by the owner or the barn boy. Samples were taken during morning milking. Milk was collected in sterile containers that had been labeled as much as 250 ml for each cow, then frozen and taken to the laboratory using a coolbox to avoid milk damage and bacterial growth.

Lactose test

Determination of lactose levels in milk quoted from Sudarmadji and Haryono (1984) was carried out with the following procedure: 25 ml of milk was put into a 50 ml measuring flask and 5 ml of $ZnSO_4$ reagent was added then shaken. Add 5 ml of NaOH solution (93 grams of NaOH diluted to 3 liters = 0.75N) and shaken until dissolved. Then dilute to the mark with distilled water. Let the suspension stand for approximately 10 minutes to precipitate all proteins. Then filtered with filter paper and the filtrate was collected. Calculate the volume of this filtrate theoretically, by subtracting the volume of precipitated protein (from the milk protein content and protein specific gravity of 1.25) and the volume of fat (from the fat content and fat specific gravity of 0.9) from the initial volume of 50 ml. 5 ml of clear filtrate was taken and then put into a 250 ml Erlenmeyer flask, add 20 ml of distilled water, KI solution (10 g KI + 90 ml of distilled water = 10% KI solution) and 50 ml of Chloramine-T solution. The Erlenmeyer was closed and shaken, then let stand for 90 minutes. After that, add 10 ml of 2 N HCl solution. Furthermore, the solution was titrated using 0.1 N $Na_2S_2O_3$ until pale yellow, add starch solution indicator and continue

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titration until gray. The blank solution was made using 25 ml of sterile distilled water and the implementation procedure was the same as in the sample (Prawesthirini *et al*., 2018).

Lactose in the filtrate (g/100 ml filtrate) is calculated using the formula:

$$A = (Tb - Ts) \times N \times 0.171 \times 1005$$

A = g lactose/100 ml filtrate
Tb = Blank titration
Ts = Titration example
N = Normality of $Na_2S_2O_3$

Calculate the lactose content in 100 ml of milk by entering the filtrate volume factor and dilution factor. Milk with a protein content of 3.2% and fat of 3.5% theoretically produces filtrate of 48.4 ml, then it is calculated using the formula:

Lactose content in 100 ml of milk = $A \times \frac{48.4}{100} \times \frac{100}{25}$ gram

Specific gravity

Specific gravity examination of the sample using a lactodensimeter. The procedure is as follows: The milk sample is stirred first until homogeneous. Then the milk sample is poured into a test tube through the tube wall without causing foam. Then the lactodensimeter is dipped into a tube containing milk so that it goes up and down. Wait until the shaking stops. Read the scale listed on the lactodensimeter (Setyorini *et al*., 2020). The readings listed indicate the 2nd and 3rd numbers behind the comma, while the 4th decimal is estimated. If the number listed on the lactodensimeter is 28, the result obtained is 0.0280. Measurements are carried out three times, each time after re-immersing the lactodensimeter. The coefficient of expansion of milk is 0.0002 per degree Celsius and a lactodensimeter is used that is calibrated at a temperature of 27.5°C. The calculation of the specific gravity of milk is the temperature of the milk minus the temperature of the lactodensimeter, then added to the lactodensimeter scale obtained and multiplied by the coefficient of expansion of the milk.

$$BJ = Scale + (T - 27.5) \times 0.0002$$

Note: T = Milk temperature

Fat test

Determination of milk fat content using the Gerber method. It is carried out with the following procedure: Milk before being stirred perfectly until homogeneous. Gerber butyrometer with a scale of 0.0-7.0% is upright on a rack and filled with 91-92% H_2SO_4 as much as 10 ml of concentrated sulfuric acid using an automatic pipette. Through the tube wall, 11 ml (according to Gerber 10.75 ml) of milk is slowly inserted so that the liquid remains separate. Then add 1 ml of amyl alcohol with an automatic pipette (BJ Iso amyl alcohol = 0.814-0.816 at 15.5°C). The tube is plugged with rubber, wrapped with a cloth and shaken with the number 8 until homogeneously mixed. The perfection of shaking is indicated by the formation of a purplish brown mixture and the disappearance of solid formations. Furthermore, the tube is immersed in a water heater at a temperature of 65°C for 5 minutes. From now on the butyrometer must always be upright with the scale part on top. Then centrifuged with the scale part on the centrifuge shaft, rotating at a speed of 1200 rpm for 3 minutes. The butyrometer is immersed again in a 65°C water bath for 5 minutes. Read the fat content on the scale part with an accuracy of 0.05%. Fat content is expressed in % which means the number of grams of fat in every 100 grams of milk.

Data analysis

The data obtained from the results of the lactose content test, specific gravity and fat test for the milk quality test are processed and presented descriptively with tables and figures.

Result

The results of milk quality tests using the lactose, specific gravity and fat test approaches at VUC Kertajaya can be seen in table 1.

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Table 1. Milk quality test results

Quality	Average	SNI 3141-1:2011
Lactose (%)	3.98	4.0
Specific Gravity (g/ml)	1.0259	1.0270
Fat (%)	2.7	3.0

The results of the milk lactose test (Figure 1) that have been carried out obtained results with an average value of 3.98%. The average value is almost close to the lactose content of cow's milk according to the Indonesian National Standard 3141.1.2011, which is 4%. Based on the results of the study, 13 fresh milk samples were obtained that met SNI (2011) and 17 fresh milk samples still did not meet SNI (2011) from a total of 30 fresh milk samples.

Figure 1. Lactose test

The results of the specific gravity (Figure 2) that have been carried out obtained results with an average value of 1.0259 g / ml. The average value is quite low for the specific gravity of cow's milk according to the Indonesian National Standard 3141.1.2011, which is 1.0270 g / ml. Based on the results of the study, 11 fresh milk samples were obtained that met SNI (2011) and 19 fresh milk samples still did not meet SNI (2011) from a total of 30 fresh milk samples.

Figure 2. Specific gravity test

The results of the milk fat test (Figure 3) that have been carried out obtained results with an average value of 2.7%. The average value is almost close to the standard for cow's milk fat content according to the Indonesian National Standard 3141.1.2011, which is 3.00%. Based on the results of the study, 10 fresh milk samples were obtained that met SNI (2011) and 20 fresh milk samples still did not meet SNI (2011) from a total of 30 fresh milk samples.

Figure 3. Fat test

Discussion

Based on the results of the lactose, specific gravity and fat test of 30 fresh milk samples from cattle owned by farmers at VUC Kertajaya, Sidomulyo Hamlet, Medowo Village, Kandangan District, Kediri Regency, the average lactose, specific gravity and fat content was obtained which was close to the Indonesian National Standard 3141.1.2011.

The results of the milk lactose test that have been carried out obtained results with an average value of 3.98%. The average value is almost close to the lactose content of cow's milk according to SNI (2011) which is 4%. The results of specific gravity that have been carried out obtained results with an average value of 1.0259 g / ml. The average value has not met SNI (2011) which is 1.0270 g / ml. The results of the milk fat test that have been carried out obtained results with an average value of 2.7%. The average value is almost close to the standard for cow's milk fat content according to SNI (2011) which is 3.00%.

Based on the research results, 13 fresh milk samples were obtained that met SNI (2011) and 17 fresh milk samples still did not meet SNI (2011) from a total of 30 samples for

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lactose content examination. Based on the research results, 11 fresh milk samples were obtained that met SNI (2011) and 19 fresh milk samples still did not meet SNI (2011) from a total of 30 samples for specific gravity examination. Based on the research results, 10 fresh milk samples were obtained that met SNI (2011) and 20 fresh milk samples still did not meet SNI (2011) from a total of 30 fresh milk samples for fat content examination.

Based on research conducted by Suhendra *et al*. (2020) on fresh cow's milk in Ngablak District, Magelang Regency, 3.98% was obtained for the average lactose content of milk, 1.025 g/ml for the average specific gravity of milk and 3.42% for the average fat content of milk. The study also found a correlation between fat and lactose content with the specific gravity of cow's milk. Increasing the fat and lactose content of milk will increase the specific gravity value of milk. The higher the fat content of milk, the higher the specific gravity value of milk. The higher the lactose content of milk, the higher the specific gravity value of milk.

Lack of lactose levels can be caused by the energy levels in the feed still not being met, most of the lactose content is formed by feed containing lactose formed by feed containing high energy. The formation of lactose is influenced by propionic acid which comes from feed, especially concentrate and high energy will be stored in the form of glucose (Christi *et al*., 2022).

The increased glucose content results in an increase in the lactose content of milk because some glucose will enter the mammary glands and be used to synthesize lactose which acts as the main precursor in milk synthesis. The increase in milk lactose, then milk production also increases because lactose acts as an osmoregulator in the mammary glands (Imanto *et al*., 2018).

The specific gravity of a material is the ratio of the weight of the material to the weight of water at the same volume and temperature. The results of the specific gravity that have been carried out obtained results in the range of 1.0187-1.0309 g/ml with an average value of 1.0259 g/ml. According to the Indonesian National Standard 3141.1.2011, the normal specific gravity of fresh milk is between 1.027-1.034 at a temperature of 20°C. Fresh milk from cattle in Indonesia has an average specific gravity of 1.0250. When compared to the standards of cattle in Indonesia, the specific gravity obtained has met the minimum specific gravity standard (Tefa *et al*., 2019).

The differences in quality that occur can be caused by variations in milk content that affect the specific gravity of milk from each individual livestock (Christi *et al*., 2022). The content dissolved in milk where the more compounds contained in milk, the specific gravity of milk will increase. Low specific gravity values can be caused by several things including changes in fat conditions and the presence of gas that occurs in milk (Anindita and Soyi, 2017).

According to Disa *et al*. (2017), specific gravity measurements are ideally carried out 3 hours after milking. This is also supported by the opinion of Satria *et al*. (2019) who stated that the specific gravity of milk varies according to storage temperature and storage time. Examination of milk quality close to milking will produce a lower specific gravity compared to the specific gravity far from milking. This is due to the solidification of fat. Solid fat has a higher specific gravity than liquid fat, in addition to the evaporation of gases in milk (Prasetyo *et al*., 2023).

The results of research on specific gravity are influenced by solids or dry matter produced from feed intake. Dry ingredients consist of fat granules (globules), lactose, protein and salt. The highest content is protein, followed by fat, lactose and minerals. Factors that influence specific gravity are milk, time and composition (Wiranti *et al*, 2022).

Milk fat has been used as a determinant of milk quality and milk price. If the milk fat produced is high, the price of milk offered is higher. Milk fat content is influenced by several factors, namely: feed, climate, lactation time and milking procedures, age of the cow and milking interval (Wiranti *et al*., 2022).

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The main factor that can affect milk quality is feed. Feed containing high fiber will increase milk fat but on the contrary if given concentrate feed it will decrease milk fat content. Green feed is a source of fiber, the more acetate production, the more fatty acid synthesis which then results in an increase in milk fat content.

Conclusion

From the results of the study of the quality of cow's milk conducted using the lactose, specific gravity and fat test approach, the average results were 3.98% lactose, 1.0259 g/ml specific gravity and 2.7% fat content. According to SNI 2011 the minimum standard for lactose is 4%, 1.0270 for specific gravity and 3% for fat. The conclusion of the quality of cow's milk using the lactose, specific gravity and fat test approach at VUC Kertajaya is good and close to the criteria according to SNI 2011.

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