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## Effect of Age at First Calving on Milk Production and Reproductive Performance of Indonesian Holstein Dairy Cattle

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### ABSTRACT

The purpose of this study was to determine the milk production and reproductive performance of dairy cattle in groups of different ages at first calving and to elucidate the effect of age at first calving on milk production and calving interval of Indonesian Holstein dairy cattle. The observation method use in this study. Records of 80 dairy cows which were born in Indonesia and had the age at first calving range of 23-32 months were used as the materials. Cows were divided into two groups based on age at first calving (AFC). Group I was cows with age at first calving of 23-27 months and group II with age at first calving of 28-32 months. The parameters observed were the total milk yield, calving interval, post-partum mating, interval from calving to conception, and service per conception. To compare data between two groups, the t-tests and descriptive analysis were used. The results showed that the total milk yield, calving interval, postpartum mating, interval from calving to conception, and service per conception in the group I did not have a significant difference from the group II. The linear regression analysis showed that the age at first calving had a weak negative effect on the total milk yield, and the age at first calving had a weak positive effect on the calving interval. In conclusion, the difference in the age at first calving did not provide a different performance on milk production and reproduction of dairy cattle.

Keywords: Indonesian Holstein dairy cattle, Milk production, Reproductive performance, The age at first calving

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### Introduction

The potential for the development of dairy farming is increasing in line with the need for domestic fresh milk consumption and public awareness of nutritional fulfillment. Factors supporting the success of a dairy farming business are livestock breeds, reproductive management, feeding, and rearing management (Atabany *et al.*, 2011; Amam and Harsita, 2019). The availability of quality breeds is needed to increase the productivity of dairy cattle in Indonesia. Dairy cows have different abilities in producing milk production. Cows that have high milk production will provide benefits for their farmers. There is a difference in milk production ability between imported Friesian Holstein (FH) cows and FH cows born in Indonesia (Aditya *et al.*, 2015; Nanda *et al.*, 2018). The productivity of dairy cows, especially milk production, is influenced by genetic factors, the environment, and the interaction of the two factors support one another, therefore improvement efforts need to be carried out together (Prabowo, 2021).

Indonesian Holstein dairy cattle are Friesian Holstein cattle that were born and

adapted in Indonesia (BSN, 2014), and are currently widely raised in Indonesia. The management of rearing heifers that will be used for replacement stocks on a farm will affect the productivity and profitability of the cows. Growth rate, poor health, and nutrition during the rearing of heifers are often causes of the delay in the age of first calving and will have an impact on fertility (Eastham *et al.*, 2018). The reproductive aspect is a supporting factor for the lactation activity of an animal, where the process of milk production will occur with a series of livestock reproduction, ranging from mating, and pregnancy to partus (Tasripin *et al.*, 2018). The reproductive parameters that can be observed in heifers are the age at first mating and the age at first calving. The age at the first calving is the beginning of the time when dairy cattle start producing and reproducing and is related to the time and cost of rearing heifers.

Several previous studies have shown that the age of first calving (AFC) varies widely and shows variation in total milk production performance of FH cattle and imported FH (Awan *et al.*, 2016; Murdani *et al.*, 2017) but is not strongly associated with reproductive

performance. In Hungary, the average AFC was 25.61 months with average milk production of 9676 kg/head/lactation (Fodor *et al.*, 2020). In Belgium, the best average milk yield was 6539 kg/head/lactation in cows with the age of first calving 22-26 months (Froidmont *et al.*, 2013). The age at first calving was 742.02±62.60 days or 24.134 months in PT. Ultra Peternakan Bandung Selatan (Tasripin *et al.*, 2018). Studies on the AFC that can affect optimal milk production and reproductive performance of Indonesian Holstein dairy cows have not been widely carried out yet. Based on those reasons, this study was conducted to determine the performance of the first lactation milk production and reproductive performance of Indonesian Holstein dairy cows in groups of cattle with different AFC, as well as to determine the effect of age at first calving on milk production and calving interval.

### Materials and Methods

The materials used in this study were the records of 80 Indonesian Holstein dairy cattle in the Livestock Breeding and Forage Center in Baturraden, located in Banyumas Regency, Central Java Province, Indonesia. The study used an observation method and selection of sample by purposive sampling, with the criteria of cows were born in Indonesia, had the age at first calving with a range of 23-32 months, had a record of milk production and reproduction, had given calving at least two times, the BCS value of cows is 2.5-3.5 (on a scale of 5) with the body weight of 400-550 kg, and had no reproduction disorders and generally healthy. All cows were reared in the same conditions as the free stall barn model, feeding in the form of forage and concentrate according to the maintenance procedures applicable at the study site. The mating method used artificial insemination, milking is carried out twice a day in the morning and evening using a milking machine.

The data was taken in the form of date of birth, date of first calving, date of second calving, date of artificial insemination, data on pregnancy diagnosis, and the total milk yield. The data were tabulated and analyzed quantitatively descriptively to calculate the mean and standard deviation of each parameter. The parameters observed were: 1) The total milk yield was calculated using the test interval method. The Test Interval Method is one of the methods for estimating milk production based on monthly milk production records. The Test Interval Method estimates milk production from the day after the recording date until the next recording day (Pratiwi *et al.*, 2013). The results of the estimation of milk production are standardized by correction factors for length of lactation, mature equivalent, and milking frequency (Kurnianto, 2022); 2) Calving interval was the time interval from the date of the first calving to the date of the second calving; 3) Postpartum mating or the first insemination after calving was the time interval calculated from the date of the first calving to the

first insemination after calving; 4) Interval from calving to conception was calculated from the time at first calving to the insemination that results in the second pregnancy; 5) Service per conception was calculated by the number of inseminations after the first calving that is carried out up to the results of the second pregnancy.

Data were analyzed using SPSS with a t-test to determine the difference in parameter values between groups, and a linear regression analysis to determine the effect of the age at first calving on the total milk production and calving interval.

### Results and Discussion

The total milk production and reproductive performance of the two groups with different ages at first calving are presented in Table 1. The average age at first calving in group I (25.65±1.31 months) that significantly lower ( $P<0.05$ ) than group II (30.18±1.47 months). The variation in age at first calving is influenced by the time of the first mating of heifers and the number of inseminations that result in the first pregnancy. In the dairybreeding installation at the study site, heifers were inseminated for the first time if they have shownestrous with a minimum body weight of 300 kg or at least 15 months old. Friesian Holstein heifers are ready for the first mating at the age of 15 months with body weights of around 300-350 kg (Moran, 2012), 300-325 kg (Maulana *et al.*, 2021). Dairy cows that are mated at the age of 15-18 months will give calving to the first offspring at the age of 24-27 months. In this study, there were 50 cows included in group I and 30 cows included in group II. The factors causing delays in the age of first mating are late sexual maturity, errors in estrous detection, lack of body weight, and the influence of environmental factors (Pirlo *et al.*, 2000; Atabany *et al.*, 2011). The management of the rearing heifer period, especially feeding after the weaning period, can affect the age of the first calving. Dairy cows with high body weight gain will show early puberty because sex maturity is more influenced by body weight than age (Englan *et al.*, 2021). The age at first calving is an important factor to reduce the cost of rearing heifers so that not delaying the optimal mating and first calving age can increase the efficiency of maintenance costs (Maulana *et al.*, 2021). Cattle with delayed age at first calving can be caused by the factor of body weight that has not been achieved at the age of first mating (Awan *et al.*, 2016) and the late appearance of first lust. The standard of body weight and age are applied so that the cow's body is ready to accept the pregnancy and the birth process. The age of first calving that is too young can have an impact on increasing the risk of difficulty in calving, decreasing milk production and milk quality (Eastham *et al.*, 2018).

Table 1 shows that there were no significant differences in total milk yield, calving interval, postpartum mating, interval from calving to conception and service per conception in cows

with a first calving age of 23-27 months and 28-32 months, although group I showed the higher average milk production and a better average of reproductive performance than group II. The different studies in Chungcheong Korea reported that the age of first calving of 24-28 months was the optimal age for dairy cows with consideration of milk production, feed costs, and reproduction (Sung *et al.*, 2016). Dairy cows that are late for mating at an older age have inefficient reproductive parameters and suboptimal milk production, thereby reducing productivity (Le Cozler *et al.*, 2009). This is probably due to cows with an earlier age of first calving having good body growth and reproductive hormonal cycles so that their reproductive performance is so good. If the hormonal cycle is good, the symptoms of lust will be more visible, making it easier to detect lust and determine the right time for heifer insemination.

The average total milk yield in group I (5162.33±779.35 kg/head/lactation) was not different from group II (4860.01±1272.50 kg/head/lactation). In a narrower age grouping, the total milk yield in the group of the age at first calving is presented in Figure 1. The total milk yield showed no differences in the group of the age at first calving of 23-24, 25-26, 27-28, 29-30, 31-32 months, that was 5230.92; 5055.34; 4943.73; 5013.03 and 4965.42 kg/head/lactation, respectively. Froidmont *et al.* (2013) state that the optimum age produces milk yield at 22-26 months, if the age of first calving is less than 22 months it will decrease the first lactation milk production by 11%, and if it is more than 30 months it will show low milk production as well. The results of this study are different from the results in California which state that milk production was highest in the group above 25 months compared to the shorter age of first calving (Ettema and Santos, 2004) and the highest first lactation milk production on imported FH cattle in BPTSP HMT Cikole was obtained in the group of cows with the first calving age of 26-29 months (Murdani *et al.*, 2017). The age of first calving is a factor that affects milk production and peak lactation (Pirilo *et al.*, 2000). An increase in the age of first calving from 21 months to 24 months will increase milk production, but over that age range milk production will decrease (Nilforooshan and Edriss, 2004). Cows that have the age at first calving of 24 months have the readiness of the body to produce milk more optimally, because mating at the age of 15 months describes that it has already reached the

required body weight and mature puberty. While in the AFC is less than 24 months, the cow is in the growth stage, and the nutrients it receives are not all for milk production (Awan *et al.*, 2016). It could be associated with the inadequate development of mammary (Sung *et al.*, 2016). If the age of calving is delayed, it indicates that the cow has a problem or a growth delay that will interfere with milk production and the hormonal system.

The efficiency of reproductive performance in dairy cows can be determined by measuring calving intervals (Prasetyo *et al.*, 2015). Calving intervals in group I (404.70±55.39 days) and group II (408.20±60.01 days) were still ideal because calving intervals will be problematic and reduce profit for the farmers if it is more than 14 months (Prasetyo *et al.*, 2015). Previous research on dairy cows at BPTSP HMT Cikole discovered that the group with age at first calving of 22-25 months showed shorter interval from calving to conception and calving interval number compared to the group with the age at first calving of 26-29 months and 30-33 months (Murdani *et al.*, 2017). The research on dairy cows in Korea, the best fertility is shown by cows that have the first calving at 23-25 months, and the worst performance is at the age of first calving above 30 months (Sung *et al.*, 2016).

Although there were no statistically significant differences in this study, the age of first calving can be a concerning aspect of reproductive performance on a dairy farm, and it is necessary to conduct studies with a greater age range of first calving.

#### The effect of age at first calving on the total milk yield

Based on the results of the study, a linear regression equation was obtained for the effect of the age at first calving on the first lactation milk yield was  $Y = 6051.54 - 36.66X$  with  $R^2$  0.9%, where Y: Milk yield, X: age at first calving (AFC), which means that the addition of one month from the age at first calving in the range AFC 23-32 months, will have a negative effect or reduce the total milk yield by 36.66 kg/head/lactation. Similar with the opinion of Murdani *et al.* (2017) that age at first calving can be used as a consideration in dairy cattle selection, where a delay in the first calving age may result in less milk being produced. The coefficient of determination result was 0.009 or 0.9%, with a significance of 0.399 ( $P > 0.05$ ) indicating a lack of influence of age at first calving on the milk yield. This suggests that in

Table 1. Milk production and reproductive performance of dairy cattle based on the age at first calving

Parameter	Average±standard deviation	
	Group I (n=50)*	Group II (n=30)*
Age at first calving (months)	25.65±1.31 <sup>a</sup>	30.18±1.47 <sup>b</sup>
Total milk yield (kg/head/lactation)	5162.33±779.35	4860.01±1272.50
Postpartum mating (days)	87.82±40.01	91.00±44.43
Interval from calving to conception (days)	123.82±57.13	128.33±62.05
Service per conception (times)	1.44±0.61	1.47±0.57
Calving interval (days)	404.70±55.39	408.20±60.01

\*Group I: cows with age at first calving 23-27 months, group II: cows with age at first calving 28-32 months.

<sup>a,b</sup> different superscripts in the same row show significant differences ( $p < 0.05$ ).

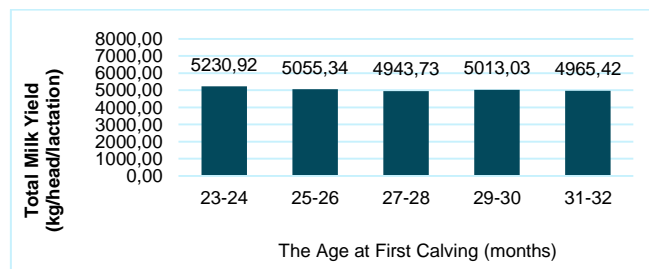


Figure 1. The average total milk yield in different groups of the age at first calving.

this study the age of the first calving is not a major factor in the performance of milk production.

### The effect of age at first calving on the calving interval

The effect of the age at first calving on the calving interval rate is indicated by the linear regression equation  $Y = 392.01 + 1.015X$  with  $R^2$  0.2%, where Y: calving interval, X: AFC, which means that every one month delay of age at first calving in the range AFC of 23-32 months, will increase the calving interval by 1.015 days and reduction in the age at first calving can decrease the calving interval. Based on the results of the analysis obtained the coefficient of determination was 0.002 or 0.2%, with a significance of 0.698 ( $P > 0.05$ ) indicating a lack of influence of the age at first calving on calving intervals. In this study, the age of the first calving was not the main factor affecting calving intervals. Calving intervals can be influenced by interval from calving to conception number and maintenance management (Murdani *et al.*, 2017), age of cattle, and postpartum mating (Prasetyo *et al.*, 2015). In a dairy farm, the calving interval figure can be corrected with suggestions for improvement in maintenance management, reproductive management, feeding, better detection of estrus, and control of cow health. Controlling the age at first calving, it can be a factor as an efforts to improve milk production and calving intervals so that they are more efficient in maintenance costs.

### Conclusions

The total milk yield, calving interval, postpartum mating, interval from calving to conception and service per conception in the group of cows with the first calving age of 23-27 did not have a significant difference from the group of cows with the first calving age of 28-32 months. The linear regression analysis showed that the age at first calving had a weak negative effect on the total milk yield, and the age at first calving had a weak positive effect on the calving interval. The difference in the age at first calving did not provide a different performance on milk production and reproduction of dairy cattle.

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