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COMPARISON OF MILK PRODUCTION AND QUALITY OF FRIESIAN HOLSTEIN DAIRY COWS TOWARDS MILKING TIME AT UPTD BPTSP HPT LEMBANG

Perbandingan Produksi dan Kualitas Susu Sapi Perah Friesian Holstein Terhadap Waktu Pemerahan di UPTD BPTSP HPT Lembang

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Abstract

Milking time is a factor that must be considered for milk production on dairy farms. Inconsistencies in the milking schedule affect the quality and volume of milk produced. This study aimed to determine the differences in milk quantity and quality between morning and afternoon milkings in second-lactation dairy cows at 15:9 milking intervals. The study used a purposive sampling method on 17 second-lactation cows, with a total of 204 milk samples collected once a week for six weeks and analyzed using a t-test. The parameters observed included milk production, protein, fat, specific gravity, Non-Fat Solids (SNF), and milk pH. The results showed that morning milk production (7,45 ± 1,98 kg), protein (3,22 ± 0,09%), specific gravity (1,030 ± 0,00 g/mL), and Non-Fat Solids (SNF) (8,82 ± 0,20%) were significantly higher ($p < 0,05$) compared to the afternoon, namely milk production (4.43 ± 1.07 kg), protein (2,93 ± 0.15%), specific gravity (1,026 ± 0,00 g/mL), and SNF (8,00 ± 0,37%). Conversely, fat content was higher ($p < 0,05$) between morning (6, 87 ± 0, 57) and afternoon (6, 89 ± 0, 51) milkings. pH values did not show a significant difference ($P < 0,05$) between morning (6,87 ± 0,57) and afternoon (6,89 ± 0,51) milkings. It can be concluded that the 15:9 interval yields different results for the morning and afternoon milkings.

Keywords: cows, milk production, milking time, milk quality, second lactation

Abstrak

Waktu pemerahan merupakan salah satu hal yang perlu diperhatikan dalam pemerahan susu di peternakan sapi perah. Ketidaksesuaian jadwal pemerahan akan memengaruhi mutu serta volume susu yang dihasilkan Penelitian ini bertujuan mengetahui perbedaan kuantitas dan kualitas susu antara pemerahan pagi dan sore pada sapi perah laktasi kedua dengan interval pemerahan 15:9. Penelitian menggunakan metode *purposive sampling* terhadap 17 sapi laktasi kedua dengan total 204 sampel susu yang diambil satu kali setiap minggu selama enam minggu

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dan di analisis menggunakan uji *t-test*. Parameter yang diamati meliputi produksi susu, protein, lemak, berat jenis, *Solid Non-Fat* (SNF), dan pH susu. Hasil penelitian menunjukkan produksi susu pagi (7,45 ± 1,98 kg), protein (3,22 ± 0,09%), berat jenis (1,030 ± 0,00 g/mL), dan Solid *Non-Fat* (SNF) (8,82 ± 0,20%) lebih tinggi secara signifikan (P <0,05) dibandingkan sore, yaitu produksi susu (4,43 ± 1,07 kg), protein (2,93 ± 0,15%), berat jenis (1,026 ± 0,00 g/mL), dan SNF (8,00 ± 0,37%). Sebaliknya, kadar lemak lebih tinggi (P <0,05) pada pemerahan sore (4,04 ± 1,28%) dibanding pagi (0,64 ± 0,29%). Nilai pH tidak menunjukkan perbedaan signifikan (P <0,05) antara pagi (6,87 ± 0,57) dan sore (6,89 ± 0,51). Dapat disimpulkan bahwa interval 15:9 memberikan hasil yang berbeda antara pemerahan pagi dan sore.

Keywords: Kualitas susu, laktasi kedua, produksi susu, sapi, waktu pemerahan

INTRODUCTION

Friesian Holstein (FH) dairy cows are milk-producing cattle with a higher average milk production than that of other dairy cattle breeds (Tasripin *et al.*, 2020). Milk production occurs during the lactation period, which is the phase after a cow gives birth to a calf and begins producing milk. The early lactation period is a critical stage that determines the overall productivity of the herd, as this is when cows begin to demonstrate their maximum potential for milk production (Adi *et al.*, 2020).

Milk production and quality play important roles in determining the nutritional value, economic value, and product safety for consumers. Milk quality is determined by its fat, protein, vitamin, and mineral content (Sigit *et al.*, 2021). Based on the Indonesian National Standard, assessing milk quality is important to ensure that milk meets quality, safety, and suitability-for-consumption requirements, as well as to determine the appropriate handling and processing steps (Akmalia, 2024).

In general, milking is performed twice a day in the morning and afternoon (Ulya *et al.*, 2025). According to Rizkiyani *et al.* (2023), the interval from morning to afternoon milking is longer than that from afternoon to morning milking. Milking time plays a role in determining milk quality because cows require more time in the morning to absorb feed for milk formation (Pramono *et al.*, 2023). Improper milking time affects both the quality and quantity of milk. Therefore, research is needed to compare milk production and quality in second-lactation FH cows between morning and afternoon milking under a 15:9-hour milking interval system at UPTD BPTSP HPT Lembang.

RESEARCH METHOD

Animal Ethical Clearance

This study did not require ethical clearance because it did not involve interventions on live or experimental animals. This study used only cow milk samples. Sampling was conducted during routine activities at the dairy farm without any invasive procedures.

Research Object

The object of this study was second-lactation Friesian Holstein (FH) cows, specifically those between 65 and 245 Days In Milk (DIM), from which milk samples were collected. The Friesian Holstein cows were obtained from the Dairy Cattle and Forage Development Center Lembang. The samples consisted of 17 fresh morning and 17 fresh afternoon milk samples. The research location is situated at an altitude of approximately 1,200 m above sea level, with an average temperature of 19.3°C, ranging from 13.8°C to 24.6°C, and relative humidity of 80.5%.

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Research Design

This study used a descriptive and observational design. Livestock sampling was carried out using a purposive sampling method with specific criteria, namely, cows in their second lactation period.

Research Variabel

The research variables included cow milk as the independent variable, milk quality testing including pH value, specific gravity, fat content, protein content, and solid non-fat as dependent variables, and milking time.

Data Collection Methods

Milk samples were collected manually (approximately 100 mL per cow), placed in a glass container, and transferred into sterile plastic bags labeled with the cow's ear tag number. The samples were then analyzed in the laboratory.

Sampling Procedure

Sanitation was performed before sample collection by cleaning the barn of cow manure using a water hose to maintain clean and hygienic conditions. After the pre-milking stage was completed, the udder was cleaned using a stimulation cloth moistened with warm water and Ecolab XY-12® udder antiseptic. Milking was conducted manually (hand milking), at 5:30 a.m. and 2:30 p.m., approximately 100 mL per cow, then collected in a glass container and placed into sterile plastic bags for testing.

Milk Production Recording

The procedure for recording milk production was performed individually for each cow using sensors installed in the milking parlour unit. The milk production data displayed on the control panel were recorded on a data sheet.

pH Testing

Milk pH was measured using a digital pH meter Smart Sensor®. The instrument was first calibrated using distilled water and dried with a tissue paper. The pH meter electrode was then immersed into the milk sample until the entire sensor tip was submerged, and left for a moment until the value on the screen stabilized.

Testing of Protein, Fat Content, Specific Gravity, and Solid Non-Fat

Milk composition testing, including protein content, fat content, specific gravity, and solid non-fat, was carried out using a Lactoscan Milk Analyzer MCC WS®.

Data Analysis

Data analysis was conducted using a normality test, followed by statistical analysis using a paired t-test with IBM SPSS Statistics 27, and described to show the production and quality of fresh cow milk samples based on pH, fat content, protein content, specific gravity, and solid non-fat content. The resulting data were compared with SNI 3141:2024 and related literature to determine the suitability of the tested samples.

RESULT AND DISCUSSION

Results

The paired t-test results showed that milk production in the morning (7.45 ± 1.98 kg) was higher than that in the afternoon (4.43 ± 1.07 kg). A significance value of < 0.001 (< 0.05) indicated a significant difference between the two milking times (Table 1). The milk protein content in

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morning milking at BPTSP HPT Lembang (3.22 ± 0.09%) was higher than that in the afternoon milking (2.93 ± 0.15%). A significance value of < 0.001 (< 0.05) indicated a significant difference in milk protein content between morning and afternoon milking (Table 2). The paired t-test results showed that the specific gravity was higher in the morning than in the afternoon. A significance value of < 0.001 (< 0.05) indicated a significant difference in milk specific gravity between morning and afternoon milking (Table 3). The solid non-fat (SNF) content in morning milking (8.82 ± 0.21%) was higher than that in afternoon milking (8.00 ± 0.37%). A significance value of < 0.001 (< 0.05) indicated a significant difference between the two milking times (Table 4). The paired t-test results showed that the average milk fat content in the morning was 0.64 ± 0.29%, whereas in the afternoon, it was much higher, at 4.04 ± 1.28%. A significance value of < 0.001 (< 0.05) indicated a highly significant difference between the two milking times (Table 5). The milk pH in the morning was 6.87 ± 0.57, and in the afternoon, it was 6.89 ± 0.51. Statistical analysis yielded a significance value of 0.200 (> 0.05). This indicates that there was no significant difference in milk pH between morning and afternoon milking (Table 6).

Discussion

A comparison of milk production showed that the output was more optimal during morning milking than during afternoon milking. This was caused by the different milking intervals at the UPTD Dairy Cattle and Forage Development Center Lembang, namely 15:9 hours. This finding is consistent with that of Vidyanto *et al.* (2016), who stated that higher milk production during morning milking is influenced by the longer interval from night to morning and cooler environmental temperatures, which provide physiological comfort to cows. In contrast, higher daytime temperatures may cause heat stress, reduce feed intake, and disrupt oxytocin secretion, which plays an important role in the production of milk. The results of this study showed that milk production during morning milking was 7.45 kg and during afternoon milking was 4.43 kg, which still falls within the normal production range for cows in their second lactation. Compared with a 12:12-hour milking interval system, total milk production can reach approximately 12-13 kg per day, which is considered better because it provides optimal time for milk accumulation in the udder. Cows milked at equal 12:12-hour intervals tend to produce relatively uniform milk volume (Rizkiyani *et al.*, 2023). Feeding management practices implemented on farms can also affect milk production. The feeding regimen at the UPTD BPTSP HPT Lembang, consisting of 50 kg of forage and 8 kg of concentrate per head per day, indicates that the cows nutritional needs are relatively met. This is consistent with the findings of Purwanti and Hatiningtyas (2023), who found that lactating dairy cows require approximately 12–16 kg of dry matter (DM) daily.

These results indicate that the milk protein content was optimal in morning milking. This is in line with Prihatminingsih *et al.* (2015), who reported that milk protein content in morning milking is generally higher than that in afternoon milking, influenced by differences in the interval between milkings. According to SNI 3141:2024, the milk protein content in cow milk generally ranges around 2.8%. Based on the literature with a 12-hour milking interval, the protein content was 2.90% in the morning and 2.98% in the afternoon (Nugraha *et al.*, 2016). In this study using a 15:9-hour interval, the values were higher, namely 3.22% in the morning and 2.93% in the afternoon. Even so, a balanced 12:12-hour milking interval is recommended because it can produce relatively homogeneous milk production and quality, resulting in more stable milk quality. Protein levels can be influenced by the feed provided, such as forage and concentrate. The higher the protein content of the feed, the greater the quantity of amino acids mobilized into the bloodstream through protein degradation, thereby increasing the availability of protein for the chemical components of milk (Prihatminingsih *et al.*, 2015). Subagyo *et al.*

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(2022) stated that, in addition to physiological factors, variations in protein levels are influenced by environmental conditions, particularly temperature.

The specific gravity results indicated a significant difference between morning and afternoon milkings, although both were within the normal range. Morning milk had a slightly higher specific gravity than afternoon milk. According to SNI (2024), the ideal specific gravity for fresh cow milk ranges from 1.027 to 1.035. Morning milk had a higher specific gravity than afternoon milk. This finding agrees with that of Hidayat and Anggraeni (2023), who reported that milk obtained in the morning tends to have a higher specific gravity than that produced in the afternoon. In addition, milk specific gravity has an inverse relationship with fat content: the higher the fat content, the lower the specific gravity, because fat has a lower density than other milk solid components (Damaeanti *et al.*, 2025). Rizkiyani *et al.* (2023) reported that a 12-hour milking interval produced an average milk specific gravity of 1.029 in the morning and 1.030 in the afternoon. This indicates that a 12:12-hour milking interval can produce milk with a specific gravity that is more homogeneous and stable between morning and afternoon milkings compared with the 15:9-hour interval in this study.

Based on the results, solid non-fat (SNF) was more optimal in the morning than in the afternoon. A 12-hour milking interval showed average SNF values of 9.30% and 8.78% in the morning and afternoon, respectively, with relatively stable results (Vergi *et al.*, 2015). At a 12-hour milking interval, SNF levels tended to be higher in morning milking, as shown in this study. This is in line with Rizkiyani *et al.* (2023), who stated that high SNF content is influenced by high protein and relatively low fat content. In this study, higher SNF levels in the morning were also accompanied by higher protein and lower fat content. The SNF levels were high because SNF represents the total milk solids other than fat, with protein and lactose being the main components. When protein levels increase, the SNF value automatically increases; furthermore, a percentage decrease in fat content makes these non-fat components more dominant in milk (Maryana *et al.*, 2024).

Milk fat content was higher during afternoon milking than during morning milking. This is in line with Vergi *et al.* (2016), who stated that the milking interval affects milk quality; the shorter the interval between milkings, the higher the milk fat content tends to increase. The decrease in milk fat content, which fell below the SNI standard in the morning, was related to the digestive processes that occurred at night. Cows have high rumination activity at night. This process produces natural substances, such as volatile fatty acids, including acetate and butyrate, which are major components of milk fat. However, a long milking interval causes milk volume to accumulate in the udder, resulting in a dilution effect that lowers the fat percentage (Kholis *et al.*, 2024). With a 12-hour milking interval, morning milk fat content was 4.36% and that of afternoon milk fat content was 3.74%. The difference was not large, indicating that a 12:12-hour milking interval produces relatively stable milk quality (Christi *et al.*, 2022). Farms generally implement improvements in feed management, such as increasing fiber (NDF) content during afternoon feeding, to address this issue (Dudi *et al.*, 2022).

Based on the results, there was no significant difference between the milk pH during morning and afternoon milking. According to Christi *et al.* (2022), milk pH values were 6.67 and 6.37 in the morning and afternoon, respectively, under a 12-hour milking interval; therefore, it can be concluded that differences in the milking interval do not cause significant deviations in milk pH quality. Milking time did not affect milk pH stability. The implementation of hygiene before milking is important for maintaining normal milk pH. According to the Indonesian National Standard (SNI) 3141:2024, the pH of fresh milk generally ranges from 6.3 to 6.8. A decrease in pH generally occurs due to lactose fermentation by bacteria into lactic acid, which increases acidity, reduces protein stability, and accelerates spoilage (Rahmaniar *et al.*, 2021).

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CONCLUSIONS AND SUGGESTION

Conclusion

Milking time affects both milk quality and quantity. Morning milking produced higher milk yield, protein content, specific gravity, and solid non-fat than afternoon milking, whereas milk fat content was higher in the afternoon. Milk pH did not differ significantly between morning and afternoon milking.

Suggestion

The recommendation that can be given is to apply a consistent 12:12-hour milking interval in the morning and afternoon to maintain the stability of milk production and quality, as a hypothesis for further research.

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Tables

Tabel 1. T-test Results for Milk Production

Variable Unit	Milking Time (Mean ±SD)		P-value
	Morning	Afternoon	
Milk Production	7,45 ± 1,98	4,43 ± 1,07	< 0,001

Tabel 2. T-test Results for Protein Content

Variable Unit	Milking Time (Mean ±SD)		P-value
	Morning	Afternoon	
Protein Content (%)	3,22 ± 0,09	2,93 ± 0,15	< 0,001

Tabel 3. T-test Results for Specific Gravity

Variable Unit	Milking Time (Mean ±SD)		P-value
	Morning	Afternoon	
Specific Gravity (g/mL)	1,030 ± 0,001	1,026 ± 0,002	< 0,001

Tabel 4. T-test Results for Solid Non-Fat (SNF)

Variable Unit	Milking Time (Mean ±SD)		P-value
	Morning	Afternoon	
Solid Non-Fat (%)	8,82 ± 0,20%	8,00 ± 0,37%	< 0,001

Tabel 5. T-test Results for Fat Content

Variable Unit	Milking Time (Mean ±SD)		P-value
	Morning	Afternoon	
Fat content (%)	0,64 ± 0,29	4,04 ± 1,28	< 0,001

Tabel 6. T-test Results for pH

Variable Unit	Milking Time (Mean ±SD)		P-value
	Morning	Afternoon	
pH	6,87 ± 0,57	6,89 ± 0,51	0,200

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