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PARITY EFFECTS ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCE OF FRIESIAN CROSSBRED DAIRY COWS

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. Author GM assisted author MI to develop the study objectives and methodology. Author MI did the fieldwork. Author MAH supervised author MI to analyze data and interpret the results. Author MI prepared the first draft. The manuscript was revised by authors MAH, GM, JPB and MEH critically reviewed and edited the script. All authors read and approved the final manuscript.

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ABSTRACT

Bangladesh is an agriculture based country of which dairy sector shares a large economy and meets a great portion of the protein requirement of its population. Friesian crossbreds are highly recommended and beneficial to rear for dairy farms in the aspect of Bangladesh. The present study determined the parity effects on Local-Friesian cross-bred dairy cows' production and reproduction performance at the Central Cattle Breeding and Dairy Farm (CCBDF), Savar, Dhaka. 77 individuals were selected for this study and the quantitative data (Gestation period, Lactation period, Milk production per day, Calf birth weight and Calving interval) from the existing database (2008 to 2019) was recorded. Kruskal-Wallis test was conducted using STATA-13 statistical software to evaluate the association between parity number and each of outcome variables (Gestation period, Lactation period, Milk production per day, Calf birth weight and Calving interval). The results of each production and reproduction outcome varied significantly by parity number ($p \leq 0.003$) except for the gestation period ($p=0.22$). The obtained median of the gestation period for 1st to 6th parity was 276-279 days without the trend of increase or decrease in relation to parity. There was decreased calving interval (median from 1st to 6th parity, 529.5-375.5 days) and lactation period (median from 1st to 6th parity, 361.5-270 days) and increased milk production per day (median from 1st to 6th parity, 5.2-8.6 liter per day) and calf birth weight (median from 1st to 6th parity, 23-28 kg) with increased parity number. The results indicated that the cattle performance at Central Cattle Breeding and Dairy Farm was satisfactory. It was concluded that should explore the source of the short lactation periods further, as it is an important economic factor for dairy farms. Along with the genetic background of the dairy cows, some environmental factors (climate, year and season of calving) and

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management factors (disease control and feeding status) should be considered for investigating the reasons for the short lactation period.

Keywords: Cattle; CCBDF; parity; productive performance; reproductive performance.

ABBREVIATIONS

CCBDF	*: Central Cattle Breeding and Dairy Farm*
MT	*: Million Ton*
COVID-19	*: Corona Virus Disease 2019*
ml	*: Milliliter*
WHO	*: World Health Organization*
L×F	*: Local×Friesian (Local and Friesian crossbreed)*
GP	*: Gestation Period*
LP	*: Lactation Period*
MPPD	*: Milk Production Per Day*
BWT	*: Birth Weight of Calf*
CI	*: Calving Interval*
K-W test	*: Kruskal-Wallis Test*
BCS	*: Body Condition Score*

1. INTRODUCTION

Bangladesh relies heavily on its developing agricultural and livestock industries [1]. However, government statistics indicated that milk production has decreased to 7.89 million tons (MT) past year, down 2.79 MT from 10.68 MT produced in 2019-2020, due to the COVID-19 (Corona Virus Disease 2019) pandemic [2]. The World Health Organization (WHO) recommended consuming 250 milliliter (ml) of milk per day equating to 15.20 MT per year in Bangladesh [3]. The livestock sector encompasses 24.44 million cattle, 6 million of which are milking cows, and 85-90% of those dairy cattle are indigenous while the rest are crossbreds of Friesian and Sahiwal [2,4]. Dairy success depends on herd reproduction performance (age at puberty, age at 1st calving, and calving interval) [5]. Environmental factors such as poor nutrition, season and temperature have also significant impacts on reproductive performance [6].

Friesian (100%) and crossbreeds ((L×F) typically have a 276 and 277 day gestation period respectively [7,8]. Gestation period is largely influenced by the calving age, dam parity number, season and temperature, calf sex and birth weight, genetic milk line, milk yield, breed, dystocia occurrence and stillbirths [9]. Lactation period, milk production, calving interval and calf birth weight are significantly related to dam parity. Assessing the relationship between parity number and productive and reproductive parameters of Local-Friesian (LF) cross-bred will yield new data to the scientific literature. The data of this study will also address the parity influence on cattle performance.

For optimal dairy farm performance, cattle should have their first calving within 2 years of age with the calving interval not exceeding 12-13 months [10]. In Bangladesh, the calving interval ranges from 365-536 days with the post-partum period ranging from 103-161 days [11].

The aim of this study was to determine the source of the persisting lack of Local and Friesian crossbred of CCBDF. The specific objectives of this study were to determine different parity effects on gestation period, lactation period, milk production per day, calf birth weight, and calving interval.

2. MATERIALS AND METHODS

2.1 Study Site and Duration

The recorded data for this study was collected in 15th to 19th March, 2020 at the Central Cattle Breeding and Dairy Farm (CCBDF), Savar, Dhaka, Bangladesh from the past record book of the farm. This organized cattle farm works for improving the dairy sector of Bangladesh under the supervision of the Ministry of Livestock and Fisheries, Bangladesh, by supplying good quality semen to the dairy farmers throughout the country and by developing artificial insemination and embryo transfer protocol.

2.2 Study Population

A total of 77 cows from the same genetic line, Local × Friesian (L×F), reared under ideal farm management over a 12-year (2008-2019) period were selected. We took productive parameters (lactation period, milk production per day and calf birth weight) and reproductive parameters (parity number, gestation period and calving interval) from the regular record books of the farm. The selected cattle farm followed the same regulations of management including the feeding status, milking, artificial insemination, and treatment protocol. The BCS (body condition score) of the cattle were almost similar 3.5-4.00 [12]

2.3 Parameters STUDIED

Gestation period (GP) (in days): The period between conception and calving [13].

Lactation period (LP) (in days): The period from calving to drying off [14].

Milk production per day (MPPD) (in liters/day): The median amount of milk produced in liters per day. We calculated this number by dividing the total amount of milk produced in a full lactation cycle with the number of days in the cycle [15].

Birth weight (BWT) (in kg): We weighed the calves with a digital scale at the time of birth [16].

Calving interval (CI) (in days): The period between two consecutive parities for an individual cow [17].

2.4 Statistical Analysis

Data obtained were entered into MS Excel 2010. The data were then coded and recoded before transferring to STATA 13 *(StataCorp, 4905, Lakeway Drive, College Station, Texas 77845, USA)* for statistical analysis. Kruskal-Wallis (K-W) test was applied to assess the association between the parity and each of response variables (GP, LP, MPPD, BWT and CI). As the collected data were not distributed normally after doing a log transformation, the preferred method for the study was therefore K-W test instead of one-way ANOVA. The K-W test compares the rank of quantitative outcomes (GP/LP/MPPD/BWT/CI) among different parity categories. The GP/LP/MPPD/BWT/CI median and range (maximum and minimum) values were estimated to show their trends in this study analysis.

3. RESULTS

The association between parity number and each of response variables (gestation period, lactation period, milk production per day, calf birth weight and calving interval) for crossbred (L×F) are presented in Table 1. The $p \leq 0.05$ was considered significant.

Each trait (production/reproduction) varied significantly by parity number ($p \leq 0.003$) except gestational period ($p=0.22$) (Table 1).

The median lactation period gradually decreased with increasing parity number (361.5 days in 1st parity, 340.5 days in 2nd, 274 days in 3rd, 272.5 days in 4th, 285 days in 5th and 270 days in 6th).The median milk production per day increased with increasing parity number (5.2 L/day in 1st parity, 6.2 L/day in 2nd, 6.3 L/day in 3rd, 5.6 L/day in 4th, 7 L/day in 5th and 8.6 L/day in 6th). Similarly, calf birth weight increased with parity number (23 kg in 1st parity, 22 kg in 2nd, 24 kg in 3rd, 24.5 kg in 4th, 26 kg in 5th and 28 kg in 6th). Calving interval values decreased with increased parity number (529.5 days in 1st parity, 517 days in 2nd, 442 days in 3rd, 398 days in 4th, 442 days in 5th and 375.5 days in 6th).

Regardless of parity number, the GP median values remained similar (276-279 days).

Table 1. Median distribution of productive and reproductive traits by parity number

Parity	Gestation period (days)	Lactation period (days)	Milk production per day (L/day)	Calf birth weight (kg)	Calving interval (days)
	Median (Min-Max)	Median (Min-Max)	Median (Min-Max)	Median (Min-Max)	Median (Min-Max)
1	278.5 (250-287)	361.5 (138-730)	5.2 (2.4-8.3)	23 (16-30)	529.5 (276-973)
2	275 (218-290)	340.5 (110-701)	6.2 (2.3-13.7)	22 (16-33)	517 (296-1122)
3	277 (224-292)	274 (102-589)	6.3 (2.6-11.5)	24 (20-32)	442 (340-918)
4	277 (267-285)	272.5 (25-485)	5.6 (3.4-12.3)	24.5 (20-34)	398 (345-970)
5	277 (268-283)	285 (149-528)	7 (3.5-11)	26 (18-33)	442 (365-543)
6	276 (224-280)	270 (39-443)	8.6 (4.1-13.7)	28 (15-37)	375.5 (338-543)
p (Kruskal-Wallis)	0.22	0.003	0.0008	0.0001	0.0001

4. DISCUSSION

Cows typically have a lifespan of 15-20 years, and milking cows are generally reared for 4.5-6.5 years up to their 5th-6th lactation period in modern farms [18]. In Bangladesh, the dairy cattle are reared up to their 13th lactation or more, based on its productivity [11]. The profitability of a dairy farm is largely measured by the herd's production and reproduction performance [19]. Long lactation periods and short calving intervals from increased parity number support a farm's elevated economic status [20]. The current study found a significant relationship between production and reproduction traits of individual cows and parity number discussed below. [Table 1].

Preceding studies in Bangladesh documented a mean L×F GP of 277.2-279.3 days [21] and 277 days in the Czech Republic [22] supporting our results of 276-279 days from 1st parity to 6th parity. The parity number had no effect on the median GP in this study. As demonstrated at [23] decreased GP with increased parity number. However, increased GP is seen when a cow is older and carries a male calf [22]. GP is a heritable trait, and the impact of GP on economic traits is rarely observed [24]. Our study also did not document significant GP variation with parity [Table 1].

The regular lactation period (LP) of L×F is 305 days [25], but the current study recorded a median LP of 361.5-270 days from the 1st to 6th parity. An earlier study reported an LP range of 185-514 days in Friesian cows [26]. Our study showed a significant LP decrease in relation to increased parity number supported by [27]. However, findings in Ethiopia [28] reported increased LP with increased parity number.

The current study documented elevated milk production with increased parity number supported by an Ethiopian study [29]. This increased milk production is likely due to udder development and gland tissue proliferation as the cow ages [30].

The median calf birth weight elevated significantly with increased parity number (23 kg in 1st parity and 28 kg in 6th parity). Our results are supported by [31]. Higher calf weight is associated with increased milk yield and lactation period [32]. Increased milk yield increases farm profitability [33].

The median calving interval (CI) significantly decreased from 375.5 days in 1st parity to 529.5 days in 6th parity as parity number increased. These finding are corroborated by the international studies [34]. Based on our finding and the findings from [35], higher parity numbers positively support a farm's productivity.

5. CONCLUSION

The study resulted the parity order influences the reproductive and productive performance of dairy cattle only. The obtained lowering trend of calving interval, growing trend of daily milk yield and calf birth weight of the study indicated the profitability and good farm management along with the optimum milk production The study resulted a reduced lactation period which can be investigated by further study analyzing the factors like genetic line, breed, climatic zone, calving season, temperatures, etc. Our data was collected from a single farm, therefore, our results are localized to that farm only.

6. RECOMMENDATION

Crossbred cows provide a higher economy for the dairy farms though they require more care in rearing. The bloodline of the crossbreed needs to maintain properly instead of rapid breeding to obtain the expected amount of milk. The management system of the dairy farms needs to improve to get the highest level of milk yield.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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