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Effect of Farm Categories on Quality and Quantity of Milk Produced by Different Crosses of Holstein-Friesian Cows

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ABSTRACT

Background: Farmers are not satisfied by the production performance of different crossbred Holstein-Friesian (HF) cows in Chattogram, Bangladesh. Therefore, the study was taken to find out the effect of farm categories on milk yield and milk constituents of different HF crossbred at Chattogram, Bangladesh.

Methods: This study was conducted from July 2014 to June 2015 in Chattogram Metropolitan Area (CMA), Potia, Mirsharai and Fatikchari upazilla (sub-district) of Chittagong, Bangladesh. For this study fourteen (14) commercial dairy farms in three different categories as A (50> milking cows), B(31>50 milking cows) ,C(11>30 milking cows) with 98 cows for each of the 3 crosses named as 50%HF×50% Local (L), 75%HF×25%L and 50%HF×50% Sahiwal (SH) at their third parity were selected. Farms under the same category were selected based on similarities in feeding and other management practices. Quality of raw milk was obtained by analyzing the milk samples collected from an individual animal of the selected farm at an interval of seven days by using a milk scanner (Lactostar, Model no. 3510, Funke Gerber, Germany) in the Laboratory of Dairy Science of Chattogram Veterinary and Animal Sciences University (CVASU).

Result: A significant difference (P<0.05) in milk yield and constituents except lactose and minerals was observed among the same and different crossbreds of HF under different farm categories. The highest daily average milk yield and quality were observed in different crosses of farms belong category A, but their performances decreased gradually with poor management systems in farms belong to categories B and C. So, farm category has a significant effect on milk quality and quantity in different crosses of Holstein. This study would help the commercial dairy farmers in choosing suitable crosses of Holstein-Friesian for farms belong to different categories.

Key words: Category A (50>milking cows), Category B (31>50 milking cows), Category C(11>30 milking cows), Holstein crosses, Milk composition, Milk yield.

INTRODUCTION

In Bangladesh dairy has been emerging as a transformation from livelihood-oriented dairy toward enterprise-driven dairy while it can still be seen as a key source of income and livelihood for millions of people (Uddin *et al.* 2020). Holstein crossbred (Holstein × local zebu) and Sahiwal crossbred cattle (Sahiwal × local zebu) are two major crossbred used in commercial dairying in Bangladesh, although, the Holstein crosses is predominates (Haque *et al.* 2011). The milk production performance of HF× L crossbred cows under Bangladesh's condition substantially improved gradually over the decades (Bhuiyan, 2015). As a result, most of the commercial dairy farmers are using different ratios of HF crosses for higher quality and quantity milk production in their farms. The breeding procedure need to be adjusted for a steady genetic trend in the herd that is related to milk production (Iqbal *et al.* 2007). However, dairy farmers need to establish permanent financial management according to their farm size (Lopes *et al.* 2010) that is related to the selection of suitable crossbred (Singh, 2006).

The commercial dairy farmers of Chittagong are interested to rearing a higher blood percentage of Holstein crosses for increased milk production. Khan *et al.* (2014) stated that the milk production performance of the crossbred was higher in F_1 cows almost everywhere the same, but it was questionable for crossing with the Friesian one or two times or more. Siddiquee (2014) recommends that an appropriate blood percentage of the exotic will be helpful to Bangladeshi farmers for higher milk yield in the peri-urban areas.

The commercial dairy sector of Chattogram, Bangladesh facing a lot of problems among them choosing a suitable cross of HF crosses for higher milk production and quality, according to the farm category is a major. However, no studies are associating both milk quality and traits with different farm categories related to Holstein Friesian (HF)

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crosses. A study is required to find out the effect of farm category with milk quality and production performance of dairy crossbred cattle reared by the commercial dairy farmers of Bangladesh. Therefore, the study was conducted to maximize marketable milk yield with optimum desired quality to the producers for increasing farm profit with the objectives of (i) compare the quality and quantity of milk yield among different crossbreds of HF under different farm categories in commercial dairying; and (ii) to find out the correlations between categories of farms with milk yield and milk composition of different crossbreds of HF under commercial dairying in Chattogram, Bangladesh.

MATERIALS AND METHODS

Study areas and study periods

The study was conducted for a period of one year, from July 2014 to June 2015 in Chattogram Metropolitan Area (CMA) and Potia Upzilla, Potiya, Mirsharai and Fatikchari upazilla (sub- district) of Chittagong, Bangladesh.

Selection of farms, crossbreds and number of animals

A total of 14 farms, 3 belongs to category A (50+ milking cows), 3 belongs to category B (31-50 milking cows) and 8 belongs to category C (11 to 30 milking cows) were randomly selected based on availability of target crossbreds, same feeding, housing, method of milking, disease preventive measures and other management practices. The category of farms was selected according to the Department of Livestock (DLS, 2014) Bangladesh. A total mixed ration or TMR was given to the animal. A total number of 294 dairy cows of which 98 cows from each crosses 50%HF×50%L; 75%HF×25%L and 50%HF×50%SH were selected from the above mentioned farm at their third parity. Artificial insemination (ID) card was used by the farmer that supplied by the local livestock office, were considered for selection of the crossbred. The dairy rations of different feed combination having similar metabolic energy (ME) and crude protein (CP) were analyzed at the Poultry Research and Training Center (PRTC) of Chattogram Veterinary and Animal Sciences University (CVASU) and a pretested structured questionnaire was used to collect information on the management condition of the farm. Based on the feed analysis and farm management data, the different category farms were selected.

Sample collection and analysis

Milk production of an individual cow throughout the lactation period was recorded daily by the researchers and farm workers. For determination of milk quality, milk samples were collected from an individual selected animal of each farm at 7 days interval by collecting morning and evening samples together, It was then immediately brought to the laboratory in an ice box for chemical analysis and analysis was done for fat, protein, lactose, minerals and, SNF using milk scanner (Lactostar, Model no. 3510, Funke Gerber, Germany) in the Laboratory of Dairy Science of CVASU.

Statistical analysis

Collected data were edited using Microsoft Excel and the descriptive statistics were analyzed using the statistical analytical software (SAS, 2008). The following statistical model was used to estimate the mean with standard errors of all the studied parameters.

$$Y_{ijk} = \mu + Fi + Bj + e_{ijk}$$

Where,

Y_{ijk} is the parameter's value.

μ= Overall mean.

F_i is the effect of farm type.

B_j effect of breed groups/Crosses.

e_{ijk} is the random error distributed as N (0, σ2).

The mean differences were compared using the least significant difference (LSD) test (Steel *et al*.1997) at a 5% level of significance.

RESULTS AND DISCUSSION

Observed milk quality of different crossbreds under different categories of farm

The daily average milk yield (Liter) and milk constituents based on the farm category and Holstein-Friesian crossbreeds are presented in Table 1. From Table 1, it's evident that there was a significant difference ($P<0.05$) in milk yield among crosses and also in the same crosses under different farm categories. Besides, the average milk production was also differed significantly ($P<0.05$) among the farm categories. Milk yield (Liter/day) of 75% HF×25% L crossbred was the highest, whereas 50%HF×50% L crossbred was the lowest irrespective of the farm categories. Milk yield increased when the proportion of exotic inheritance increased from 50 to 75 per cent was an agreement to Singh (2016). Significant ($P<0.05$) difference in production performance of 75% HF × 25% L also may be attributed to the variations in the level of management was an agreement to Kumar *et al.* (2017) and Nath *et al*. (2016).

Observed milk fat percentage in different farm categories and crossbreds

There was a significant difference ($P<0.05$) in fat percentage of milk among different crosses and the same crosses under different farm categories. The highest fat percentage was recorded in 50%HF × 50%L and the lowest in 75%HF×25%L crossbred irrespective of farm categories. There were significant ($p<0.05$) differences in fat percentage among the different crossbreds of HF. Milk fat percentage was highest in 50%HF×50%L and the lowest for 75%HF×25%L crossbred irrespective of farm categories. Our results were similar to the findings of Haile *et al*. (2009); Cheruiyot *et al.* (2018). Farm average fat percentage was significantly ($P<0.05$) higher in farms belongs to category A compared to farms belongs to category B and C. Regular supply of fodder and experience inefficient feed management might be the cause for average higher fat percentages in farms belongs to category A compared to category B and C. Yeamkong *et al.* (2010) findings that variability of fat across

farm size could be associated with the availability of roughage and the ability of farmers to manage and utilize feed resources was similar to our results.

Observed milk protein percentage in different farm categories and crossbreds

There was a significant difference (P<0.05) in the average protein percentage of milk among different farm categories. The highest protein percentage was recorded in 50%HF×50%L and lowest in 75%HF×25%L crossbred irrespective of farm categories. Our findings were similar to the results of Cheruiyot *et al.* (2018) and Haile *et al.* (2009). A non-significant difference was observed in protein percentage between 50% crosses of HF with Local (L) and Sahiwal (SH) under the same and different farm categories. Our findings were an agreement with Haile *et al.* (2009). The average protein percentage of different farm categories was differed significantly (P<0.05). The average protein percentage was significantly higher in farms belongs to category A compared to B and C. That difference might be attributed due to differences in management and feed supply of the farms under different categories. The farms belong to B and C have often changed their rations according to availability of roughage and meet the scarcity of forage with non-fiber higher energy concentrate feed compare to farms belongs to category A. Altering the nutrition by changing the proportion of protein in the diet has been shown to affect milk protein composition Tacoma (2016) was an agreement to us.

Observed milk lactose percentage in different farm categories and crossbreds

There was no significant difference in lactose content among different farms categories and crosses. Comparatively higher lactose content was found in 50%HF×50%L crossbred under farm category A and the lowest in 75%HF×25%L cross under category B farm. Lactose percentage was comparatively higher in the case of 50% Holstein crosses with Local (L) and Sahiwal (SH) compare to 75% crosses of Holstein (HF) under different farm categories. But the differences were non-significant. Our findings were similar to Shibru *et al.* (2019) and Wangdi *et al.* (2016). The average lactose percentage was higher in farms belongs to category A compared to farms belongs to category B and C. Supply of higher concentrate and imbalance of roughage and concentrate ratio in ration by the farms belong to category B and C and supply comparatively balanced ration with a proper ratio of roughage and concentrate in farms under category A might be the cause for the higher concentration of lactose under category A farms compare to B and C. Our findings were an agreement to Basset *et al.* (2012).

Observed milk mineral percentage in different farm categories and crossbreds

The mineral content of same and different HF crosses did not differ in the same and different farm categories (Table 1). The highest percentage of minerals were observed in 50%HF×50%L crossbred and the lowest in 75%HF×25%L crossbred irrespective of farm categories (Table 1). Furthermore, there were no significant differences (P<0.05) observed in the mineral content of milk among different farm categories. Our findings were in agreement to Noori *et al.* (2014) and Gemechu *et al.* (2015).

Observed milk SNF percentage in different farm categories and crossbreds

In the case of lactose percentage of milk, there was no significant difference (P<0.05) among the farm categories

Table 1: Milk quality and quantity of different crossbred under different farm categories.

Crosses	MY (Liter/day)	Fat%	Protein%	Lactose%	Minerals%	SNF%
			Farm category-A			
50%HF×50%L	10.94±3.781	4.33^{a}±0.421	3.44^{a}±0.160	4.58^{NS}±0.080	0.75^{NS} ±0.083	8.75^{a}±0.302
75%HF×25%L	13.56^{a}±8699	3.82^{a}±0.266	3. 38^{b}±0.0856	4.56^{NS}±0.120	0.72^{NS}±0.635	8.72^{a}±0.136
50%HF×50%SH	12.13^{a}±4.248	4.15^{a}±0.361	3.42^{a}±0.302	4.54^{NS}±0.139	0.73^{NS}±0.073	8.72^{a}±0.219
Farm average	12.21±5.476	4.10±0.369	3.43±0.183	4.56±0.113	0.73±0.514	8.73±0.219
	**	**	**	NS	NS	**
			Farm category-B			
50%HF×50%L	10.83±4.152	4.25^{b}±0.421	3.43^{a}±0.296	4.58^{NS}±0.073	0.74^{NS}±0.084	8.74^{a}±0.353
75%HF×25%L	12.61^{b}±4.318	3.76^{b}±0.317	3.37^{b}±0.140	4.54^{NS}±0.120	0.72^{NS}±0.077	8.65^{c}±0.250
50%HF×50%SH	11.70^{b}±4.188	4.01^{b}±0.336	3.41^{a}±0.136	4.55^{NS}±0.116	0.73^{NS}±0.070	8.68^{c}±0.195
Farm average	11.71±4.220	4.0±0.358	3.40±0.190	4.56±0.103	0.73±0.327	8.69±0.266
	**	**	**	NS	NS	**
			Farm category-C			
50%HF×50%L	10.68±4.192	4.19^{c}±0.358	3.41^{a}±0.301	4.56^{NS}±0.113	0.73^{NS}±0.069	8.71^{c}±0.264
75%HF×25%L	11.40^{c}±4.276	3.68^{c}±0.257	3.35^{b}±0.179	4.56^{NS}±0.115	0.72^{NS}±0.057	8.63^{c}±0.286
50%HF×50%SH	11.46^{c}±2.933	3.95^{c}±0.335	3.38^{a}±0.180	4.55^{NS}±0.109	0.73^{NS}±0.062	8.65^{c}±0.292
Farm average	11.18±3.80	3.94±0.317	3.37±0.22	4.56±0.112	0.73±0.063	8.65±0.281
Level of significance	**	**	**	NS	NS	**

Different letter in the same column differed significantly at (P<0.05) level of significance.

Table 2: Correlation regression between milk yield and other milk constituents.

	MY	FAT	PRT	LAC	MIN	SNF
MY	1					
Fat	-0.56**	1				
PRT	-0.31**	0.37**	1			
Lac	0.06**	-0.07**	-0.06**			
Min	-0.60**	0.06**	-0.38**	-0.12**	1	
SNF	-38**	0.04**	-0.91**	0.19**	0.50**	1

(NS= non-significant, **= Significant at 5% level)

MY= Milk yield, PRT= Protein, LAC= Lactose, MIN= Mineral, SNF= Solids not fat.

and crossebreds (Table 1). The highest lactose percentage was found in 50%HF×50%L crossbred of farms belong to category A and the lowest in 75%HF×25%L crossbred in farms belong to category B (Table 1). Our findings were similar to Shibru *et al.* (2019) and Wangdi *et al.* (2016). The average lactose percentage was highest in farms belongs to category A compared to categories B and C (Table 1*).* This may be attributed to the energy balance difference among farm categories was an agreement with Costa *et al.* (2019).

Correlation with milk yield and other milk constituent

From the correlation regression (Table 2) it was found that correlation with milk production and milk composition (fat, protein, lactose, mineral SNF) has a great impact on dairy cattle in different farm categories. In this study, most of the milk traits showed a negative strong significant (P<0.05) correlation with milk yield, fat (-0.560), protein (-0.307), minerals (-0.602) and SNF (-0.379) and a weak positive significant (P<0.05) correlation were observed between milk yield with lactose (0.06). Sourabh *et al.* (2017) also reported that a negative correlation between milk yield and major milk constituents. These findings indicate that selection of crosses with increased blood level of HF for higher milk production may tend to decline milk composition was an agreement with Alphonsus and Essien (2012).

CONCLUSION

It is revealed that there were a significant influence of farm categories on the quality and quantity of milk. A significant difference was also found in the case of quality and quantity of milk in the same crosses under the different farm categories. The quality and quantity of milk production were better in farms belong to category A compared to B and C. Though, daily average milk yield per cow was highest in 75%H×25%L crossbred compare to other crosses. However, the qualities with the quantity of milk remain constant for 50%HF×50%L crossbred and varied in 75%H×25%L and 50%HF×50%SH crossbreds irrespective of farm categories. Most of the commercial dairy farms of Bangladesh belong to category C. Therefore, it can be said that, starting a commercial dairy farm with the 50%HF×50%L crossbred would be suitable for their profitability. However, 75%HF×25%L and 50%HF×50%SH crossbreds were suitable for category A farms, where framers had a long experience for managing dairy cows but these crosses can also be reared in the rest of the farm categories by improving their knowledge for management and feeding practices for dairy cattle. This study discovered the rearing of 50%HF×50%L crossbred can be beneficial for all the farmers as the dairy business mainly depends on the quality and quantity of milk produced. This study will help the researchers to uncover the critical areas of dairying.

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