Effect of Feeding Methods on Feed Intake, Milk Production and Milk Quality of Holstein-Friesian Cows

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ABSTRACT
This study aimed to determine the effect of different feeding methods on feed intake, milk production, and milk quality of lactating Holstein-Friesian (HF) cows. The materials used in this study were 16 lactating cows (2nd–3rd) with the bodyweight of 550-650 kg, which were divided into 2 treatments based on feeding methods. The treatments were the TMR method (T0) and the component feeding method (T1). Data on feed intake, milk production, and milk quality were tabulated and then analyzed using t-test. The results showed that the average dry matter intake, organic matter intake, and milk production in T1 was significantly (P<0.05) higher than T0 (15.54 vs. 11.53 kg, 14.89 vs. 11.01 kg, and 21.06 vs. 15.89 kg, respectively). However, the effect of feeding methods on milk quality was not significant (P>0.05). The relationship between dry matter intake and milk production could be explained by the following equation: $Y_{milk\ production} = 0.6X_{DMI} + 11.6$, indicating that milk production was significantly affected by DMI. Based on this regression equation, it can be interpreted that an increase in DMI of 1 kg can increase milk production by 0.6 kg. The relationship between organic matter intake and milk production could be expressed by the following equation: $Y_{milk\ production} = 0.7X\ OMI + 11.6$, indicating that milk production was significantly affected by OMI. Based on this regression equation, it can be interpreted that an increase in OMI of 1 kg can increase milk production by 0.7 kg. In conclusion, feed consumption, milk production, and milk quality of the dairy cows in the component feeding method were higher than in the TMR method.

Keywords: *Holstein-Friesian Cows, Feeding Methods, Feed Intake, Milk Production, Milk Quality.*

1. INTRODUCTION

Holstein-Friesian (HF) cows is a breed of dairy cows that has the ability to produce high milk production, long lactation period, and good milk quality. This breed of cows is kept by many breeders in Indonesia [1].

Increasing the milk production of the Holstein-Friesian cow can be achieved through an appropriate feeding system to increase feed consumption. Efforts that can be made to increase livestock productivity include improving the quality of the feed and increasing dry matter intake. Increasing dry matter intake can be done through feeding methods.

There are three feeding methods. First, component feeding, that is feeding concentrate first and then forage or vice versa. Second, selective feeding is the provision of concentrate and forage simultaneously, but the forage and concentrate feed are separated. Third, the total mixed ratio (TMR) is feeding concentrate and forage which are mixed (not separated) in one feeder. Giving with this system can give maximum effect on dry matter intake (DMI). As stated by [2] who reported that the TMR feeding system had the maximum effect on DMI, milk production, and milk quality in caged cattle [3].

Dairy cows raised at BBPTU-HPT Baturraden are dairy cows that have high genetic potential but their milk production is not optimal according to their genetic potential. The feeding of dairy cows at BBPTU is carried out using the TMR method, but the DMI has not been maximized because there is still a lot of leftover feed that is not consumed by livestock. The TMR feed given tends to be a bit wet due to the high-water content

of the forage considering the high rainfall in Baturraden. So it is necessary to do research using other methods of feeding by feeding forage and separate concentrates (non-TMR).

2. MATERIALS AND METHODS

The materials used in this study were 16 lactating cows (2nd–3rd) with the bodyweight of 550-650 kg, which were divided into 2 treatments based on feeding methods. Each treatment consisted of 8 replications. The treatments were the TMR method (T0) and the component feeding method ((T1). Feeding was carried out for 100 days of the study. In T0 group, animals received forage elephant grass and concentrate mixed in the Jeulor machine, while those in T1 group received a component feeding method, of which forage and concentrate were separated by giving forage first and then concentrate.

The frequency of feeding in each treatment was carried out 2 times (7 am and 3 pm) a day. The amount of feeding for each treatment was adjusted to the needs of each animal which had been calculated based on their body weight. The treatment feed formulations used are shown in Table 1.

Table 1. Composition of feed ingredients based on dry matter

Feed Ingredient	%	Proportion
Forage	50	50
Concentrate		
Coconut Meal	20	9.5
Soybean Meal	12	6.0
Pollard	25	12.5
CGF	18	8.5
CGM	2	1.0
Cassava Waste	21	10.0
Mineral mix	2	2.5
Total	100	100

The variables observed in this study were feed consumption, milk quality (fat content, protein content, lactose, specific gravity, solid non-fat, and total solid). Milking was done 2 times a day in the morning, at 06.00 AM and in the afternoon, at 04.00 PM using a milking machine. Milk from the milking place (cage) was accommodated in a bucket and weighed using a digital scale with a capacity of 30 kg, then the weight (kg) was recorded. Next, the milk in the bucket is transferred to a milk can and sent to a cooling unit.

Milk production was calculated based on the amount of milk produced in the morning and evening during the 100-day lactation period. Milk production was calculated in 4% FCM by using a correction factor as the following formula:

4% FCM milk production = (0.4 x milk production) + 15 (milk production x % fat). Milk quality test was carried out once a week for 100 days of the study using Lactoscan to measure protein content, fat content, lactose content, SNF, total solid, and BJ milk.

Data on feed intake, milk production, and milk quality obtained were tabulated and then analyzed using t-test.

3. RESULTS AND DISCUSSION

3.1. Feed Intake

The results show that different feeding methods had significant effects on the dry matter intake (DMI), organic matter intake (OMI), and crude protein intake (CPI), but had no significant effect on crude fiber intake (CFI). DMI, OMI, and CPI in T1 are higher than that in T0. DMI is influenced by several factors, such as body weight, milk production, and the quality of feed ingredients [4]. DMI in T0 is lower because the TMR feeding methods used the mixture of forage and concentrate that is tended to be wet due to high water content in the forage. Feed that is not consumed by the livestock quickly can cause an unpleasant aroma that can further decrease the palatability of the feed, causing decreased feed consumption. Feed intake in T1 treatment is higher than that in T0 treatment because the forage and the concentrate are given separately, so the feed do not quickly become smelly. [5] reported that DMI is not influenced by CP content in the feed. DMI has an important role to meet the need of nutrients for production and health function of the animals. OMI is directly proportional to DMI, of which the higher the DMI, the higher the OMI.

The average nutrient intake of dairy cows with different feeding methods is shown in Table 2.

The increase in OMI and CPI in the T1 treatment shows that the OMI and CPI are directly proportional to the DMI. This is because organic matter is part of dry matter, so when the DMI increases, the OMI will also increase, similarly when the DMI decreases, the OMI will also decrease. This is in accordance with the previous study of [6], who reported that the high and low OMI will be influenced by the high and low DMI, because most of the dry matter components consist of organic matter components, the difference between the two lies in the ash content. [7] also reported that the organic matter content is the largest component in dry matter so that the OMI will follow the pattern of DMI.

Total digestible nutrient intake (TDNI) in TMR and non-TMR feeds is significantly different. [8] reported that the higher TDN level in the ration, the higher the

Table 2. Average nutrient intake of dairy cows with different feeding methods

Parameter	Treatment	
	T0	T1
Body weight (kg)	551.6±72.2	575.3±43.4
Nutrient intake		
Dry matter (kg DM/head/day)	11.53±0.34[a]	15.54±0.75[b]
Organic matter(kg OM/head/day)	11.01±0.82[a]	14.89±0.81[b]
Crude protein (kg OM/head/day)	1.71±0.06[a]	2.93±0.12[b]
Crude fiber (kg OM/head/day)	495±0.31	4.51±0.43
TDN (kg OM/head/day)	8.01±0.21[a]	11.72±0.87[b]

Different superscript within the same rows shows significant differences ($P < 0.05$)

Table 3. Average milk production and milk composition of dairy cows

Parameter	Treatment group	
	T0	T1
Milk production (kg/head/day)	15.89±0.54[a]	21.06±0.64[b]
Fat content (%)	3.54±0.06	3.55±0.05
Protein content (%)	2.66±0.02	2.69±0.05
Lactose content (%)	3.82±0.03	3.82±0.04
SNF (%)	7.35±0.04	7.36±0.11
Total solid (%)	11.14±0.26	11.16±0.37
Specific weight	1.025±0.00	1.025±0.00

Different superscript within the same rows shows significant differences ($P < 0.05$)

TDNI. [9] reported that TDNI is influenced by DM rations consumed, the higher the DM rations, the higher the TDNI. This is in accordance with the results of the study that ration levels affect TDN levels. The TDNI is influenced by the quality of the ration. The TDNI will increase if the rations given are of good quality [9]. High TDNI indicates that feed is more digested and utilized by the body because energy is a source of energy resulting from the digestive process in the body where TDNI can affect livestock productivity [4].

1.2. Milk Production

The average milk production and composition of dairy cows with different feeding methods during the study are listed in Table 3.

The results of statistical analysis show milk production and fat content of dairy cows in the two treatment groups are different. In Table 3, it can be seen that milk production in treatment (T1) is higher than (T0). This is because the DMI in the T1 treatment is higher than T0. There is an increase in DMI in T1, this is due to improvement in feeding management. The production and quality of milk are strongly influenced by the consumption of feed and the quality of the feed given.

The regression equation for DMI with milk production was $Y_{milk\ production} = 0.6X\ DMI + 11.6$ with ($R^2 = 0.40$), indicating that milk production is significantly affected ($P<0.01$) by DMI. Based on the regression equation, it can be interpreted that an increase in DMI of 1 kg can increase milk production by 0.6 kg.

Regression equation for OMI with milk production was $Y_{milk\ production} = 0.7X\ OMI + 11.6$ ($R^2 = 0.35$), indicating that milk production is significantly affected ($P<0.01$) by OMI. Based on the regression equation, it can be interpreted that an increase in OMI by 1 kg can increase milk production by 0.7 kg. The R^2 value indicates that the milk production of dairy cows as much as 35% is influenced by the OMI and 65% is influenced by other factors.

The results of the analysis show that the treatment of the feeding method does not make a difference to the composition of milk (fat, lactose, protein, SNF, and TS) (Table 3). [10] reported that milk production and composition are influenced by several factors, such as genetic (breed, individual, age, lactation duration) and environmental (climate, feed, disease, management) factors. Milk fat and protein content are very sensitive to the amount, composition, and nutritional value of the ration, although the response to protein composition is

not as fast as milk fat content. Milk protein is synthesized in the mammary gland from readily available precursors and in general, the availability of the amino acids methionine and lysine is a limiting factor in the synthesis of milk production [11]. Sources of amino acids that are digested in the intestines of dairy cows come from two main sources, namely synthesized microbial protein in the rumen and non-degraded feed protein in the rumen.

4. CONCLUSION

Feed intake, milk production, and milk quality of the dairy cows in the component feeding method group are higher than in the TMR method group. This is indicated by the results of the average DMI of 15.54 kg vs. 11.53 kg, the average OMI of 14.89 kg vs. 11.01 kg, respectively. Milk production of the cows in the component feeding method group is higher than in the TMR method (21.06 kg vs. 15.89 kg). Milk quality is not significantly different.

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