Fresh Milk Quality Testing in Medan

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Abstract
The purpose of this study was to determine the physical and organoleptic characteristics of milk sold by dairy farmers or dairy outlets and the suitability of the milk based on SNI 3141.1 in Medan. The material used in this study was 10 L of fresh cow's milk purchased from several dairy farmers in the Medan. This study used a survey method with a t-test and data were analyzed descriptively. The parameters observed were the reductase number, alcohol test, boiling point, and pH value of fresh milk. The results of this study indicate that milk from dairy farmers in Medan does not meet SNI 3141.1.

Keywords: Reductase Number, pH Values, Boiling Points Test, Alcohol Test

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Introduction

Indonesia is a developing country with a significant livestock sector, marked by government efforts to improve public welfare through several programs, such as meat self-sufficiency and livestock assistance. The livestock raised include ruminants (cattle, goats, sheep) and poultry, including chickens, ducks, quail, and others. The cattle raised by farmers in this country are both beef and dairy cattle.

Dairy cattle are the primary source of milk. Indonesia's dairy cattle population in 2017 was 5,448,000 head, spread across the country. This number increased from 5,339,000 in 2016. As the number of cattle increased, milk production in 2017 reached 920,093 tons, a 0.81% increase. The spread of dairy cattle has reached North Sumatra Province. The livestock population increased from 1,400 in 2016 to 1,948 in 2017. Several areas in the province also raise this type of dairy cattle, such as Medan City, which has a population of 274. The livestock population significantly impacts milk production.

The high protein content of milk makes this animal product highly nutritious. In addition to these nutrients, milk's largest component is water, which reaches 80%, followed by other nutrients such as lactose, calcium, phosphorus, and other minerals. Pure milk is the liquid taken from lactating dairy cows, containing natural ingredients that are not modified by other ingredients.

Milk's nutritional content can be reduced or altered if observed closely. For example, the color of the milk can change. The yellowish-white color of milk can be altered by the addition of other ingredients intended to give it a white or yellow color. Furthermore, the milk's distinctive aroma can also be altered by the addition of other ingredients, as can flavorings such as rice water. These practices are among the most common forms of fraud found at fresh milk outlets, including those in Medan Sunggal District.

Milk adulteration that is often done is adding milk with water with the aim of increasing the volume of milk produced, mixing milk with milk that is no longer suitable for consumption or spoiled is also done by some milk sellers. In addition, milk is added with flour to increase the thickness of the milk, the addition of coconut milk to the milk and the most dangerous is the addition of chemicals to the milk sold. In addition to milk adulteration using these ingredients, this product can also be damaged due to contamination by microorganisms. One of the milk contaminants is microorganisms that contaminate during the milking process such as milkers, livestock, tools used that are not cleaned before use. Pratiwi (2018) found that 50% of farmers who milk milk in Medan City are not hygienic in the process and found 1 milk sample positive for Salmonella sp. Therefore, physical and organoleptic testing of milk characteristics must be carried out to determine the level of freshness of milk sold at milk outlets around Medan City with a simple method.

Literature Review

2.1 Milk

Milk is a white secretion of the mammary glands which has nutritional value and is obtained from healthy livestock (Potter, 1976; Buckle et al, 1985; Winarno, 1993). Milk is a natural food that is almost perfect because it contains essential nutrients such as protein, calcium minerals, phosphorus, vitamin A, thiamine (vitamin B1), and lactose (Almatsier, 2002). This livestock product is widely consumed by consumers, whether from cows or goats. The highest nutritional content in milk is water, at 87.5%. Furthermore, milk has a sweet and salty taste, derived from its lactose and mineral content (Winarno, 1993).

Table 1. Nutrition Content of Milk per 100 grams

Nutritions Content	Composition
Energi (kkal)	61
Protein (g)	3,2
Fat (g)	3,5

Nutritions Content	Composition
Carbohydrate (g)	4,3
Calcium (mg)	143
Phosphore (mg)	60
Iron (mg)	1,7
Vitamin A (μg)	39
Vitamin B_1 (mg)	0,03
Vitamin C (mg)	1
Water (g)	88,3

Source: List of Food Ingredient Composition (Depkes RI, 2005)

Research Methodology

This research was conducted in Medan. The materials used were 10 liters of fresh cow's milk, 1 liter of each taken from dairy farmers in Medan, 70% alcohol, methylene blue, bunsen burners, test tubes, test tube racks, droppers, cotton wool, erlenmeyer flasks, pH meters, incubators, stirring rods, measuring cylinders, and cotton wool.

The research began with the preparation of cow's and goat's milk purchased from dairy farmers and dairy outlets in Medan. The milk purchased was milk from morning and evening milkings. The research variables were then tested in the laboratory. The variables observed in this study were reductase activity, alcohol content, boiling point, and pH.

3.1 Reductase Test

Ten milliliters of milk was placed in a sterile test tube. Then, 2 ml of methylene blue was added, homogenized, and tightly covered with cotton wool. The tube was then placed in an incubator (37ºC). The time course of the sample was observed and recorded (Modified by Susilawati et al., 2013).

3.2 Alcohol Test

Milk is placed in a reaction tube, 5 ml of which is then added to it. 5 ml of 70% alcohol (1:1) is then added. Changes in the milk are observed (if it coagulates, the milk has gone bad, and vice versa).

3.3 Boiling Points Test

Five ml of milk is placed in a test tube. The test tube is heated using a Bunsen burner until it boils. The heating process is then stopped (if the milk clumps on the walls of the test tube, the milk is not good, and vice versa).

3.4 pH Value

Pour 25 ml of milk into an Erlenmeyer flask. The electrode is dipped in a suspended position into the milk. Once the reading on the monitor stabilizes, it is recorded.

Results

4.1 pH Value

The results of statistical analysis using the t-test obtained no significant difference ($P>0.05$) with SNI on milk pH in Medan Sunggal I (Table 1). The pH value of the observed milk samples varied from 5.79 to 6.53. A total of 11 milk samples (73.3%) observed had lower values compared to SNI 3141.1 (2011) which states that milk pH is 6.3-6.8. A total of 4 samples (26.7%) observed were in a suitable condition, while 11 samples (73.3%) were in a condition unfit for consumption because their pH values were below the standard. This condition can be caused by improper milk treatment, namely not pasteurizing and the condition of the milking stall that is not maintained. This can reduce product quality because the product can be contaminated through the air or the milking area environment. In addition, the product is not

put into milk cans and is not immediately stored at low temperatures. This is in line with the opinion of Rachmawan (2001) that milk is milked, filtered, then the milk is put into milk cans and stored at a low temperature, namely 4^{o}C while waiting for delivery to the industrial house.

Another factor that can affect milk quality, particularly pH, is storage time. The observed sample storage period was more than 2 hours, resulting in the pH value dropping to acidic (below pH 6). This is supported by research by Umar et al. (2014), which states that long storage time can reduce the reductase number and acidity (pH) of pasteurized cow's milk. Furthermore, improper milk handling can also increase the growth of microorganisms in milk. The acidic condition of the product can indicate bacterial contamination. This is supported by Zakaria et al. (2013), which states that microorganisms grow very quickly in milk because this product has high nutritional value, resulting in a short storage time if not handled properly.

Unfit for consumption dairy products are caused by the activity of lactic acid spoilage agents such as *Streptococcus thermophiles*, *Lactobacillus lactis*, and *Lactobacillus thermophiles*. The decrease in milk pH is caused by lactic acid bacteria that play a role in breaking down lactose into lactic acid. This statement is supported by Buckle et al. (2007) that lactic acid spoilage bacteria are *Lactobacillus lactis, Lactobacillus thermophillus,* and *Streptococcus thermophiles*. The higher activity of lactic acid bacteria during lactose breakdown results in a decrease in the pH value to become more acidic.

4.2 Reductase Number

Based on statistical analysis using a t-test, a highly significant difference ($P<0.01$) was found with the Indonesian National Standard (SNI) for milk during the reductase test. The bacterial activity of the milk samples observed varied from 30 to 150 minutes (Table 1). The higher the bacterial activity, the shorter the time required for the milk to return to its normal color. Conversely, a longer time indicates that the milk is in good condition or fresh. This is consistent with research by Umar et al. (2014) who conducted a study on pasteurized cow's milk, which showed that the samples still had good reductase values after 7 days of storage. This indicates that the reductase value of pasteurized milk decreases with increasing storage time.

The activity of the reductase enzyme in the methylene blue reagent indicates high microbial activity in the milk. This is indicated by a very rapid color change from blue to white. This is in accordance with Fardiaz (1989), who stated that the blue-to-white color change in milk samples accelerates with increasing bacterial counts.

This is due to the oxygen consumed by microorganisms that grow and can be active when the methylene blue reagent is mixed into the sample, resulting in a color change to white. This is in accordance with the opinion of Buckle et al. (2007), that in milk there is a reductase enzyme produced by germs. The change in the blue color of the methylene blue reagent to colorless is due to the presence of this enzyme. Therefore, to quickly determine the quality of milk, a reductase test can be used on the sample. In accordance with the opinion of Hadiwiyoto (1994) that the quality of milk is acceptable if the blue color of the reagent disappears in a storage period of more than 2 hours and less than 6 hours and the number of microorganisms ranges from 4-20 million.

The results of this study differ from those of Yudonegoro et al. (2014) who distinguished the reduction time of milk samples from farmers and TPS with results of 7.43 hours and 6.83 hours respectively. These results differ from the study of Susilawati et al. (2013) who conducted a study on bacterial reduction due to heating which showed that bacterial activity can decrease when heated. The difference in results in this study was caused by contamination factors that contaminate the milk from poor husbandry management, pens that were not cleaned before milking, feces storage areas close to the milking area, sanitation and hygiene of equipment, unpasteurized milk and poor storage treatment of milking equipment. This is supported by Sudono et al. (2003) who stated that milk quality can be affected by an unclean

environment around the pen. Several factors that contaminate milk include dirty pens, feces attached to the udder, urine and various other impurities in the pen.

Microorganism contamination can occur from upstream to downstream product treatment. Furthermore, milk obtained from outlets is not properly treated, namely by cooling, resulting in high bacterial activity in the product, resulting in high reductase values. This is in accordance with Ismanto et al. (2013) who stated that the growth of spoilage microbes can be prevented through a cooling process to extend the shelf life of milk. According to Rofi'i (2009), inhibition of bacterial growth and enzymatic activity is more effective when storing milk samples at low temperatures (10ºC) compared to storage at room temperature. Furthermore, product shelf life also affects bacterial activity in the product. This is in accordance with the opinion of Umar et al. (2014) who stated that the reductase number and acidity (pH) of milk will be affected by storage time.

The MB reagent used will change the color back to white. The basis for determining the number of bacteria in a sample is the time it takes for the color to change from blue to white. Enzyme activity in certain bacteria in milk causes the reduction power to appear. Many studies have shown that the magnitude of the reduction power and the number of bacteria in milk are related. Therefore, one procedure used to determine the quality of milk is the reduction power test, both in fresh and pasteurized conditions. The difference in oxidation-reduction power of 300 mV is caused by the milk's contact with air during milking. This also forms the basis for the reduction test. Oxygen is needed by bacteria in milk to grow and produce reducing substances.

4.3 Boiling Points Test

The boiling point test results for the milk samples are shown in Table 2. In the study, 80% of the samples tested showed negative results. This result aligns with the standards for fresh milk. The Indonesian National Standard (SNI) (2011) states that milk quality requires a negative boiling point test. The boiling point test results indicate that the cow's milk used as samples, particularly from Medan, is still of good quality and suitable for consumption, as there is no adulteration.

Table 2. pH Levels, Reductase Number, Boiling Points Test, and Alcohol Test

Samples	pH	Reductase Number (min)	Boiling Point Test	Alcohol Test
S1	6,18	60	Negative	Negative
S2	6,02	60	Negative	Negative
S3	6,20	60	Negative	Negative
S4	6,10	60	Negative	Negative
S5	6,16	60	Negative	Negative
S6	6,05	60	Negative	Negative
S7	6,10	60	Negative	Negative
S8	6,10	60	Negative	Negative
S9	6,00	45	Positive	Positive
S10	5,59	45	Positive	Positive
S11	5,86	30	Positive	Positive
SE	0,68	6,32		

4.4 Alcohol Test

In the study, 72,7% of the observed samples showed negative results, meaning no coagulation occurred in the milk that was dripped with alcohol (Table 2). This result is in accordance with the standards for fresh milk. The Indonesian National Standard (SNI) (2011) states that the milk quality requirement is a negative 70% alcohol test. The alcohol test results

obtained indicate that the cow's milk used as samples, especially from Medan, is still of good quality and is suitable for consumption because there is no milk adulteration. The milk used as the study sample has an average storage time of 2-4 hours. The results of this study are in line with research conducted by Nababan et al. (2015) that the quality of liquid milk becomes increasingly unsuitable for consumption if stored at room temperature for a long time.

Conclusion

The conclusion that can be obtained from the research results is that milk samples taken from farmers in Medan which are 3 samples do not comply with SNI 3141.1.

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