Correlation of Protein Contents and Milk Temperatures, with Milk Density of Friesian Holstein (FH) Cow in Ngablak District of Magelang Regency Central Java

Danes Suhendra*, Mirza Aulia Rahman, Megawati

Study program of Animal Science, Faculty of Agricultural, Tidar University

*) Corresponding author
E-mail: danes_suhendra@untidar.ac.id

Abstract

Indicators of milk quality commonly used by the Milk Processing Industry (MPI) is the milk density (MD). Some factors that influence the milk density is milk protein in the form of casein and milk temperatures. This study aims to examine the correlation between protein content and milk temperature to milk density. The material used was 90 lactating FH cows in the II - III of lactation period and 2 – 3 of lactation months. The analysis used is simple linear correlation regression. The results showed that the increase in protein content caused an increase in the milk density by 73.48%. The decreased in temperature caused an increase in the milk density by 5.25%. Protein content and milk temperature to milk density had a significants correlation value (P <0.01). The overall calculation shows that there is a relationship between the protein content and milk temperature to milk density. Protein content with milk density, shows a very strong positive correlation. The milk temperature and the milk density shows a very strong negative correlation. The conclusion is that there is a positive relationship between protein content to milk density, and a negative relationship between milk temperature to milk density. The higher the protein content, the higher the milk density. The lower the milk temperature, the higher the milk density value.

Keywords: milk, protein, temperature, density

Introduction

Friesian Holstein (FH) is very commonly cultivated in Indonesia as a milk-producing cow. The average milk production of FH cows is 2,000 - 2,500 liters in one lactation period. High milk production causes FH cows to be cultivated more in Indonesia as milk producers (Syarief and Sumoprastowo, 1990). FH cows have a predominantly black and white striped coat color, and sometimes red and white stripes are found. The size of the head is relatively long, straight and wide, with a relatively short horn shape and curving forward. FH cows have a docile temperament and are relatively calm (Siregar, 1993).

Milk is a white liquid which contains complete nutrients in the form of protein, lactose, fat, several vitamins, minerals, and hormones that are excreted by the mammary glands in adult female mammals which act as food for their children (Guetouache et al., 2014). Milk is a food that contains balanced and complete nutrition with a perfect nutritional ratio, so it is needed by humans. The main components of milk dry matters are protein (casein), carbohydrates (lactose), fat, vitamins and minerals (Prasetya, 2012). Protein is one of the constituent components of milk which plays an important role because it has economic value and high nutritional value in

milk. Protein plays a role in the growth and regeneration of body cells.

The consumption of fresh milk will continue to increase in line with an increase in population, economic growth, increase in the quality of education, awareness of nutrition and changes in lifestyle. The quality of milk from local farmers is still below from the standard, even below the standards set by the cooperative and the Milk Processing Industry (MPI) (Anindita and Soyi, 2017). One of the aspects used by the cooperative and MPI as an indicator of acceptance of fresh milk from local dairy farmers is the milk density (MD). Each dairy cooperative and MPI made different MD standards for milk acceptance. Besides MD, other components that are often used are the levels of milk protein (casein). Milk density affected by milk temperature and casein contents. Several MPI apply bonus prices for farmers who deposit milk with protein content above the MPI's standard. The Indonesia National Standardization Agency (2011) regulates that the minimum value for MD cow's milk at 27 ° C is 1.027 and the minimum protein content is 2.80%. Research conducted by Gabas et al. (2012), shows that the higher the milk temperature, the lower the milk density.

The purpose of this study was to examine the relationship between protein content and milk temperature, to milk density. The benefit of this research is to provide information to dairy farmers in the form of knowledge regarding the relationship between levels of milk protein and temperature, to milk density. So that later it can be used as a basis for improving milk quality. The benefits for MPI are that being MD is an indicator of milk quality which includes levels of fat, lactose, and milk casein.

Material and Method

Material

The materials used in this study were 90 lactating FH cows in the II – III lactation period and 2 - 3 lactation months with milking frequency twice a day, every morning and evening. The equipment used was a stainless steel bucket with a scale to accommodate and measure the volume of fresh milk, lactoscan to measure the quality of the fresh milk, glasses bottle for collected milk samples, ice box for storaged milk samples before analyzed. Ngablak Subdistrict was chosen as the research area based on data from the Central Agency of Statistics (2019) showing that Ngablak is the district with the highest milk production in Magelang Regency in 2018, amounting to 574,634 liters.

Research Method

This research began with a survey, which was conducted one month before starting the observation and sampling of the study. The survey was conducted to select cows to be used as research material based on the livestock recording cards they have. The research location used was the Tri Argo

Mulyo Dairy Cows Association, Ngablak District, Magelang Regency, Central Java. The milking is done manually (hand milking) twice a day, every morning and evening. The collection of milk samples was carried out proportionally, namely mixing the results of the milking in the morning and evening proportionally based on the percentage of the milking volume in the morning and evening, then 200 ml was taken as the main sample. The main sample was analyzed using a lactoscan machine made in Bulgaria owned by the Banyuaji Cooperative in Getasan District, Semarang Regency. The variables observed were milk density (MD), protein content, and milk temperature.

The data obtained were then analyzed by simple linear correlation regression analysis using the SPSS version 16.0 program. The interpretation of the correlation coefficient used according to the instructions from Sugiyono (2006) is:

- 0.00 – 0.199 = Very Low Correlations
- 0.20 – 0.399 = Low Correlations
- 0.40 – 0.599 = Medium Correlations
- 0.60 – 0.799 = High Correlations
- 0.80 – 1.000 = Very High Correlations

Results and Discussion

Based on the analysis of the milk quality (protein content, milk temperature, and milk density) that has been carried out, the results of the analysis are as shown in Table 1.

Table 1. Observation results of fat content, lactose content, and milk density.

Parameters	Ranges	Average	Standard
Protein Content (%)	2.08 – 3.21	2.63	Minimum 2,80*
Milk Temperature (°C)	4.70 – 28.8	19.00	27*
Measured milk density	1.016 – 1.032	1.023	1,027 – 1,030*
True Milk Density	1.018 – 1.034	1,025	1,027 – 1,030*

*The Indonesia National Standardization Agency (2011)

The average milk protein content was 2.63%. This value is low for the protein content of cow's milk. Protein is one of the constituents of milk which plays an important role because it has economic value, high nutritional value, and so on in milk. The higher the milk protein content, the higher the selling price. The lower the protein content, the lower the selling value. The Indonesia National Standardization Agency (2011) determines the minimum fat content of cow's milk is 3.00 % with a minimum protein content are 2.8%.

According to Zurriyati et al. (2011) stated that the fat and protein content in milk is the most important component because it can affect the price and quality of milk.

Susanti and Hidayat (2016) stated that protein is the main macro molecule needed by all living things. Protein plays a role in the synthesis of new proteins needed by the body. Protein will undergo hydrolysis in the gastrointestinal tract and only free amino acids can be absorbed by the intestinal wall. Amino acids and peptides that are formed from natural protein digestion will be

absorbed and utilized in various tissues as body proteins. Milk protein is a very heterogeneous macro molecule, consisting of five forms, namely casein, whey protein, milk fat globule protein, enzymes and other minor proteins. The main proteins in milk are casein and whey. Oka et al. (2017) said that

the protein content of milk is influenced by several factors, one of which is the type of feed used. Milk protein content is also greatly influenced by the lactation period, namely the longer the lactation period, the milk protein content tends to decrease.

Tabel 2. The regression equation, correlation coefficient (r), coefficient of determination (R^2) between protein content (PC) to true milk density (TMD), and milk temperature (MT) to measured milk density (MMD).

Variabels	Regression Equation	r	R^2
PC to TMD	y = -55,57 + 56,81x	0,86	0,735
MT to MMD	y = 557,63 - 526,60X	-0,23	0,052

Protein Contents and True Milk Density

Based on the data in Table 2., it is shown that the regression equation between protein content (PC) and true milk density (TMD) is y= -55.57+56.81X. This regression value indicates a positive relationship between PC and TMD. The higher the PC, the higher the TMD value. The correlation coefficient (r) is 0.86, which indicates that the positive relationship between PC and TMD is very strong. The value of determination (R2) is 0.735, meaning that the increase in PC will affected of 73.5% on the increase in the value of TMD. This is consistent with the statement from Sugiyono (2006), which states that the correlation coefficient (r) of 0.80 – 1.000 means that it has a very strong correlation.

Protein content (PC) of 2.63% is low (Table 1.), but it can increase the true milk density (TMD). This is because the protein in the total solid milk has a large enough molecular weight, causing an increase in true milk density (TMD). Lestari and Soesilo (2017)

stated that the α-casein, β-casein, and κ-casein bands were 32, 24, and 19 kDa in size, respectively. Saputra (2018) states that protein is part of the total solid of milk or milk solid material. It is confirmed by Vidiyanto et al. (2015) that the total solid milk is the main factor affecting the high density of milk.

Milk Temperature and Measured Milk Density

Based on the data in Table 2., it is shown that the regression equation between milk temperature (MT) and measured milk density (MMD) is y= 557,63 - 526,60X. This regression value indicates a negative relationship between MT and MMD. The lower the MT, the higher the MMD value. The correlation coefficient (r) is -0.23, which indicates that the negative relationship between MT and MMD is weak. The value of determination (R2) is 0.052, meaning that the increase in MT will affected of 5.2% on the increase in the value of MMD. This is consistent with the statement from Sugiyono

(2006), which states that the correlation coefficient (r) of 0.20 – 0.399 means that it has a weak correlation.

Lowering the temperature of the milk will cause the compaction of several components of milk, such as water and milk fat. In accordance with the opinion of Sutrisna et al. (2014), a decrease in milk temperature will lead to the compaction of fat globules. The density of fat that is compacted will be greater than that of fat in the liquid state. Gabas et al. (2012), shows that the higher the milk temperature, the lower the milk density.

The value of the correlation coefficient (r) and determination (R2) is low, because in addition to decreasing the temperature of the milk causes an increase in the measured milk density (MMD), heating (temperature increase) of milk will also cause an increase in the measured milk density (MMD). This is because the water content in the milk is evaporated, thus increasing the proportion of the total solid of milk. This is explained by Miskiyah (2011) which states that there will be water evaporation in heated milk, thereby increasing the density of the milk.

Conclusion

Protein content (PC) has a very strong positive correlation to the milk density (MD). The higher the milk protein content, the higher the milk density. Milk temperature (MT) has a weak negative correlation with milk density. The lower the temperature of the milk, the higher the density of the milk.

References

Anindita, N. S., and D. S. Soyi. 2017. Case Study: Monitoring the quality of animal food through testing the quality of cow's milk circulating in the city of Yogyakarta. Journal of Indonesian Animal Husbandry. 19(2): 96 – 105.

Central Bureau of Statistics. 2018. Magelang Regency in numbers. Central Bureau of Statistics, Jakarta.

Gabas, A.L., R.A.F. Cabral, C.A.F. Oliveira, and J.Telis-Romero. 2012. Density and rheological parameters of goat milk. Cienc. Tecnol. Aliment. Campinas. 32(2): 381-385.

Guetouache, M., G. Bettache and M. Samir. 2014. Composition and nutritional value of raw milk-review. Issues in Biological Sciences and Pharmaceutical Research. 2(10): 115 – 122.

Indonesia National Standardization Agency. 2011. Indonesia National Standardization: Fresh milk-Part1: Cow, Jakarta.

Lestari, D. and V. V. Soesilo. 2017. Antibacterial activity of goat milk casein peptide hydrolysis by papain toward Pseudomonas aerugunisa. Journal of Food Science and Agricultural Products. 1(2): 81 – 92.

Miskiyah. 2011. Study of Indonesian national standards for liquid milk in Indonesia. Journal of Standardization. 13(1): 1 – 7.

Oka, B., M. Wijaya, and Kadirman. 2017. Chemical characterization of milk for dairy cows in Sinjai Regency. Journal of Agricultural Technology Education. 3(2): 195 – 202.

Prasetya, H. 2012. Raising Dairy Cows. Pustaka Baru Press, Yogyakarta.

Saputra, F.T. 2018. Evaluation of the total solid fresh milk of Tawang Argo farmers based on Indonesian National Standards. Journal of Tropical Livestock. 19(1): 22 – 26.

Siregar, S.B. 1993. Dairy Cows, Types, Maintenance Techniques and Business Analysis. Penebar Swadaya, Jakarta.

Sugiyono. 2006. Qualitative and Quantitative Research Methods R & D. Alfabeta, Bandung

Susanti, R. and E. Hidayat. 2016. Protein profile of milk and its processed products. Jurnal MIPA. 39(2): 98 – 106.

Sutrisna, D. Y., I. K. Suada, and I. P. Sampurna. 2014. The quality of goat's milk during storage at room temperature is based on milk density, boiling test, and viscosity. Indonesia Medicus Veterinus. 3 (1): 60 – 67.

Syarief, M. Z. and C. D. A. Sumoprastowo.1990. Dairy Livestock. CV. Yasaguna, Jakarta.

Vidiyanto, T., Sudjatmogo, and S. M. Sayuthi. 2015. Display of production, milk density, lactose and water content in dairy cow's milk due to different milking intervals. Animal Agriculture Journal. 4(2): 200 – 203.

Zurriyati Y., R.R. Noor and R.R.A. Maheswari. 2011. Molecular analysis of the kappa (κ-casein) genotype and the milk composition of the Etawah, Saanen and Cross-breed goat's milk. Journal of Animal and Veterinary Science. 16(1): 61-70.