Raw and pasteurized milk quality of D-farm milk processing unit at Faculty of Animal Science, IPB University

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ABSTRACT: The Faculty of Animal Science, IPB University, produces pasteurized milk daily under the D-farm milk processing unit. In order to maintain the product quality, as well as its safety, the fresh milk as raw the main material and the produced pasteurized milk quality is tested periodically. The aim of this research is to evaluate the quality of fresh and pasteurized milk produced by the D-farm milk processing unit. The tested fresh milk was originated from two different farms, while the tested pasteurized milk was made by using pasteurizer machine and double-wall pan heating. The tests were carried out by using a lactoscan milk analyzer. The results showed that the fresh milk used by the D-farm milk processing unit had good milk quality, even though still below the SNI standard, while the produced pasteurized milk has met the SNI standard. In addition, the pasteurization by using pasteurizer produced better pasteurized milk quality compared to the traditional pasteurization by using double-wall pan heating.

Keywords: Quality; Fresh milk; Pasteurized milk; D-Farm milk processing unit

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INTRODUCTION

The Faculty of Animal Science, IPB University, held potential resources in the farming area, including the dairy farm. The efforts to develop upstream to downstream farming business are done by establishing a milk processing unit to process the fresh milk as raw material into processed products with higher added value. The higher added value would help develop D-Farm into an income generating unit. This is in line with IPB university policy of building various entrepreneur venture models in every unit in the university.

The development of the milk processing unit is a the implementation of the Faculty of Animal Science commitment to improve the human resources quality through milk consumption. Milk is a nutrient-rich food and is important for health. The Ministry of Agriculture of the Republic of Indonesia (2012) emphasized that nutrition intake is essential to boost the quality of national human resources. The fresh milk quality as raw material would determine the dairy products quality produced by the D-Farm. Quality assurance of the raw materials, as well as the processing technology, that includes pasteurization is carried out continuously by the D-farm milk processing unit. This research aims to evaluate the fresh milk quality originated from different dairy farms and compare the pasteurized milk quality made by using modern (milk pasteurizer machine) and traditional (double-wall pan heating) method.

MATERIALS AND METHODS

The fresh milk from two dairy farms in Bogor is used as raw material for the pasteurized milk and compared for its quality. The milk is collected for 4 times on different days. The milk pasteurization is done by using two different methods as research treatments, which are by using milk pasteurizer machine and double-wall pan heating. The pasteurization temperature is set at 65℃ for 30 minutes in accordance with SNI 01-3951-1995 following the principle of Low Temperature Long Time/LTLT pasteurization (Ranieri, *et al.*, 2009). After pasteurized, the milk is cooled down by using a refrigerator until reached 10℃ and then tested for its quality. The fresh and pasteurized milk quality test is carried out by using Lactoscan with following the company instructions.

Data analysis

The obtained data were analyzed by using analysis of variance (ANOVA) to determine the treatment effect on the observed variables. If the treatments showed significant differences the analysis is continued with Duncan's test (Kesumawati, Retta and Sari, 2017). The quality comparison between fresh and pasteurized milk, all of the pasteurized milk quality data both from modern and tradition methods are combined and presented as mean value.

RESULTS AND DISCUSSION

Milk quality from different dairy farms

The fresh milk quality collected from two different dairy farms and milking days in Bogor, West Java, showed non-significant difference (Table 1). This showed that both farms which provide fresh milk for the D-farm milk processing unit produce same milk quality. According to the SNI standards (3141.1: 2011), the fresh milk quality in this research did not meet the SNI standards for non-fat dry matter, specific gravity and protein, except for the fat content. Even though most of the chemical content did not meet the standard, the fresh milk in this research showed to still be able to be used to produce good pasteurized milk.

Mardalena (2008) explained that different milking time would affect the fresh milk quality. The different milking time intervals between morning (17 hours) and evening (7 hours) caused different milk quality. The longer time interval in the morning milking caused the udder to be in a long empty condition and caused lower udder pressure.

A low udder pressure will then increase the milk secretion in the udder and resulted in better milk quality. Petrov *et al.*

(2016) stated that different dairy farms management will produce different milk quality. Their research in Turkey showed that organic dairy farming management produced milk with higher protein compared to the conventional farm management.

Table 1. Milk quality from different dairy farms in Bogor

Milk quality	Farm origin		SNI*
	Farm A	Farm B	
Fat (%)	3.52±0.17a	3.97±0.24a	Min 3.0
Non-fat dry matter (%)	7.53±0.13b	7.59±0.24b	Min 7.8
Specific gravity (g mL^{-3})	1.0265±0.0004b	1.0263±0.0008b	Min 1.0270
Lactose (%)	4.14±0.07b	4.17±0.13b	--
Salt (%)	0.61±0.01b	0.62±0.02b	--
Protein (%)	2.76±0.05b	2.780.09b	Min 2.8
Added water (%)	8.81±1.84a	7.63±3.33a	--
Freezing point (ºC)	-0.474±0.010a	-0.481±0.017a	-0.520 - -0.560

Note: Different letters on the same column indicate significant difference at P<0.05.
*Indonesian National Standard (SNI) for dairy cattle's fresh milk SNI 3141.1: 2011

The milk quality is also determined by the milking techniques. The milking technique has been improving along with technological advance, but has not been well distributed, especially in some rural and suburban areas. Hand milking is still commonly used in the rural areas. Milking practices that are hygienic with good sanitation and appropriate storage and transportation will greatly reduce milk damage (Fillimon *et al*., 2011). In this research, the tested fresh milk is only collected during morning milking.

Fresh and pasteurized milk quality in the D-farm milk processing unit

Pasteurized milk is now one of the most preferred dairy products by consumers. Milk pasteurization is one way to extend the shelf life of the fresh milk (Chandan, *et al*., 2008). Marcondes *et al* (2014) stated that the nutritional quality of fresh milk is influenced by internal factors of the dairy cattle, such as breed, lactation time, feed, conditions of the mammary gland, lactation intervals and milking conditions. Pasteurization is a processing technique aimed to prevent pathogenic microbes contamination so that milk is safe for consumption by humans. The pasteurization process is done by heating the milk below its boiling point, so it would not change the nutritional value, consistency and taste of the milk. In the pasteurization process heating is generally carried out through a heating exchanger (Chandan *et al*., 2008). The quality comparison of the fresh and pasteurized milk produced by D-farm can be seen in Table 2.

The results showed that the produced milk by D-farm milk processing unit has meet the Indonesian National Standard SNI 01-3951-1995 requirements (Table 2). This showed that the pasteurization process carried out at the D-farm milk processing unit of the Faculty of Animal Science of IPB has fulfilled the requirements and produced good pasteurized milk for consumption. The pasteurization process does not reduce the overall quality of the fresh milk, except for the reduced milk fat and increased milk specific gravity. The decreased milk fat due to pasteurization occurred due to the breakdown of fatty acid compounds into volatile compounds by heating. The pasteurization by the D-farm milk processing unit are carried out through 2 different methods, that are by using a double wall pan heating at 63ºC for 30 minutes and by using a pasteurizer machine at the same pasteurization temperature and time.

The pasteurization can be done in two ways of heating, 72ºC for 15 seconds or 63ºC for 30 minutes. The heating at 72ºC for 15 seconds is generally done with a plate

heat exchanger by flowing the milk rapidly to the heating exchanger and rapidly cooled down to below 10ºC in order to prevent reactivation of spores and microbes (Chandan *et al.*, 2008).

The pasteurization is aimed to: 1) Killing certain vegetative microbes, especially pathogenic microorganism; 2)

Enzyme inactivation; 3) Products preservation; and 4) Maintaining sensory quality (FAO, 2013). Reta and Addis (2015) also stated that pasteurization will prevent microbial contamination that are harmful for human health, such as *Escherichia coli*, *Staphylococcus aureus,* and other coliform microbes.

Table 2. Comparison of quality of fresh milk and pasteurized milk for D-farm production

Milk quality	Type of milk		SNI pasteurized milk *
	Fresh milk	Pasteurized milk **	
Fat (%)	3.75±0.31a	3.32±0.46b	Min 2.8
Non-fat dry matter (%)	7.56±0.18a	7.76±0.45a	Min 7.7
Specific gravity (g mL^{-3})	1.0264±0.0006 b	1.0274±0.0014a	--
Lactose (%)	4.15±0.10a	4.25±0.25a	--
Salt (%)	0.61±0.02a	0.63±0.04a	--
Protein (%)	2.77±0.07a	2.84±0.17a	Min 2.5
Added water (%)	8.22±2.64a	6.44±6.11a	--
Freezing point (ºC)	-0.477±0.014a	-0.487±0.033a	--

Note: Different letters in the same column indicate significant difference at P<0.05
* Indonesian National Standard (SNI) for pasteurized milk SNI 01-3951-1995
**Mean value of both modern and traditional milk pasteurization

Table 3. Pasteurized milk quality by modern and traditional pasteurization

Quality	Pasteurization process technology	
	Modern	Traditional
Fat (%)	3.63±0.06a	3.01±0.47b
Non-fat dry matter (%)	8.11±0.19a	7.41±0.34b
Specific gravity (g mL^{-3})	1.0285±0.0007a	1.0263±0.0009b
Lactose (%)	4.44±0.11a	4.06±0.19b
Salt (%)	0.66±0.02a	0.60±0.03b
Protein (%)	2.97±0.07a	2.71±0.13b
Added water (%)	6.73±0.35a	6.15±0.85a
Freezing point (ºC)	-0.513±0.014b	-0.462±0.025a

Note: Different letters on the same column indicate significant differences at P<0.05

Pasteurized milk quality from different pasteurization method

The pasteurization in the D-farm milk processing unit are carried out in 2 ways, which are by using double-wall pan heating at 63ºC for 30 minutes and using a pasteurizer machine at the same pasteurization time and temperature. The condition is due to the limited amount of milk pasteurizer which is around 40 liters/day, while the D-farm should process around 400 liters of milk daily, thus the double-wall pan heating pasteurization is

performed to fulfill the quota. In this research, we compare the quality of both pasteurizations method to assess the production. The pasteurized milk quality comparison by using a double-wall pan heating (traditional) and pasteurizer machine (modern) method can be seen in Table 3. Wolderiam and Asres (2015) investigated the quality of pasteurized milk and found higher total fat content (4.75-4.9%) and lower lactose content (1.14-2.07%) content compared to the result of this research.

The different results can be caused by several factors, such as research location, farm type, and the breed of the dairy cattle. However, it can be stated that variations in the pasteurized milk quality is highly depended on the type of pasteurization and the used fresh milk quality.

The different pasteurization methods in this study showed a significant effect to the quality of the produced pasteurized milk. Pasteurization by using pasteurizer machine produced better products compared to the traditional pasteurization by using double-wall pan heating. This is due to the condition that pasteurizer machine had more controlled and stable environment, with constant heating temperature is constant and aseptically and closed. On the other hand, double-wall pan pasteurization is more unstable, noting that the heat from the gas stove is constantly changing (affected by external factors, such as air and wind) and not closed with pot lid as it has to be constantly manually stirred to prevent milk damage. Moreover, the heating would eliminate some nutritional compounds through evaporation.

CONCLUSION

The fresh milk used at D-farm milk processing unit of the Faculty of Animal Science of IPB had good quality, but still below the SNI standards. The pasteurized milk quality produced at D-Farm has meet the SNI requirements. The milk pasteurization carried out by using pasteurizer machine produced better pasteurized milk compared to the traditional pasteurization by using double-wall pans heating.

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