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Effects of breed, management system, milk yield and body weight on onset of postpartum ovarian cyclicity in cows

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Abstract

To determine the factors affecting onset of postpartum ovarian cyclicity (PPOC) milk progesterone concentrations were measured in 84 cows. About 30% showed cyclicity within 120 days of parturition. Intensively managed cows started cyclicity earlier (P>0.05) than extensively managed animals. Holstein-Friesian crossbred cows started ovarian cyclicity earlier (80.2 ± 17.5 days) with higher proportion (37.9%) than local zebu cows (84.8 ± 21.0 days) and about 13.3%, respectively (P>0.05). The cows yielding 4-12 kg milk/day required 73.5 ± 10.0 days to start ovarian function earlier than those producing 1-2 kg/day (84.8 ± 21.0 days) (P>0.05). Cows with lower (<200 kg) and higher (>300 kg) body weights started ovarian activity by 81.6 ± 16.6 and 76.3 ± 17.4 days, respectively (P>0.05). Cows with lower body weight showed PPOC at lower rate (5.2%) than those of medium (38.3%) and higher body weight (33.3%) (P<0.05). The delayed onset of PPOC prolonged the calving interval. (*Bangl. vet*. 2015. Vol. 32, No. 1, 27 – 34)

Introduction

To achieve satisfactory economic benefit from the dairy industry, intercalving interval should not exceed 365 days (Haresign *et al.,* 1983; Opsomer *et al.*, 1996). Decrease in fertility is a major cause of economic loss with higher culling rate (Khatib *et al.*, 2009). Prolonged interval (>85 days) between calving and onset of ovarian function is regarded as one of the most important reproductive problems (Coleman *et al.,* 1985). Prolonged suppression due to negative feedback of progesterone secreted by the corpus luteum and the placenta during pregnancy causes the pituitary to be refractory at very early postpartum period (within 10-12 days) as indicated by lack of response to exogenous gonadotrophin-releasing hormone (Alam and Dobson, 1986). As a result of absence or very low output (<1.0 ng/mL) of gonadotrophin, the ovary is relatively quiescent and the cow remains anoestrous. Dietary energy supplementation hastens the onset of postpartum ovarian function (Lalman *et al.,* 1997). Among various factors, management, nutrition, suckling, and body weight are the most important determinants of the initiation of cyclicity (Fitzpatrick, 1994). The present study was designed to investigate factors that may affect the onset of postpartum ovarian cyclicity in dairy cows.

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Materials and Methods

Experimental animals and their management

Eighty-four lactating cows were selected at random: 30 were local zebu, 37 were crosses of Holstein-Friesian and 17 were crosses of Sahiwal or Sindhi with local zebus. Average milk yield was 3.8 ± 2.4 kg/day, and estimated mean body weight at calving was 262.6 ± 68.9 kg. The body weight of the cows was estimated immediately after calving and every 10 days up to 120 days postpartum using a standardized tape from the Swedish Association for Livestock Breeding and Production, Eskilstuna, Sweden (Comb MAAl). The body condition of cows was scored (1-5 scale) following modification of the method of Nicholson and Butterworth (1986). All cows calved normally and had no history of periparturient diseases. The cows were apparently healthy and free from detectable abnormalities of the genital tract. Routine treatment against liver fluke and round worms was practised and the cows were vaccinated routinely against haemorrhagic septicaemia, anthrax, blackquarter and foot and mouth diseases. Twenty seven cows belonged to a commercial dairy farm where intensive management was practised, and the remaining 57 belonged to smallholders where the cows were managed extensively. In intensively managed farms, the cows were supplied with stall feed approximately 5 kg straw, 10 – 15 kg green grass and 3 – 5 kg concentrates per cow per day in two meals. In extensively managed smallholdings most cows were tethered and grazing for approximately eight hours daily. In addition to that in most farms, 5 kg straw was supplied to each cow daily. In both management systems, all cows had free access to drinking water. All cows were milked by hand with their calves present. In commercial dairy farms, the cows were milked twice daily at an interval of 8 hours and in smallholdings, most cows were milked once daily. In commercial dairy farms, milk yield was determined by interviewing the farmer or from the farm register.

Progesterone radioimmunoassay (RIA)

Skim milk was used for analysis of progesterone concentrations. Milk samples (10 mL) were collected from each cow into tubes containing an 8mg sodium azide tablet (MERCK, Germany) at 10 day intervals starting at parturition until the animals showed signs of standing oestrus. The milk samples were centrifuged at room temperature for 15 minutes at 1000g to remove fat before the skimmed milk was assayed for progesterone. The solid-phase-radioimmunoassay technique was used as described by the Joint FAO/IAEA Division, Vienna, Austria using ^{125}I-labelled progesterone as the tracer (Shamsuddin *et al.*, 2006). Progesterone profiles of >3.0 nmol/L were considered to be of luteal origin. The intra and inter-assay coefficients of variation were 6.3% (n = 13) and 9.0 (n = 3), respectively. The percentage binding at zero level was 31.0 ± 2.3, and the assay sensitivity was 0.6 nmol/L.

Statistical analysis

All the recorded and calculated data were analysed using the SPSS statistical computer package for the analysis of variance. Results are given as means ± standard error of mean. The data were analysed using the Student's *t*-test. The ANOVA was performed to compare data among selective groups.

Results and Discussion

Among 84 cows only 25 (29.7%) started cycling (detected by measuring milk progesterone) within 120 days of parturition (Table 1). In this study, cyclic cows showed progesterone peak(s) before showing behavioural oestrus. This is an agreement with Claycomb *et al.* (1996). No cyclic cows showed a continuous low level of progesterone. Holstein-Friesian crossbred cows started postpartum ovarian cyclicity soonest (80.2 ± 17.5 days; n = 14) and local zebu cows started last (84.8 ± 21.0 days; n = 4). However, the difference between breeds was not significant (P>0.05). More Holstein–Friesian crossbred cows started ovarian cyclicity (37.9%; n = 37) than, local zebu cows (13.3%; n = 30), but the difference was not significant (P>0.05). The milk yield, body condition score and body weight at calving were higher (5.4 ± 2.5 kg/day, 2.8 ± 0.4 and 307.5 ± 65.5 kg, respectively) in Holstein-Friesian crossbred cows than in local zebu cows (2.0 ± 0.7 kg/day, 2.0 ± 0.4 and 206.7 ± 38.0 kg, respectively). Holstein-Friesian crossbred cows had higher BCS (2.8 ± 0.4) and body weight (307.5 ± 65.5 kg) than other crossbreds (Sahiwal or Sindhi crossbred; BCS 2.5 ± 0.6; body wt. 251.7 ± 45.4 kg) and local zebu cows (BCS 2.0 ± 0.4; body wt. 206.7 ± 38.0 kg). The poorer performance of local zebu cows could be due to genetic differences (Darwash *et al.,* 1996). Postpartum ovarian cyclicity and uterine involution take longer in some heavier breeds then in smaller dairy breeds (Sloos and Dutty, 1980). Fonseca *et al.* (1983) reported that high-producing Jersey cows ovulated earlier than Holstein-Friesian crosses. Shamsuddin *et al*. (1997) found that Sahiwal and their crosses showed lower fertility than Holstein-Friesian and their crosses with local zebu cows. Contrarily, Pereira *et al.* (1995) found no relationship between early postpartum ovarian cyclicity and breed. This may be due to better adaptation of local cows to the environment.

Table 2 shows that the cows reared under extensive management began postpartum ovarian cyclicity later (88.1 ± 20.0 days; n = 14) than those intensively managed (73.5 ± 10.0 days; n = 11), but the difference was not significant (P>0.05). Fewer extensively managed cows showed postpartum ovarian cyclicity (24.6%; n = 57) than those managed intensively (40.8%; n = 27) but the difference was not significant (P>0.05). The milk yield, body condition score at calving and body weight at calving were higher (6.3 ± 2.4 kg/day, 2.9 ± 0.4 and 319.4 ± 63.0 kg, respectively) in intensively managed cows than those extensively managed (2.6 ± 1.0 kg, 2.2 ± 0.6 and 232.2 ± 51.4 kg, respectively). Intensively managed cows with adequate diet and proper health care, can produce optimum reproductive performance (Laben *et al*., 1982). On the contrary, Peters (1984) stated that in spite of good management some cows show inferior reproductive performance. This may be due to variation to adaptation to the environment. Reasonable energy balance is necessary at calving of first lactating cows; otherwise ovulation was delayed, impairing subsequent reproductive performance (Samarütel *et al.,* 2006). Poor management might influence the hypothalamo-pituitary ovarian system and thereby delay postpartum cyclicity (Morrow *et al*., 1989).

Fitzpatrick (1994) found that cows managed semi-intensively showed longer postpartum period than cows in free range systems. The cows managed intensively started cyclicity earlier, when provided with proper veterinary care, routine anthelmintic treatment and feed supplementation. Controlled temperature and humidity influenced the resumption of cyclicity. Extensively managed cows did not have feed supplementation.

The effects of milk yield on onset of postpartum cyclicity are presented in Table 3. Cows with higher milk yield (4-12 kg/day) started postpartum cyclicity earlier (73.5 ± 10.0 days; n = 11) than those with lower yield (1-2 kg/day) (84.8 ± 21.0 day; n = 4) or medium yield (2-4 kg/day) (89.4 ± 20.6 days; n = 10) but the differences were not significant (P>0.05). More crossbred cows with higher milk yield began postpartum ovarian cyclicity (40.3%; n = 26) earlier than low-yielding cows (16.7%; n = 24) but the difference was not significant (P>0.05). Highest body condition score and body weight at calving (3.1 ± 0.3 and 322.3 ± 56.1 kg, respectively) were recorded in high-yielding cows and lowest (1.8 ± 0.4 and 196.9 ± 26.4 kg, respectively) in low-yielding cows. There is a negative correlation between high milk yield and subsequent reproductive performance (Darwash *et al.,* 1996). Long acyclic period with ovarian dysfunction was observed in high-yielding cows, similar to the results of Kumar *et al.* (2009). Cows with ovarian cysts and/or increased peak milk production had significantly longer calving-to-first oestrus and calving-to-conception intervals as well as lower conception rates than average producing cows without cysts (Kinsel and Etherington, 1998). Differences in plasma concentrations of LH, progesterone and prostaglandin $F_{2\alpha}$ were reported by Eley *et al.* (1981). However, Fonseca *et al.* (1983) and Darwash *et al.* (1996) observed that high-producing cows with positive energy balance ovulated earlier than lower-producing herd mates. On the contrary, high milk production may result in delayed postpartum cyclicity (Kluezek and Traczykaski, 1987). Short dry periods resulted in fewer days open in the subsequent lactation; however, this was entirely due to the lower milk yield associated with shortened dry periods (Kuhn *et al.,* 2007). No significant differences between high and low yielding cows were observed by Harrison *et al. (*1990). Cows producing less milk were mostly local and managed extensively and were being used for many purposes.

Cows (n = 59) with lower body weight (252 – 200 kg) at calving started postpartum ovarian cyclicity at a mean of 115 days (Table-4). On the contrary, cows (n = 6) with higher body weight (301 – 455 kg) at calving started postpartum ovarian cyclicity 76.3 ± 17.4 days after calving (Table 4). These cows started their ovarian cyclicity between 60 and 115 days postpartum. Eighteen cows weighing 201-300 kg at calving started their postpartum cyclicity earlier 81.6 ± 16.6 days than the cow with body weight 301-455 kg, and 59 with the body weight 115 – 200 kg. The daily milk yield and body condition score at calving were highest (6.0 ± 2.4 kg and 3.0 ± 0.4, respectively) in cows of high body weight at calving but lower (2.0 ± 0.9 kg and 1.8 ± 0.5, respectively) in cows with low body weight at calving. Energy balance and body weight play an important role in determining the postpartum interval to 1st ovulation and subsequent fertility (Britt, 1995). Doren *et al.* (1986) demonstrated a weight change of the cow from conception until parturition was more closely associated with days postpartum to conception than birth weight. Richards *et al.* (1986) and Roche *et al.* (2007) reported negative impact of poor BCS on return to oestrus. Dietary restriction during late pregnancy results in weight loss and decrease in body fat reserve, and delays return to oestrus postpartum (Dziuk and Bellows, 1983), but Richards *et al.* (1986) stated that both pre and postpartum dietary restriction of feed supplementation causes weight loss and decreased body fat at calving, which ultimately reduces the reproductive efficiency of cows. Cows which, had gained body weight following calving began their ovarian cyclicity earlier (Pleasants and Barton, 1992). Weight gain within 60 days of normal parturition resulted in earlier onset of oestrus. Cows that lose body weight after parturition have impaired reproductive performance, and this could be due to genetics, diseases and undernourished condition (Spitzer *et al.,* 1995). Pérez-Hernández *et al.* (2002) stated that delaying suckling for 8 hours after milking increases the proportion of cows ovulating within 100 days of calving, shortened the calving to first ovulation interval and improved calf performance without adversely affecting cow's milk yield or body weight change.

Table 1: Effects of breed on onset of postpartum ovarian cyclicity in cows

Breeds	Onset of ovarian cyclicity (days)	% onset of ovarian cyclicity	Milk yield per day	Body condition score at calving	Body weight at calving
Local zebu	84.8 ± 21.0 (n = 4)	13.3 (n = 30)	2.0 ± 0.7 (n = 30)	2.0 ± 0.4 (n = 30)	206.7 ± 38.0 (n = 30)
Holstein-Friesian x local zebu	80.2 ± 17.5 (n = 14)	37.9 (n = 37)	5.4 ± 2.5 (n = 37)	2.8 ± 0.4 (n = 37)	307.5 ± 65.5 (n = 37)
Sahiwal/ Sindhi x local zebu	82.9 ± 18.8 (n = 7)	18.8 (n = 17)	3.6 ±1.6 (n = 17)	2.5 ± 0.6 (n = 17)	251.7 ± 45.4 (n = 17)

The difference in the rate of onset of cyclicity between breeds was not significant (P>0.05)

Table 2: Effects of management on the onset of postpartum ovarian cyclicity in cows

Management	Onset of ovarian cyclicity (days)	% onset of ovarian cyclicity	Milk yield per day	Body condition score at calving	Body wt. at calving (kg)
Extensive	88.1 ± 20 (n = 14)	24.6 (n = 57)	2.6 ± 1.0 (n = 57)	2.2 ± 0.6 (n = 57)	232.2 ± 51.4 (n = 57)
Intensive	73.5 ± 10 (n = 11)	40.8 (n = 27)	6.3 ± 2.4 (n = 27)	2.9 ± 0.4 (n = 27)	319.4 ± 3.0 (n = 27)

Cows managed intensively were heavier (201-300 kg), produced more milk and showed postpartum ovarian cyclicity earlier. The Holstein-Friesian crossbred cycled earlier and at high rate. Holstein-Friesian crossbred cows can be introduced in an intensive farming system with proper management and health care, otherwise it would be very difficult to achieve a calving interval of 365 days.

Table 3: Effects of milk yield on onset of postpartum ovarian cyclicity in cows

Milk yield (kg)	Onset of ovarian cyclicity (days)	% onset of ovarian cyclicity	Milk yield per day	Body weight at calving
1-2	84.8 ± 21.0 (n = 4)	16.7 (n = 24)	1.8 ± 0.4 (n = 24)	196.9 ± 26.4 (n = 24)
3-4	89.4 ± 20.6 (n = 10)	29.4 (n = 34)	2.4 ± 0.4 (n = 34)	257 ± 54.7 (n = 34)
5-12	73.5 ± 10.0 (n = 11)	40.3 (n = 26)	3.1 ± 0.3 (n = 26)	322.0 ± 56.1 (n = 26)

Table 4: Effects of body weight at calving on onset of postpartum ovarian cyclicity in cows

Body wt. at calving (kg)	Onset of ovarian cyclicity (days)	% onset of ovarian cyclicity	Milk yield (kg/day)	Body condition score at calving
152-200	115.0^{b} (n = 59)	5.2^{a} (n = 19)	2.1 ± 0.9 (n = 19)	1.8 ± 0.5 (n = 19)
201-300	81.6 ± 16.6^{ab} (n = 18)	38.3^{b} (n = 47)	3.7 ± 2.1 (n = 47)	2.5 ± 0.5 (n = 47)
301-455	76.3 ± 17.4^{ab} (n = 6)	33.3^{ab} (n = 18)	6.0 ± 2.4 (n = 18)	3.0 ± 0.4 (n = 18)

n = number of animals; a, b values with different superscripts differ significantly from each other ($P<0.05$)

Body weight at calving is an important determinant for the onset of postpartum ovarian cyclicity. In this study, cows started their ovarian cyclicity within four months of parturition where intensively management systems were practised. On the other hand, cows producing less milk were mostly local and managed extensively and being used for many purposes, had poor postpartum reproductive performance.

Conclusions

Based on the range of performances, the factors with the greatest potential influence on the initiation of ovarian activity after calving were good body condition at calving. It is suggested that Holstein-Friesian crosses is the best choice of animals to improve milk production in a near-tropical environment like Bangladesh. They hate the heat, their reproduction is awful and their maintenance costs are disproportionally high to the amount of milk that they can produce from forages (Rendel and Hickman, 1978).

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