Correlation of udder volume and teat size with milk production of Holstein Friesian cows at lactation periods 1 - 6 (Case study at Capita Farm, Semarang, Central Java)

R Hartanto, A A Pamungkas, E Prayitno, A Prima and D W Harjanti

Laboratory of Beef and Dairy Sciences, Department of Animal Science, Faculty of Animal and Agricultural Sciences, Universitas Diponegoro, Tembalang Campus, Semarang City, Central Java, 50275

E-mail: rudyharta@gmail.com; rudyhartanto@lecturer.undip.ac.id

Abstract

The aim of the study was to analyze the correlation between udder volume and teat size with milk production at various lactation periods (1-6) of Holstein Friesian dairy cows in Capita Farm, Semarang District, Central Java. The study used 59 Holstein Friesian dairy cows in lactation periods 1-6 and lactation months 1-10. The body weight was 497.71 ± 44.73 kg and the milk production was 14.43 ± 4.43 liters/day/head. The study was conducted by observation. Parameters observed were lactation period, udder volume, teat size (teat circumference and teat length) and daily milk production. Correlation analysis was used to determine the degree of relationship between udder volume and teat size with milk production. The results of this study indicate that there was a very significant correlation between udder volume and milk production, but teat circumference and teat length did not correlate with milk production. The correlation between udder volume (X) and milk production (Y) was positive and in lactation periods I: 0.888; II: 0.814; III: 0.949; IV: 0.968; V: 0.999 and VI: 0.957. The form of this relationship follows the regression equation Y = 1.793 X - 1.554 (R^2 = 0.650). It was concluded that in Holstein Friesian dairy cows in CV. Capita Farm showed if the volume of the udder increases, the milk production will also increase. This occurred in all lactation periods (1-6) tested.

Keywords: lactation period, udder volume, teat size, milk production, CV. Capita Farm

Introduction

Holstein Friesian cows are a type of dairy cows that are commonly kept in Indonesia, including Central Java, with milk production reaching 4,500-5,500 kg/lactation period. Milk production was influenced by genetic factors and environmental factors. Genetically, Holstein Friesian cows are able to produce more milk than other breeds of dairy cow. Although the same breed, but if different individuals, then the genetic ability is also not exactly the same. This genetic ability includes internal factors which are factors of the individual dairy cow itself, including udder volume and teat size. Udder

volume and teat size are one of the internal factors related to the ability to produce milk and the effectiveness of milking. Dairy cows that have a large udder volume will visually have high production [1, 2, 3].

The udder develops rapidly during puberty and the first pregnancy where there is an elongation of the duct system, the branching system and the multiplication of epithelial cells due to the activity of estrogen, progesterone and placental lactogen [4, 5]. Milk production in the 1st lactation period will increase until the 4th lactation period and then decrease until the cow is rejected. This increase occurred due to the repair and multiplication of epithelial cells, especially when the cage was dry. However, in the 5th period, there was a decrease in production because the rate of repair of epithelial cells was slower than the damage to epithelial cells that occurred during milk production. Enlargement and multiplication of these epithelial cells causes milk production to increase and the udder volume also increases [6]. A good teat is symmetrical and uniform in size. Dairy cows with large udders tend to have teats with a larger size and distance between the teats than other dairy cows with smaller udders [2, 7, 8].

So it was suspected that there was a close correlation between udder volumes, teat size and milk production whose values are not the same between lactation periods. This study aimed to analyze the correlation between udder volume and teat size with milk production at various lactation periods (1-6).

Materials and Methods

Materials

The material used was 59 Holstein Friesian dairy cows in Capita Farm, Semarang District, Central Java. The dairy cows have a lactation period of 1–6 and lactation months of 1–10. Daily milk production was 14.43±4.43 liters/day/head with a body weight of 497.71±44.73 kg. Tape measure was used to measure udder volume and teat size. In addition, stationery was used to record the results of measurements and observations of milking results, and cameras for documentation.

Methods

The study used an observational method with the observed parameters were lactation period, udder volume, teat size (teat circumference and teat length), and daily milk production. Measurement of udder volume was carried out at 05.00 before the morning milking and at 16.00 WIB before the afternoon milking, and the measurement of the teat size was carried out at 05.00 WIB before the morning milking. The amount of milk production was measured twice, namely at the time of milking in the morning and in the evening after measuring the volume of the udder. Animals were not given special treatment before or after data collection.

Udder volume was measured based on the Kuczaj [9] method, namely by measuring the length × width × height of the udder. The length of the udder was measured from the front end to the back end of the udder, the width of the udder was measured from the right side to the left side of the udder, and the udder height was measured from the bottom end of the udder to the top of

the udder using a measuring tape in cm. After that it was calculated into udder volume and converted into dm^3 or liters.

The observed teat size was the length of the teat and the circumference of the teat. Teat length was measured by measuring the length from the base of the teat to the tip of the teat with a measuring tape in cm on all four teats, and then averaged. Teat circumference was measured by wrapping a measuring tape around the teat in cm on all four teats, and then averaged. Measurement of milk production was carried out by milking lactating cows in the milking parlor to obtain milk production. The results of the measurement of milk production were obtained from the results of milking that had been recorded by the cage employees at the morning and evening milk production which had previously been measured for the volume of the udder. Measurement of months and lactation periods was obtained by looking at data from existing records in the company.

Statistical Analysis

The value of the closeness of relationship between udder volume, teat size (teat circumference and teat length) with milk production at various lactation periods was analyzed using correlation analysis, based on the formula Sugiyono [10]:

$$\mathbf{r_{x_i y}} = \frac{\mathbf{n}(\sum \mathbf{x_i y}) - (\sum \mathbf{x_i}).(\sum \mathbf{y})}{\sqrt{\{\mathbf{n}.\sum \mathbf{x_i^2} - (\sum \mathbf{x_i})^2\}.\{\mathbf{n}.\sum \mathbf{y^2} - (\sum \mathbf{y})^2\}}}$$

Whereas r = coefficient of correlation; X = udder volume or teat size; Y = daily milk production.
IBM SPSS 25 was used in the calculation process to increase accuracy [11, 12].

Results and Discussion

The results of the correlation between udder volume and teat size with daily milk production at various lactation periods in Holstein Friesian cows in Capita Farm was presented in Table 1. Udder volume and milk production in Holstein Friesian cows in Capita Farm shows a very significant correlation ($P \leq 0.01$), as stated by Sugiyono [10] if the coefficient of correlation (r) is between 0.8 – 1.0 then it is said to have a very strong relationship. This phenomenon was also seen in Illustration 1, where the graph between udder volume and milk production in each lactation period has a relatively similar shape. The curve shows that the increase in udder volume (X) was also followed by an increase in daily milk production (Y). Based on the regression analysis, it was known that this relationship follows the equation $Y = 1.793 X - 1.554$ ($r^2 = 0.650$). A very significant correlation between udder volume and milk production in this study was because the udder is an organ that plays a role in milk production and holds milk before milking [4]. In a healthy udder, the larger of the udder indicates the higher of the number and activity of secretory cells in milk synthesis, so that the milk production produced is

higher. Milk production was influenced by udder dimensions, age, body weight, lactation duration, microclimate conditions and maintenance management [1, 7, 8]. While other researcher reported that milk production was strongly influenced by the activity and number of secretory cells in the udder tissue and the availability of substrates from feed nutrients to be synthesized into milk [6, 13, 14].

Table 1. Correlation between Udder Volume and Teat Size with Milk Production at Various Lactation Periods

Variable	r	P-value
UV and DMP P1	0.888	0.000
UV and DMP P2	0.814	0.001
UV and DMP P3	0.949	0.000
UV and DMP P4	0.968	0.000
UV and DMP P5	0.999	0.000
UV and DMP P6	0.957	0.001
TC and DMP P1	0.508	0.064
TC and DMP P2	0.290	0.361
TC and DMP P3	-0.082	0.833
TC and DMP P4	0.413	0.235
TC and DMP P5	0.545	0.206
TC and DMP P6	0.479	0.276
TL and DMP P1	0.394	0.164
TL and DMP P2	0.275	0.386
TL and DMP P3	-0.385	0.306
TL and DMP P4	0.111	0.761
TL and DMP P5	-0.317	0.489
TL and DMP P6	0.357	0.432

* UV: udder volume, DMP: daily milk production, P: lactation period, TC : teat circumference, TL: teat length , r : coefficient of correlation, P-value : level of significance

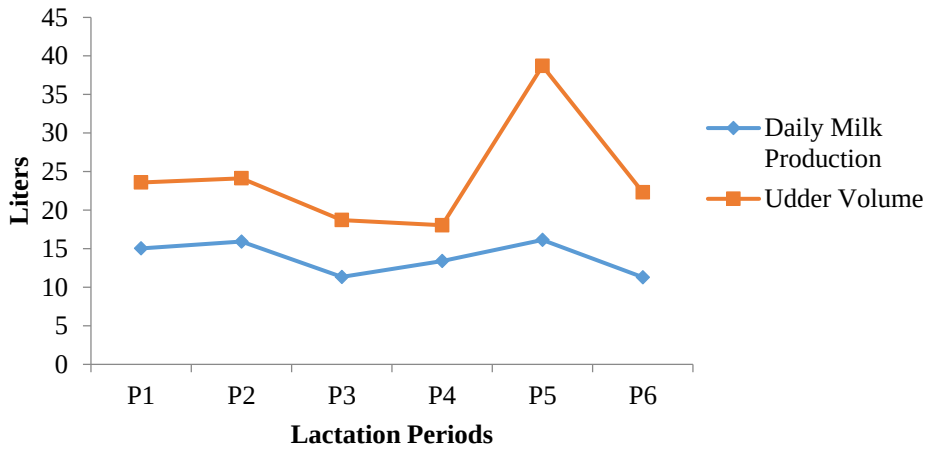

Illustration 1. The Curve of Udder Volume and Daily Milk Production at Various Lactation Periods

Teat size (teat circumference and teat length) with milk production of Holstein Friesian cows in Capita Farm did not have a significant correlation ($P > 0.05$). These results were in agreement with Damayanti et al. [2] which states that teat size does not affect daily milk production in Naksatra Kejora

Farm, Temanggung District, Central Java. Murti [7] expressed the opinion that the size of the teat did not affect the milk produced and accommodated in the udder, but it was suspected that it can affect the effectiveness of the milking process. Hogeveen et al. [15] also expressed the opinion that the teat did not play a role in producing milk, but plays a role in the rate of milk flow when milking so that it affects the effectiveness of milking. Putting is only a channel organ in the udder that acts as a way out of milk when milking during lactation. This was in accordance with the opinion of Habib et al. [16] that the teat is a canal organ that is attached to the udder and is covered with skin which functions for the passage of milk during the milking process.

Conclusion

There was a very significant correlation between udder volume and milk production, but teat circumference and teat length were not correlated with milk production. The larger the volume of the udder, the milk production also increases.

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