Milk Quality Distribution of Dairy Cattle at Local Farm in West Java

N D Yanthi¹, Muladno², N Herlina¹, R Damayanti³, A Anggraeni⁴ and S Said⁴

¹ Biotechnology Research Center, Cibinong, Bogor 16691
² Faculty of Animal Husbandry, Bogor Agricultural University, Darmaga Campus, Bogor 16680
³ Faculty of Veterinary Medicine, Bogor Agricultural University, Darmaga Campus, Bogor 16680
⁴ Livestock Research Institute, Ciawi, Bogor 16720

nova.dy@gmail.com

Abstract. This research aimed to analyze the quality of milk (content and chemical composition) at several local farms in West Java province. Milk is a food that has complete nutritional value in balanced proportion. Good quality of milk contains the composition of fat content, total solids, protein, water and contamination level that meet the criteria in the Indonesian National Standard (SNI) 3141.1.2011. The milk quality parameters were analyzed by the FT 120 MilkoScan™ (Foss). The milk was collected as much as 50 ml and then dipped in a milkoScan probe. The parameters observed included pH, specific gravity, fat, protein, water and non-fat dry matter (%). The highest fat content found in milk samples from Subang district i.e. 3.62 ± 1.40. Lembang district has the highest lactose concentration among the other sampling regions which is 4.58 ± 0.22. The highest concentration of dry matter content was found in Subang district (12.57 ± 1.87). The highest value at the content of the non-fat dry ingredients in the Subang area was 8.87 ± 0.70. The milk density from Pangalengan and Lembang were 103.244 ± 2.51 and 103.27 ± 1.74 respectively. The concentration of FPD from the Subang district was 0.55 ± 0.06 (highest results and overreach the SNI value). The highest concentration of acidity was in the Subang district with a value of 7.84 ± 1.41.

1. Introduction
Milk is food that has excellent and complete nutritional value in balanced proportions [1]. All food elements contained in milk can easily be absorbed by the blood so that it can be utilized by the body. Therefore, milk is also beneficial in supporting the growth and health of the body. Milk quality has the relations with several factors related to genetics, nutrition, management, health, markets, and environmental conditions; so not all of these factors can be controlled [2].

People who need to consume milk everyday have already increased. People begin to realize the good nutritional value contained in milk. At present, the community’s consideration to consume milk and dairy products is more on the quality of the milk produced, either it is a matter of natural taste, cow welfare management, or the right price [3]. These selection considerations were obtained with standardized livestock raising management. According to Norring et al. [4] the improved management,
better nutrition, effective selection for higher production, and the daily milk yield of cows have already increased. Milk quality is the basis for evaluating milk prices. The impact of milk quality will affect the processing dairy products. Fresh milk is perishable food because it has a high water content around 87% and has a complete nutritional value that is good for human, animal and microorganism consumption. Good quality of milk contains the composition of fat content, total solids, protein, water, and contaminated content in milk based on the Indonesian National Standard (SNI) 3141.1.2011. This research aimed to analyse the quality of the milk content as a parameter for evaluating the quality of milk located at local farms in West Java province.

2. Materials and methods

2.1. Data collection and animal management
The material used was dairy milk from West Java districts included Lembang, Pangalengan, Tasikmalaya, Sumedang, Subang, Sukabumi Bogor, and West Bandung. At the time of sampling, the udder and nipples were cleaned by water, and then, they were dried after that time. The milk was collected in a sterile container using a 50 mL bottle. It was stored in an icebox during the trip to the laboratory. Milk quality analysis was done at the LIPI Animal Biotechnology Research Center Laboratory in Cibinong. The tool used for milk quality analysis was MilkoScanTM FT 120 (Foss). The analysis process with MilkoscanTM utilizing MilkoScanTM Probe was entered into 50 mL of milk.

2.2. Observation Variables
Then the parameter values would be observed. The parameters observed included the value of protein, fat, dry matter, dry matter without fat, lactose, specific gravity (BJ), freeze point deviation (FPD), and acidity (%).

2.3. Data analysis
The data were analyzed using MS Excel 2010.

3. Result
The data obtained from this research was the measurement of chemical content parameters of milk and the measurement of somatic cells from several locations that are used as materials for milk quality assessment. The chemical content of milk was influenced by the level of somatic cell concentration (Cinar et al 2015). Figure 1 illustrates the percentage of somatic cell concentrations in milk infected with subclinical mastitis.

![Figure 1. Concentration of somatic cells subclinical mastitis suspected milk of level based](image)
According to McFadden M 2011 somatic cells in milk could be categorized in each level, namely Positive 1 (250,000 - 400,000 cells / ml); Positive 2 (400,000 - 1,500,000 cells / ml); Positive 3 (1,500,000 - 5,000,000 cells / ml); Positive 4 (above 5,000,000 cells / ml). While for negative conditions less than 250,000 cells / ml. The highest concentration at positive level 2 was in Lembang district. In Pangalengan and Sumedang districts, the average numbers of somatic cells was at positive level 1. On the other hand, the highest somatic cell value at positive level 3 was in Bogor.

**Table 1. Milk quality of several parameters in the West Java Districts**

| Milk Quality Of Parameter | Minimal | Maximal | Average | Standard Nasional Indonesia* |
|---------------------------|---------|---------|---------|-------------------------------|
| Protein                   | 0.1     | 6.95    | 2.81±0.106 | 2.8                           |
| Fat                       | 0.31    | 11.19   | 3.05±1.944 | 3.0                           |
| Total Solid               | 7.8     | 19.17   | 11.21±2.202 | 10.8                          |
| Solid Non-Fat             | 1       | 10.32   | 7.53±2.061  | 7.8                           |
| Lactose                   | 0.34    | 9.34    | 5.03±1.857  | -                             |
| Density                   | 1015    | 1037    | 1029.45±4.692 | 1.027                        |
| FPD                       | 0.311   | 0.648   | 0.50±0.59   | -0.520 - 0.560                |
| Acidity                   | 3.43    | 13.43   | 6.70±1.663  | 6.0 – 7.5                     |

*SNI 3141.1.2011

Table 1 shows the average quality of milk content of dairy cows in West Java local Farms. The content of milk quality parameters appeared to have a very wide range. The minimum value of milk quality of parameters was far below the standards issued by the Nasional Standardization of Indonesia (SNI). Meanwhile, the maximum value of milk quality parameters spread in 6 regions of West Java exceeded the SNI. According to [5, 6, 7], the quality of milk was influenced by several aspects including species, genetic variations, health, environment, management, lactation stage, feed and age of cattle.

**Table 2. Milk quality of dairy cattle at local farm in West Java**

| Location   | Fat     | Protein | Lactose | Total solid | Solid non Fat | Density | FPD | Acidity |
|------------|---------|---------|---------|-------------|---------------|---------|-----|---------|
| Pangalengan | 1.13±0.80ab | 3.11±0.78a | 4.35±0.052b | 9.78±1.45c | 8.57±0.784 | 1032.44±2.51 | 0.50±0.04 | 6.52±1.97b |
| Sumedang   | 2.77±1.09ab | 3.01±0.42a | 4.47±0.21c | 11.42±1.19c | 8.59±0.35a | 1030.50±1.83 | 0.51±0.03 | 6.42±1.12ab |
| Subang     | 3.62±1.40ab | 3.51±0.48a | 4.22±0.48ab | 12.57±1.87a | 8.87±0.70a | 1029.39±2.57 | 0.55±0.06 | 7.84±1.41a |
| Lembang    | 1.92±0.71bc | 2.97±0.31a | 4.58±0.22a | 10.62±0.95ab | 8.65±0.46a | 1032.27±1.74 | 0.50±0.03 | 6.11±0.77b |
| Bogor      | 1.68±0.71cd | 3.20±0.46a | 3.76±1.11b | 9.92±1.45bc | 8.07±1.44a | 1028.67±6.56 | 0.47±0.09 | 6.04±1.29b |
| Tasikmalaya| 1.75±1.18e | 3.00±0.30a | 4.35±0.61a | 10.30±1.31bc | 8.45±0.71a | 1030.95±4.11 | 0.50±0.05 | 6.21±0.91ab |

Table 2 shows the results of the calculation of milk quality parameters in smallholder farms. The fat content in milk samples in Subang district was at 3.62 ± 1.40. This value was the highest among other district and also above the SNI value. This condition was very significant for 4 other district (Pangalengan, Bogor, Tasikmalaya and, Lembang) except in the Sumedang district. For other district, the content of mastitis milk fat was below the value determined by SNI. The lowest fat composition was 1.13 ± 0.80 in Pangalengan district.

The concentration value of protein content in all sampling regions showed the value with a concentration that met the average SNI value above 2.8. According to Osorio et al. [8], high protein concentrations could improve milk quality. From the results obtained, the lowest protein content was 2.97 ± 0.31 in Lembang district. Lactose content in Bogor district showed the lowest concentration.
among other districts with a value of 3.76 ± 1.11. The value of lactose concentration in Lembang was 4.58 ± 0.22 higher than Sumedang district with a value of 4.47 ± 0.21 and Tasikmalaya district with a value of 4.35 ± 0.61. Moreover it was in Pangalengan and Subang districts, the values were 4.35 ± 0.52 and 4.22 ±0.48 respectively. The highest concentration of dry matter content was indicated in Subang 12.57 ± 1.87 compared to Pangalengan, Bogor and Tasikmalaya districts. The lowest total solid concentration in Pangalengan district was 9.78 ± 1.45. While the dry matter content in Subang district is almost the same as Sumedang and Lembang districts. According to SNI data, the value of good dry matter concentration was at a concentration of 10.8. In addition to Pangalengan, the Bogor district also had a dry matter concentration value below the SNI value of 9.92 ± 1.45

Meanwhile, the concentration of solid non-fat almost all sampling areas had concentration values that the same concentration content. The highest value was in the level of solid non-fat in Subang district with a value of and the lowest in the Bogor district was 8.07 ± 1.44. The concentration of milk density from all sampling districts had values above SNI with almost the same value for each district with the highest concentration being in Pangalengan and Lembang districts respectively 1032.44 ± 2.51 and 1032.27 ± 1.74. While Bogor district had the lowest concentration value of 1028.67 ± 6.56. FPD concentrations for all milk samples measured showed almost the same value. Subang had the highest FPD concentration of 0.55 ±0.06 with a concentration value above SNI. The lowest FPD concentration from Bogor district with a value below the average SNI was 0.47 ± 0.09. The highest concentration of acidity in Subang district with a value of 7.84 ± 1.41 is higher than that of Bogor, Lembang and Pangalengan districts. Bogor district gave the lowest acidity concentration results from other regions namely 6.04 ± 1.29.

4. Discussion

Milk secretion in mammary glands has several parameters that will be used as a benchmark to determine the assessment of milk quality. The assessment will have an impact on the income of farmers. Assessment of milk quality includes the chemical composition of milk. The tendency of decreasing the quality of fresh milk produced by cows can be caused by various problems. Starting from the feed, genetic to the health of livestock itself. Cow milk quality problems are included in maintenance management. According to Gorniak et al. [9], almost all concentrations of milk content had a large influence on the increase in environmental temperature. So that the impact of decreasing the quality of milk. In its report, Sari et al. [10] stated that the effect of the lactation stage is very influential on some udder properties and chemical composition of milk.

According to Tacoma et al. [1] milk protein is currently considered the most important source of bioactive peptides. Because milk protein has a complex function in regulating the growth and development of the body's health, regardless of the division of protein that is in milk. From the results of the research conducted showed SD protein at each location with a protein concentration value above the value of SNI 2011. Zaabza et al. [11] in his report confirmed that milk protein is influenced by the genetic characteristics of individual livestock besides the environmental temperature also gives a different effect on the concentration milk protein [12]. This statement reinforces the results obtained, from the minimum and maximum concentrations of protein in milk there are large differences in milk protein content.

Besides that, Zaabza et al. [12] also stated that the environment had a very big influence on protein and milk fat. In the value of the concentration of fat produced in each sampling location, there are some significant differences in the value of SNI. In Pangalengan district, it had the lowest milk fat content of all locations. The concentration of milk fat is strongly influenced by the forage feed. The large volume of livestock and the limited forage in Pangalengan district was one of the causes of the small value of milk fat content. Pangalengan one of the centers of dairy milk centers in West Java. In addition, according to Smith et al. [13], that the concentration of fat in milk was also influenced by the time of
lactation and food. Milk fat according to McCarthy et al. [14] plays an important role in the sensory properties of liquid milk, so milk fat is one of the benchmarks for the quality value of milk.

Lactose, as the main osmotic component in milk, is the main determinant of milk volume and glucose is the main precursor of lactose biosynthesis [15]. According to Henao-Velásquez et al. [16], water content in milk is determined by the concentration of fat and protein content, in which water secretion is highly dependent on lactose synthesis. So that lactose can change depending on glucose variations in somatic cell counts and also the availability of energy to carry out physiological processes. The results of this study show that lactose concentration is low in Bogor district. Bogor is the lowest district compared to other sample districts. with the Bogor topography so that the availability of energy sources needed to carry out physiological processes is also very little so that it becomes one of the factors that influence lactose content.

High and low BJ milk values are influenced, among others, by the pattern and quality of feed provided. Feed raw materials are deposited as nutrients in the form of mass [17] so that it can affect the value of milk's specific gravity content. The specific gravity produced in the milk sample observed is above the Indonesian national standard value and does not have a large difference between one region and another. although there is a minimum value that is not in accordance with SNI.

The total concentration of solid and non-fat solid is influenced by the large concentration of protein, fat, and sugar in milk. There are large differences between regions regarding total solid clams content. The total solid is strongly influenced by the concentration of fat found in milk. Meanwhile according to Sudharka et al. [18] solid non-fat is very dependent on the concentration of protein and lactose. According to Ibnelbachyr et al. [19] a significant increase was obtained in dry matter and fat at the lactation stage, while the decrease of occur at the beginning to the end of lactation at a concentration of protein content, and at the middle of lactation influenced the high lactose content.

FPD concentration is influenced by water content as a constituent of milk. The higher the water content, the greater the FPD will be. The results obtained from the FPD values for each region did not show a large difference, but the FPD SD score is still below the national recommended value. The overall acidity level of the results obtained is still within the recommended value, but differences in the degree of acidity are seen in some sample districts. The acidity of milk is strongly influenced by the intake of feed given. Cows or livestock that are kept in conditions of rich forage or concentrate as well as a well-maintained environmental temperature will produce good milk production also in accordance with Indonesian national standards.

5. Conclusion
The quality and quantity of milk are strongly influenced by the health and feed provided. Cows or livestock that are kept in conditions of rich forage or concentrate as well as a well-maintained environmental temperature will produce good milk production also in accordance with Indonesian national standards. Somatic cells can be an indicator for udder health. Somatic cell concentration affects the quality of the milk's chemical composition.

Acknowledgments
This research was funded by the Hibah Insenif Sinergi Grant of 2016 from the Ministry of Research and Technology and Higher Education No. 290 / SP2H / LT / DRPM / III / 2016

References
[1] Tacoma R, Fields J, Ebenstein D B, Lam Y W and Greenwood S L 2016 Characterization of the bovine milk proteome in early-lactation Holstein and Jersey breeds of dairy cows. J Proteomics 130 200–210 doi:10.1016/j.jprot.2015.09.024
[2] Giovannini C I, Alonso D S P, Soares D C T, Jakeline F C J F, Silva T E and Nicolau E S 2015 Milk quality in high production systems during dry and rainy seasons according to normative instruction No 62. African Journal of Biotechnology, 14(43) 2957-2965
[3] Cinar M, Serbeste U, Ceyhan A and Gorgulu M 2015 Effect of somatic cell count on milk yield and composition of first and second lactation dairy cows Italian Journal of Animal Science 14 3646

[4] Norring M V A and Munksgaard L 2012 Milk yield affects time budget of dairy cows in tie-stalls J. Dairy Sci. 95 102–108 doi:10.3168/jds.2010-3458

[5] Das R, Sailo L, Verma N, Bharti P, Saikia J, Imtiwati and Kumar R 2016 Impact of heat stress on health and performance of dairy animals: A review Veterinary World 9(3) 260-268 doi: 10.14202/vetworld.2016.260-268

[6] Oltenacu P A and Broom D M 2010 The impact of genetic selection for increased milk yield on the welfare of dairy Anim.Welfare 19(S) 39-49

[7] Silanikove N, Leitner G, Merin U and Prosser C G 2010 Recent advances in exploiting goat’s milk: Quality, safety and production aspects Small Ruminant Res. 89(2-3) 110-124 doi:10.1016/j.smallrumres.2009.12.033

[8] Osorio J S, Lohakare J and Bionaz M 2016 Biosynthesis of milk fat, protein, and lactose: roles of transcriptional and posttranscriptional regulation Physiol Genomics 48 231–256 doi:10.1152/physiolgenomics.00016.2015

[9] Gorniak T, Meyer U, Südekum K H and Dânicic S 2014 Impact of mild heat stress on dry matter intake, milk yield and milk composition in mid-lactation Holstein dairy cows in a temperate climate Archives of Animal Nutrition 68(5) 358-369 http://dx.doi.org/10.1080/1745039X.2014.950451

[10] Sari M, Yilmaz I and Önk K 2015 Effects of lactation stage, lactation order and udder types on udder traits and composition of milk in Tuj ewes Ankara Üniv Vet Fak Derg 62 313-318

[11] Zaabza H B, Gara A B, Hammami H, Ferchichi M A and Rekik B 2016 Estimation of variance components of milk, fat, and protein yields of Tunisian Holstein dairy cattle using Bayesian and REML methods Arch. Anim. Breed 59 243–248

[12] Arieli A, Adin G and Bruckental I 2004 The effect of protein intake on performance of cows in hot environmental temperatures J. Dairy Sci. 96 3028–3033

[13] Smith D L, Smith T, Rude B J and Ward S H 2013 Short communication: Comparison of the effects of heat stress on milk and component yields and somatic cell score in Holstein and Jersey cows J. Dairy Sci. 96 3028–3033 http://dx.doi.org/ 10.3168/jds.2012-5737

[14] McCarthy K S, Lopetcharat K and Drake M A 2017 Milk fat threshold determination and the effect of milk fat content on consumer preference for fluid milk J. Dairy Sci. 100 1702–1711 https://doi.org/10.3168/jds.2016-11417

[15] Ramos T M, Costa F F, Pinto I S B, Pinto S M and Abreu L R 2015 Effect of somatic cell count on bovine milk protein fractions J Anal Bioanal Tech 6 5 http://dx.doi.org/10.4172/2155-9872.1000269

[16] Henao-Velasquez A F, Munera-Bedoya O D, Herrera A C, Aguadelo-Trujillo J H and Cerón-Muñoz M F 2014 Lactose and milk urea nitrogen: fluctuations during lactation in Holstein cows R. Bras. Zootec. 43(9) 479-484 http://dx.doi.org/10.1590/S1516-35982014000900004

[17] Standar Nasional Indonesia 2011 Susu segar-bagian I: Sapi. Badan standardisasi Nasional. ICS 67.100.01.

[18] Sudhakar K, Panneerselvam S, Thiruvenkadan A K, Abraham J and Vinodkumar G 2013 Factors affecting milk composition of crossbred dairy cattle in southern India International Journal of Food, Agriculture and Veterinary Sciences 3(1) 229-233

[19] Ibnelbachyr M, Boujenane I, Chikhi A and Noutfia Y 2015 Effect of some non-genetic factors on milk yield and composition of Draa indigenous goats under an intensive system of three kiddings in 2 years Trop Anim Health Prod 47 727–733 DOI 10.1007/s11250-015-0785-8