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Article

Genetic admixture and performance diversity of high yielding dairy cows surrounding the Baghabari Milk Vita areas of Bangladesh

Md. Shahjahan*

Lal Teer Livestock Limited, Anchor Tower, 108, Bir Uttam C.R. Dutta Road, Dhaka 1205, Bangladesh

*Corresponding author: Dr. Md. Shahjahan, Senior Scientific Officer (Breeding), Lal Teer Livestock Limited, Anchor Tower, 108, Bir Uttam C.R. Dutta Road, Dhaka 1205, Bangladesh. E-mail: sajubau@gmail.com

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Abstract: This study was planned to clarify the recent milk and reproductive performances of high yielding dairy crossbreds based on various genotype, parity and location beside the Baghabari Milk Vita areas of Bangladesh. Performance records were collected from total 81 crossbred cows from both 15 households in Sirajgonj and Pabna districts, and six *bathan* areas at Sirajgonj. Genetic admixture of various breeds identified in the studied areas showed diverse performance. Milk production not varied statistically (16.27 to 19.33 liters per day as peak) either for genotype, parity or region but differed in number of AI services for last pregnancy in L×HF×SL (1) and L×HF×JE (2.18) genotypes at household level. Average 70 days observed between the day of calving and next fertile AI service in dairy farming. The study on *bathan* revealed about 23 months for age at first fertile AI in high yielding dairy cows with average 1.92 AI services per cow for last conceive. Peak milk production identified in HF crossed with local than HF×SL and JE genotypes. Screening, record keeping and controlled AI or mating with specific targeted breed could increase breed uniformity and productivity of high yielding crossbreds not only in Milk Vita region but also other milk pocket areas of this country. In addition, breed composition study is required for ensuring specific breed effects on production performance to design a planned breeding for sustainable dairy breed development in Bangladesh.

Keywords: milk production; genetic dilution; repeat breeding; artificial insemination; dairy breed

1. Introduction

There are about 23.10 million cattle populations in Bangladesh where 6 million are dairy cattle, and its 85-90% and 10-15% belong to indigenous Zebu type (*Bos indicus*) and crossbreds, respectively (DLS, 2012; Hamid and Hossain, 2014). The average milk production of indigenous cattle ranged between 0.50 to 2.50 liters per day while the crosses of Holstein-Friesian, Jersey, Sahiwal and Red Sindhi with indigenous found average 5 to 10 liters per day (Islam, 2009). There are 3.79 million milch cows available in our country which belongs to 35% of all cows and 16% of total cattle populations (Samad *et al.*, 2014). The annual milk production in Bangladesh is 6.97 million while the demand noted 14.48 million tons (DLS, 2015).

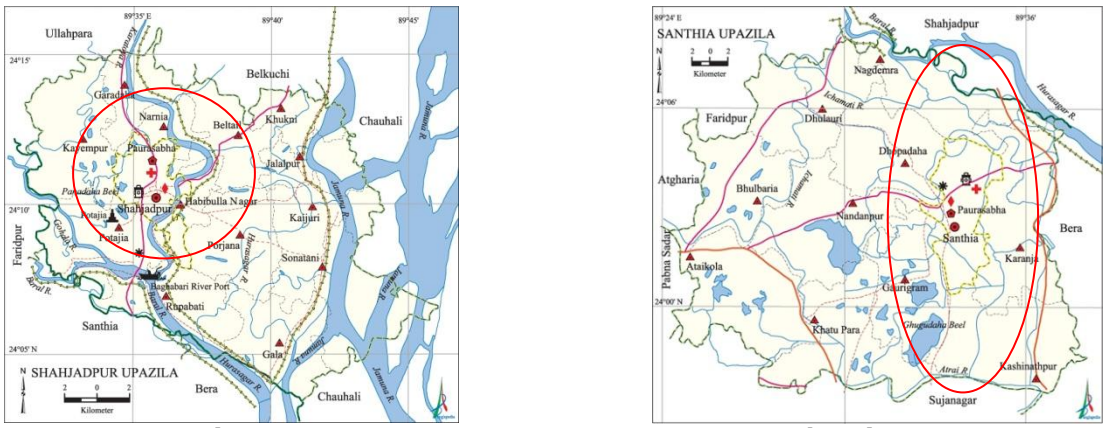
In Milk Vita area the high yielding crossbred cattle populations are mainly developed from the imported purebred bulls and semen of various temperate breeds like Australian-Friesian-Sahiwal, Holstein and Jersey with local Pabna milking cows (PMC). This PMC were originated from the introduction of different tropical breeding bulls such as Sahiwal, Hariana and Red Sindhi with our *Deshi* cows through cattle development project early before the end of British ruled in Indian sub continent and its regular consequences around the Pabna and Sirajgong districts of Bangladesh.

Although several studies conducted earlier in the Baghabari Milk Vita areas about performance of high yielding dairy cows very little attention paid on specific genetic admixture based production variation. Therefore this study was designed to identify available genetic admixtures in both household and *bathan* areas of Milk Vita

areas with their milk and reproductive performances so that an updated concept could be drawn from a famous dairy concentrated area of Bangladesh.

2. Materials and Methods

This study was conducted on 45 individual crossbred dairy cows from 15 randomly selected households by a preselected survey questionnaire on 8-9 July, 2016 from Sirajgonj (Shahjadpur) and Pabna (Sathia) districts of Bangladesh (Figure 1). Another study was performed with the same aim on 36 cows from six randomly selected *bathans* of Shahjadpur Upazila at Sirajgonj district on 27-28 December, 2016. All surveyed data were firstly extracted into MS excel version 2010 (Microsoft, Redmond, WA, USA). The gathered data were then analyzed via *F* test (one way ANOVA) including descriptive statistics using SPSS version 16 (SPSS Inc., Chicago, IL, USA) with Tukey's HSD and DMRT *post hoc* mean separation tests.



Sirajgonj district *Pabna district*

Figure 1. Location of the surveyed areas (red circled) in Sirajgonj and Pabna districts.
Source: Banglapedia

3. Results and Discussion

3.1. Genetic admixture of high yielding cows

The genetic admixture in the studied dairy herds revealed the combination of several breeds in which the frequency of Holstein-Friesian (Figure 2) was the highest regarding predominant individual breed characteristics followed by Jersey (Figure 3) and Sahiwal (Figure 4) with local cows (mainly Pabna cattle). One of the major reasons of this admixture is random and unplanned artificial insemination and such situation originated from non/zero-record keeping system. The dairy farmers usually known and introduced Holstein-Friesian in their dairy herd for higher milk production by artificial insemination in those areas. As most of the farmers received free veterinary and necessary cares from Milk Vita they used the bull semen provided by their inseminators as free. Milk Vita introduced Sahiwal and Jersey breeds to their contract or known farmers beside Holstein-Friesian breed previously. It is another vital reason for genetic dilution in the studied cattle populations. In few household, the farm owners reared bulls for breeding purpose and those bulls were randomly mated with the cows irrespective of breeds (mainly in *bathan*). The farmers always conduct the breeding issue with higher exotic blood level based on present milk business in existing animals and without concerning the genetics for future generations because of lower or lack of knowledge about admixture of breeds and possible consequences on rearing and production aspects.

3.2. Performance diversity of high yielding cows at household level

The performance of studied high yielding cows revealed that there was no significant differences existed in the milk and reproductive traits of different crossbred cattle populations belonging to various genetic admixture (genotype), parity and location except total number of AI services for last conceive (Table 1). The overall mean indicated that average peak milk production recorded up to 18.22 liters at three months of lactation while most of the cows were conceived by 1.38 AI and again inseminated within average 70 days after parturition. It was found that highest 2.18 AI services needed for last pregnancy in Local×Holstein-Friesian×Jersey crossbred but lower services observed in that crossbred having Sahiwal instead of Jersey. It could be the consequences of exotic blood level variations in those crossbred regarding reproductive failure.

The study of Nath *et al.* (2016) found 13, 8 and 6 liters of milk per day from Holstein-Friesian, Jersey and Sahiwal crosses at household level in Mithapukur Upazila of Rangpur district which were comparatively lower than this observation because of average production levels. Similar findings were observed by the study of Samad *et al.* (2014) in Sarsha Upazila of Jessore district where average 8 and 5 liters milk were recorded daily from Holstein-Friesian and Sahiwal crossbreds cattle having lactation period 262 and 250 days, respectively. Kabir and Kisku (2013) identified higher service pre conception (1.64) and post partum heat period (136 days) than our findings. Das *et al.* (2003) confirmed 132 days post partum heat period in Local (Pabna) ×Friesian crossbred in Milk Vita areas of Sirajgonj district during the period of 1990 to 1998. Another experiment stated that calving to conception interval of Holstein-Friesian and Jersey crosses with local were 148 and 101 days, respectively (Sarder *et al.*, 1997). The total milk yield by 100 days recorded average 6.67 and 6.15 liters per day in Local×Friesian and Local×Sahiwal×Friesian genotypes, respectively, at F_3 generation at Savar Dairy Farm (Majid *et al.*, 1996), in which milk production was lower than this study. These results suggesting higher genetic gain in the cattle genetic resources of Milk Vita area which could be the outcome of more conscious of farmers about the breeding of their cows and also screening best animals based on days of open for sustaining milk business and reducing production cost in farming. The results of Miazi *et al.* (2007) were in agreement with the present study revealing that Local×Jersey population needed 1.25 AI services per conception and 92.92 days in post partum heat period but not for Local×Friesian crossbred for those traits. These results pointed out the higher sustainability of Jersey crossbreds than Friesian crossbreds in local environment. The findings of Paul *et al.* (2013) also supported the previous findings for those two genotypes in a rural area of Sirajgonj district.

Figure 2. High yielding dairy crossbreds with predominant characteristics of Holstein-Friesian breed: (a-d) Local×Holstein-Friesian and (e-f) Local×Sahiwal×Holstein-Friesian.

Figure 3. High yielding dairy crossbreds with predominant characteristics of Jersey breed: (a-b) Local×Jersey, (c) Local×Sahiwal×Jersey and (d) Local×Holstein-Friesian×Jersey.

Figure 4. High yielding dairy crossbreds with predominant characteristics of Sahiwal breed: (a-c) Local×Sahiwal, (d-f) Local×Holstein-Friesian×Sahiwal

Table 1. Performance diversity of different crossbreds randomly selected in the household of Milk Vita areas.

Variable	Category	n	Trait (Mean±SE)		
			Peak milking at three months (liter/day)	Total AI service in last calving	Days open (d)
Genotype	L×HF	21	18.95±1.49	1.14±0.08^{ab}	68.57±5.62
	L×HF×SL	7	18.14±2.60	1.00±0.00^{b}	72.86±5.10
	L×HF×JE	11	16.27±0.79	2.18±0.52^{a}	70.91±6.25
	L×JE	6	19.33±2.09	1.17±0.17^{ab}	70.00±5.00
	Probability		**0.630**	**0.015**	**0.972**
Parity	1	9	15.44±1.25	1.22±0.15	67.22±5.96
	2	15	18.27±1.24	1.40±0.21	79.67±7.36
	3	4	23.75±5.78	1.00±0.00	58.75±11.25
	4	9	17.33±1.37	2.00±0.60	62.22±3.02
	≥5	8	19.50±2.30	1.00±0.00	69.38±3.95
	Probability		**0.176**	**0.233**	**0.224**
District	Pabna	15	17.13±0.97	1.27±0.21	69.67±7.71
	Sirajgonj	30	18.77±1.20	1.43±0.20	70.17±2.84
	Probability		**0.379**	**0.598**	**0.941**
Overall mean			***18.22±0.86***	***1.38±0.15***	***70.00±3.14***

SE= Standard Error; L= Local (mainly Pabna cattle), HF= Holstein-Friesian, SL= Sahiwal and JE= Jersey cattle breed

Table 2. Performance diversity of different cattle breeds randomly selected in the *bathan* of Milk Vita areas.

Variable	Category	n	Trait (Mean±SE)		
			Age at first fertile AI service (month)	Total AI service in last calving	Peak milking at three months (liter/day)
Genotype	L×HF	14	21.93±1.38	2.29±0.41	18.57±0.91^{a}
	L×HF×SL	15	21.47±1.51	1.60±0.24	15.60±0.83^{b}
	L×JE	7	27.57±2.54	1.86±0.34	15.57±0.69^{b}
	Probability		**0.065**	**0.315**	**0.028**
Parity	1	11	23.00±2.44	1.91±0.34	13.91±0.61^{b}
	2	7	23.14±2.42	1.71±0.36	17.00±0.79^{ab}
	3	6	22.17±2.17	2.00±0.82	17.50±1.45^{ab}
	≥4	12	22.83±1.36	2.00±0.30	18.83±0.93^{a}
	Probability		**0.993**	**0.966**	**0.002**
Overall mean			***22.83±1.01***	***1.92±0.20***	***16.75±0.56***

SE= Standard Error; L= Local (mainly Pabna cattle), HF= Holstein-Friesian, SL= Sahiwal and JE= Jersey cattle breed

3.3. Performance diversity of high yielding cows at *bathan* areas

Individual study on high yielding cows at *bathan* revealed that about 23 months were needed for their first fertile AI services after maturity and average 1.92 AI services were required for the last conception (Table 2). Number of AI services was not differed significantly based on genotype and parity but genotype and parity showed significant differences in peak milk production of high yielding milch cows in our studied areas. It was observed that Local×Holstein-Friesian genotype provided average highest 18.57 liters milk per day while lower in Local×Holstein-Friesian×Sahiwal crossbred. Highest and lowest milk production recorded in fourth (20 liters/day) and first parity (13.91 liters/day), respectively.

Das *et al.* (2003) observed that Local (Pabna)×Friesian genotype attained puberty at 28 months of age in Baghabarighat region of Sirajgonj while its service per conception and average milk production per day recorded as 1.36 AI and 8.28 liters, respectively. A study of Baset *et al.* (2012) showed comparatively much lower milk production in different crossbreed cattle populations of Friesian with Pabna (8.28 liters/day) and Sahiwal (6.78 liters/day) breeds in the *bathan* of Milk Vita areas with proper feeding systems including less service per conception (1.36 to 1.37) which were agreed with the findings of Majid *et al.* (1995) and Roy *et al.* (2007). But in this study it was observed that lower sexual maturity and higher service per conception for the same genotype which might be the reason of greater exotic blood admixture in the local genetic resources and consequent non adaptive signs in our environment representing reproductive failure. Mamun *et al.* (2015)

observed 36.43 months for age at first calving and 1.21 for service per conception in Holstein-Friesian crossbred in Uzankashir Char of Mymensingh district. These results pointed out lower genetic diversity comparing the animals of Milk Vita *bathan* regions at Sirajgonj. The puberty age of Local×Friesian was agreed with the research of Maizi *et al.* (2007) and Nahar *et al.* (1992) mentioning 21.60 and 17.67 months, respectively, but not with Local×Jersey crosses which might be the reason of lower number of cows of that crossbred in studied area or lower up-gradation of those studied crossbreds through Jersey breed. In the rural area of Rajshahi district the age of first fertile AI service, and interval between calving and conception identified 28.10 months and 153 days, respectively, for Local×Holstein-Friesian crossbred with 11.63 liters milk per day as peak production while for the same traits the values were 27.30 months, 145 days and 9.10 liters milk per day in Local×Sahiwal×Holstein-Friesian crossbred. These findings are also suggesting the superiority of high yielding milk cows surrounding the Baghabari Milk Vita areas of Bangladesh.

4. Conclusions

It is concluded that unique dairy cattle herd of different crossbreds available around the Baghabari region of Milk Vita. But the genetic admixture revealed random and unplanned artificial insemination between or among breeds which also affecting the performance of cattle population. To elucidate the association of different breeds on production performance the study on breed composition is required to clarify existing genetic makeup and specific breed effect on the variation of production. Screening of predominant coat colored cattle population based on performance from specific breed should be inseminated or controlled natural mating by superior breeding bull of that breed to reduce genetic admixture and increase the uniformity of herd simultaneously either in appearance and performance. But nevertheless further studies are needed with more individual cows of different crossbreds to find out the reason of repeat breeding and sustainability of those high yielding cows. In addition, the effects of crossbreeding on the quality of milk and meat would be interesting studies concerning the welfare of human health issues for both existing and next generation.

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Conflict of interest

None to declare.

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