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DIETARY DICALCIUM PHOSPHATE SUPPLEMENTATION ENHANCES PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF CROSSBRED AND LOCAL DAIRY COWS

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ABSTRACT

This study was carried out to investigate the productive and reproductive performances following oral supplementation of dicalcium phosphate (DCP) in different crossbred and local dairy cows. A total of 64 dairy cows of different genetics were selected for the study. All the cows were divided into four different groups and each group consists of 16 cows, namely Local (L), Local ×Holstein Friesian (L×HF), Local × Sindhi (L×S) and Local ×Sahiwal (L×SA). Each group of dairy cows were again subdivided into two subgroups like control and DCP supplement group. We assessed the productive performances such as milk production and lactation length, as well as reproductive performances such as service per conception, post-partum heat period and calving intervals among different breeds of cows as well as in the matching DCP supplement group. The productive performance among the different groups of cows i.e. L×HF, L×S, L×SA and Local cows were found significantly ($p<0.01$) different. Interestingly, DCP supplement group showed a significant increase of productive performances compared with the control group. Likewise, reproductive performance such as service per conception in different crossbred and Local cows also decreased significantly ($p<0.01$) with DCP supplement group than the control. Contrarily, the post-partum heat period and calving intervals in different crossbred and Local cows were slightly lower in the DCP supplemented group than control that did not differ significantly. Therefore, the study reveals that L×HF crossbred were found to be better performer followed by L×SA, L×S and Local cows, and DCP supplementation improve all the parameters studied irrespective of genetic variation.

Keywords: Dicalcium-phosphate, reproduction, dairy cows, reproductive performances.

Introduction

Dicalcium-phosphate (DCP) is a livestock dietary supplement used to combat calcium and/or phosphorous related deficiencies in all livestock. Granulated DCP with the correct ratio of phosphorus and calcium that ensures high biological potency making it more bioavailable for both beef and dairy cattle. Despite social and economic development, the burden of malnutrition across the globe remains unacceptably high and the contribution of dairy products are widely recognized to alleviate malnutrition and poverty of the society. A vital relationship exists between nutritional status, human capital and economic standing. Malnutrition adversely affects the physiological and mental capacity of individuals, which in turn hampers productivity levels, making them and their respective countries more susceptible to poverty (Islam *et at* 2017, Siddiqui 2020).

Bangladeshis depends on agro-based economy and in this respect livestock sector contributes 1.9% to the GDP (BBS 2021-22). Nearly 24.58 million heads of cattle are distributed throughout the country. About 85% of cattle are indigenous in origin and some types of them, like Red Chittagong, Pabna, North Bengal Grey and Munshiganj are far better producer than other in the existing low input management system (Hamid *et al.* 2017). The role of dairy cattle is very important for improving human nutrition as well as national income which nearly always been part of a mixed farming system in Bangladesh. The dairy firms are earning on an average 73% net return form average monthly revenue US$ 79 per cow (Datta *et al.* 2019). About 92% of dairy cattle are local and non-descriptive which are a vital component of the agricultural farming system of Bangladesh. Milk productions of these cows are much lower in comparison with improved breed

and scientist are trying to improve production of those indigenous cattle using different technology, for example crossing is one of them are mentioned above and another by supplementing diet.

There are about 24.70 million cattle in Bangladesh and the milking cow is about 3.74 million (FAO 2016). The average milk yield per cow is 1.7L for local and 5.08L for crossbred was studied (Islam et at 2017, Quddus 2017). The crossbred cows generally yield from 600 to 800 L per lactation of 210 to 240 days (Khair *et al.* 2013, Khan 2018). The annual milk yield is about 11.98 million metric tons (DLS 2020-21). To improve the reproductive and productive performances of dairy herd, good management system is an essential factor. The postpartum estrus in cows was reported to be shorter in free stall rather than those in tied stall housing (King *et al*. 1976). An adequate supply of clean water promotes normal rumen function, high feed intake, digestion, and nutrient absorption (Islam *et at.* 2008, Giri 2020). The loss of productivity was calculated as 1.62 kg per day per animal due to variation in temperature (Agarwal *et al*. 1987). It is reported that the crossbred cows are very much susceptible to mastitis due to their larger teats. A rigid system of hygienic measure is to be applied for the control of such type of disease (Roy *et al*. 1993). Reproductive and production disorders (PD) of cross-bred dairy cattle significantly reduce their productivity which is of great concern of dairy producers worldwide because most reproductive disorders adversely affect the future fertility (Khair *et al*. 2013) and crossbred cows have different disease patterns compared to their indigenous counterparts (Mollah *et al.* 1989). Therefore, system is to be developed to protect the animals from adverse conditions and for easy operation regarding feeding, management, vaccination, medication etc. The economic traits of cows are generally related with their reproductive capacity. It is desirable that a cow with full reproductive efficiency should have calved first at about two years of age then every 12-14 months interval to make the herd economic and profitable (Wiltbank 1970). The reproductive performance is determined on the basis of puberty age, early first calving, high milk yield and shorter calving interval. But these parameters are different in different crosses (Rahman *et al*. 1987).

The economic returns from dairy farmers depend on these traits. The low productivity of milking cow in the country is due to poor genetic characteristics, shortage of feeds, fodder and wide spread of diseases (Miazi *et al.* 2007). For better performances of indigenous and crossbred suitable breeds of different cows have to be developed in our country through selection, crossbreeding and upgrading together with improved management practices. Data for productive and reproductive performances of these crossbred cows are limited. Considering the above circumstances, the present research work has been undertaken with the objectives of figuring out the productive and reproductive parameters of Local and crossbred dairy cows in the Gazipur district. The study also evaluated the dietary DCP supplementation to enhance productive and reproductive performances of different crossbred and local cows.

Materials and Methods

The study area was selected from regularly guided farm by veterinarian of upazila livestock hospital in Gazipur district namely: Gazipur Sadar, Kaliakair, Kaligonj, Shreepur, Kapasia, and Tongi which are particularly suitable for fulfilling the objectives set for the study. The main consideration in selecting the areas for the study due to lack of similar type of study was not conducted previously in this area. Besides a large number of crossbred and indigenous dairy cows were raised in this area and co-operation from the respondents were expected to be high, so that the reliable data would be obtained. The survey schedule was prepared to obtain the desired information from the dairy owners. The survey schedule contained the following major items of information: Firstly, owner's information, owner's educational status, cattle information, housing, feeding and breeding system etc. Secondly, the productive and reproductive parameters of crossbred and local dairy cows. Thirdly, the owner was asked to supply DCP as oral supplement to their cows accordingly the suggestion given at 1 table spoon for 7 kg of feed.

The experimental dairy cows were divided into 4 genetic groups according to their genetic merit as local (L; n=16), Local ×Holstein Friesian (L×HF; n=16), Local × Sindhi (L×S; n=16) and Local ×Sahiwal (L×SA; n=16). These four genetic groups of cows were further subdivided into two subgroups, one was no supplement control and another, DCP supplemented group. Data were collected

during July, 2012 to August, 2013 through direct interviews and personal visits to the house of selected farmers. The productive and reproductive performances of 64 cows of local (n=16) and crossbred (n=48) were collected from farm records. The following parameters were studied to determine economic traits of different genetic groups in this study. These were services per conception (number), post-partum estrus (days), daily milk yield (liter), and lactation length (days), lactation yield (liter), and calving interval (days).

Service per conception was determined as the average number of services or insemination required for each successful conception. It is a major indicator of the fertility and also the reproductive efficiency of cows. The onset of post-partum estrus was calculated from interval between the date of calving and the date of first detected estrus after calving and was calculated in terms of days.

Milk yield means total amount of milk produced per day. Milk yield is the most important productive and economic traits and used as an important criterion to choose a dairy cow. Daily milk yield = Sum of the amount of milk obtained in the morning and in the afternoon per cow.

The total quantity of milk given throughout the lactation period is defined lactation yield. Lactation length was calculated from the date of starting of milking after calving up to the beginning of dry period which is measured in days. Calving interval is defined as the interval between two successive calving. The dates of first calving to the date of second calving accomplish the first calving interval. Similarly, the dates of second calving to the date of third calving accomplish the second calving interval and so on.

Statistical analysis: Data were analyzed using analysis of varience (ANOVA).

Results and Discussion

The productive performances of the dairy cows were measured by observing their yield of milk, length of lactation period, milk yield per lactation, and reproductive performances were measured by service per conception, post-partum period and calving interval.

The average milk production of different crossbred and local cows was presented in Figure 1. It was found that the average milk yield of L×HF, L×SA, L×S and local cows were 9.8±2.9, 6.1±2.8, 4.3±1.1 and 2.4±0.7 liter/day, respectively and was found significantly difference ($p<0.05$) among the groups. The highest production was found in the L×HF crossbred dairy cows. Further, the sub-group of matching breeds mentioned above supplied with oral DCP and average milk production was recorded for L×HF, L×SA, L×S and local breeds were 10.9±2.7, 7.3±2.4, 6.15±1.2 and 3.5±1.0 liter/day, respectively. There was significant difference ($p<0.01$) in milk yield compared with the no supplement control group of different genetic breeds. DCP supplementation shows a significantly higher production trend irrespective of the genetic variation. This is probably due to the re-establishment of calcium and phosphorus balance which are drained through the milk. It reveals that L×HF crossbred produces higher quantities of milk than indigenous or local cows, that might be due to the high genetic potentials. A study by Islam *et al. (*2008), reported that the average production of milk per day from crossbred and indigenous dairy cows were 6.7 and 1.6 liters, respectively, and similar findings by Mamun *et al.* (2015) found that the average milk yield per day of Holstein Frisian and Indigenous cows were 7.6±1.7

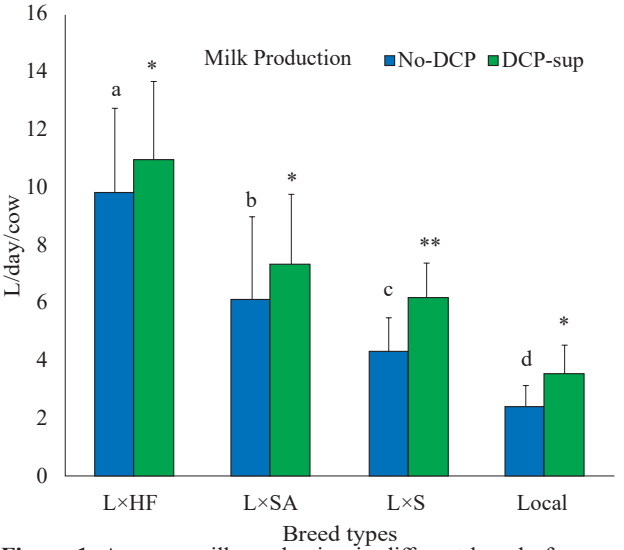


Figure 1. Average milk production in different breed of cows. Each study group contain 8 milking cows. L; Liter, L×HF; Local ×Holstein Friesian, L×SA; Local ×Sahiwal, L×S; Local × Sindhi, ^{abcd} data having similar superscript did not differ significantly ($p<0.05$) among genetic group and the t-test between treated and non-treated groups ** indicates 1% level of significance * indicates 5% level of significance.

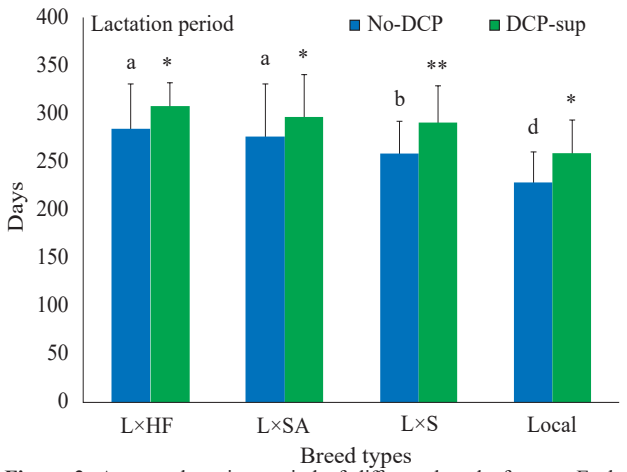


Figure 2. Average lactation period of different breed of cows. Each study group contain 8 milking cows. L×HF; Local ×Holstein Friesian, L×SA; Local ×Sahiwal, L×S; Local × Sindhi, ^{abcd} data having similar superscript did not differ significantly ($p<0.05$) among genetic group and the t-test between treated and non-treated groups ** indicates 1% level of significance * indicates 5% level of significance.

and 1.7±0 liters/day, respectively. The slight variation between the two studies might be due to the use of diet and technological variation. The average milk production of different crossbred and local dairy cows is shown in Table 1. The table shows that maximum milk production was found in L×HF cross and gradually lower milk production was recorded in L×SA cross, L×S cross and local cows.

The lactation length of L×HF cross, L×SA cross, L×S cross and Local cows were 284.6±46.7, 277.1±55.0, 258.8±34.3 and 228.8±31.9 days, respectively and in matching DCP supplemented group were 308.9±24.7, 297.1±45.0, 291.8±38.3 and 258.8±35.9 days, respectively, which were significantly ($p<0.01$) higher for all genetic group than their respective control group (Figure 2). The lactation period of present study is partially in agreement with the result of Islam *et al.* (2008), who observed that the average lactation period for local and crossbred dairy cows was about 228 and 259 days, respectively.

The average service per conception of different crossbred and local dairy cows are presented in Table 1. It was observed that service per conception of different crossbreds i.e. L×HF, L×SA, L×S and Local cows were 2.3±0.0, 2.2±0.7, 1.9±0.6 and 3.2±0.7, respectively, but in the DCP supplement group number of service decreases in all groups and found the average services of 1.6±.0, 1.3±0.7, 1.4±0.5 and 1.9±0.8, respectively. Statistical analysis showed that there were significant differences ($p<0.01$) within the service per conception of different genetic groups of cows. A previous study by Sultan (1995) showed data on service per conception of local (L), Sahiwal (SL), Sahiwal×Friesian(F1), Jersey (J), Local×Jersey (F1) and Local×Friesian were 1.7±0.2, 1.1±0.7, 2.05±0.0, 2.01±0.3, 1.396±0.0 and 1.68±0.1, respectively. Mondal (2010) and Asfaw *et al.* (2001) found that the service per conception were 1.6±0, 1.6±0.6, 1.6±0.6, 1.60±0.5 and 1.67±0.6 for Jersey cross, Sahiwal cross, Sindhi cross, Holstein cross and Chittagong cross cows, respectively in commercial dairy farm. All those findings prove that due to genetic variation the service per conception differ among the trait and our study further suggest that oral DCP supplement improve the conception rate and reduce service per conception regardless of genetic variation.

The average days of post-partum heat period of different crossbred and Local dairy cows are presented in Table 1. The average post-partum heat period of L×HF cross, L×SA cross, L×S cross and Local cows were 89.4±28.6, 105.6±41.0, 127.0±43.4 and 119.4±52.1 days, respectively and found significantly different ($p<0.01$) among the genetic groups. Again, post-partum heat period in the DCP supplemented group were 78.4±18.7, 92.2±45.1, 97.3±44.2 and 110.1±42.1 days, respectively, which were significantly different ($p<0.01$) in compared with the respective control. Previously, Ali (2000) conducted an experiment post-partum heat period in crossbred and local cows and found 109.5±26.8 and 103.8±18.5 days, respectively. The result of present experiment also agrees nearly with the findings of Azizunnesa *et al.* (2010) and Miazi *et al.* (2007).

The average days of calving interval of different crossbred and Local dairy cows are presented in Table 1. It was observed that calving intervals of L×HF cross, L×SA cross, L×S cross and Local cows were 391.9±33.8, 398.2±42.7, 422.0±42.0 and 422.6±64.1 days, respectively and 364.5±23.5, 378.2±35.7, 402.0±38.1 and 412.6±44.2 days respectively in the DCP supplemented group. Statistical analysis showed that there were significant differences

Table 1. Reproductive performances of different crossbred and local dairy cows (mean±SD)

Parameters		Local ×Holstein Friesian (L×HF) cows	Local× Sahiwal (L×SA) cows	Local × Sindhi (L×S) cows	Local (L) cows
Service per conception (number)	Control	2.3^{b}±0.0	2.27^{d}±0.7	1.98^{c}±0.6	3.2^{a}±0.7
	DCP supplement group	1.6±0.7**	1.3±0.7**	1.4±0.5*	1.9±0.8***
Post-partum period (days)	Control	89.4^{c}±28.6	105.6^{b}±41.0	127.0^{a}±43.4	119.4^{a}±52.1
	DCP supplement group	78.4±18.7	92.2±45.1	97.3±44.2*	110.1±42.1
Calving interval (days)	Control	391.9^{b}±33.8	398.2^{b}±42.7	422.0^{a}±42.0	422.6^{a}±64.1
	DCP supplement group	364.5±23.5*	378.2±35.7	402.0±38.1*	412.6±44.2

^{abcd} data having similar superscript did not differ significantly ($p<0.05$). **= 1% level of significance

($p<0.01$) within the calving interval of different types of dairy cows. Calving intervals are found shorter in the DCP supplement dairy cows. Halim (1992) worked on local and crossbred dairy cows and reported that average calving was 445 and 425 days, respectively and these values were slightly higher than the present study. Previous studies also found a similar result by Asfaw et al. (2001) and conclude with significant differences ($p<0.01$) in the calving interval of different genetic types of dairy cows.

Conclusion

The study concluded that Holstein Friesian crossbred were better performer both in the productive and reproductive performances and, then Sahiwal cross, Sindhi cross cows. The local cows were the poor performers. The oral dietary DCP supplementation increases productive performances as average milk production and lactation period increases, irrespective of genetic variation. Likewise, oral dietary DCP supplementation increases the reproductive performances by reducing the service per conception, post-partum heat period and calving intervals and improve the fertility rate of crossbred and local dairy cows.

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