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Post milking behaviours and influence of different factors on post milking behaviours in jersey crossbred cows under tropical conditions

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Abstract

Post milking behaviour of dairy cows has grave influences on their production efficacy as intra-mammary infection (IMI) is related to post milking standing period. A number of genetic and environmental features controls and affect post milking behaviour of dairy cow. The aim of present study was to investigate post milking behaviours and the influence of different factors like parity, stage of lactation, time of milking and seasons on post milking behavioural features, the experiment was conducted on 94 Jersey crossbred cows during total days of lactation in their respective sheds post milking operations. Impact of parity revealed that primiparous cows are having significantly ($P<0.01$) better post milking standing period (PMSP) as compared to multiparous cows. Seasons shows significant ($P<0.01$) influence upon PMSP and it is least in rainy seasons because during rainy weather there is high temperature-humidity index which is more stressful for dairy animals in tropical conditions. Cows during evening milking time showed significant ($P<0.01$) improved PMSP as compared to morning milking time because during evening there is availability of fresh green fodder in the feeding trough just after milking process. It can be concluded from the obtained investigation from this study that seasons, parity, stages of lactation and time of milking significantly showed influence on post milking behaviours and post milking standing period of Jersey crossbred cows in tropical conditions.

Keywords: Tropical condition, Jersey crossbred cow, post milking standing period, intra-mammary infection

Introduction

Large ruminants play an important role in livelihood and economic sustenance of poor section of society for centuries. Maintenance of optimum milk production with better health status is a challenge for dairy farmers at tropical lower Gangetic region. High-producing Jersey crossbred cows of this region are susceptible to severe climatic change in this region which may hamper their milking behaviour, milk quantity and quality of those cows. In India, across high-production cows, crossbred cattle contribute around 28% of total milk production of our country, and nearly 55% of total milk produced by cattle. Contribution of livestock sector to national economy in term of GDP at current prices is 4.1% (DAHD, GOI, 2019) ^[1]. Jersey crossbred contributes major portion in milk production from crossbred cows, nearly (57.77%) in India (Vijayakumar *et al.* 2019) ^[19] and they are main crossbred cow species at tropical parts of the land. The normal productivity of crossbred cows is 7.61 kg/day, which is 2.04-fold more than indigenous breeds and 3.16-fold higher than that of non-descript Indian cows (DAHD, GOI, 2019).

Post milking behaviour of dairy cows has grave influences on their production efficacy as intra-mammary infection (IMI) is related to post milking standing period and that induce great economic loss to farmers due to decline in milk production owed to IMI. There are many factors that influence intra-mammary infection (IMI) at individual as well as herd level. Health of udder is also influenced by lying behaviour and consequently effect cow welfare, milk production and milk quality. A long-accepted mastitis management practice of having at least 30 minutes voluntary standing period of cows after milking assumed to reduce the risk of intra-mammary infection and mastitis. Keeping cows on their feet for a certain period of time after milking (at least 30 min) will increase the chances that the teat canals have closed prior to the udder gets contacted with the stall surface when the cows lie down, thus, decreasing the odds of bacterial penetration of the teat. Encouraging cows to remain standing after milking has been a long-accepted practice surmised to decrease the incidence of intra mammary infection (IMI) in lactating dairy cows.

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This practice is done to increase the chances that the teat canals will have closed prior to the udder contacting the surface substrate of shed when the cow lies down as a result decreasing the chances of bacterial penetration of the teat and by association results in a decreased risk of IMI (Tyler *et al* .1997; Johansson *et al* .1999) [18, 7]. Thus, for better understanding of post-milking standing time, it is needed to study, possible factors that may affect post-milking standing duration also.

Although, there are very limited studies has been done regarding the relation of post-milking standing period with intra-mammary infection or somatic cell count, the existence of an association between post-milking standing time and udder health in terms of SCC and infection rates, has long been hypothesized. Keeping in view the above background, present study was planned to examine the post-milking behaviours and effect of factors (parity, stage of lactation, time of milking and seasons) on post-milking behavioural features in their respective sheds after they came back from milking byre post milking operations in Jersey crossbred cows.

Materials and Methods

Location of the study

The present study was carried out on ninety-four (94) Jersey crossbred cows belonging to 1st to 8th lactations and maintained at organized dairy farm at ICAR-National Dairy Research Institute, Eastern Regional Station, Kalyani, West Bengal. The altitude of the city is 9.75 meter above mean sea level, latitude and longitude position being 22°58'30"N and 88°26'04"E, respectively. The climate of Kalyani is warm and tropical; the extreme ambient temperature in summer goes up to 39°C and minimum temperature in winter falls down to about 8°C. The usual annual rainfall is around 1000-2000 mm, maximum of which is received primarily from early June to September. The observations were collected in groups of stock both morning and evening period after milking operations complete and cows returns to their respective shed and entire lactating herd i.e., 94 animals of the farm (cattle yard) were covered within one week and repetitively done for 9 months period.

Management of Cows During the Experimental Period

All investigational animals were kept under loose housing system. All the feeding management practices and the feed ingredients were similar for the entire lactating herd. Concentrate mixture, seasonal green fodder (ad libitum) and straw were provided to complete the nutrient necessity of all the lactating animals. The quantity of concentrate was considered for every animal as per their body weight and milk production level. Concentrate was accessible @1.5 kg/day as the maintenance regime between 8 to 8.30 A.M. and rest of the quantity was provided during milking. Clean and healthy water stream was provided throughout the entire day.

Recording of parameters

Post-milking behaviour was observed at the respective shed after milking operations is done at milking byre of cattle yard, organized farm at ERS (Eastern regional station)- NDRI by machine milking, two times in a day i.e., during morning from 6.00 to 8.00 AM and evening from 2.30 to 4.30 PM. The post-milking behavioural features of cows were noted down after they came back from milking byre from outside of the boundary wall of the respective shed without disturbing them.

All the behavioural parameters were observed at weekly period of intervals by a single observer during the study period to evade personal error discrepancy.

Post Milking Behaviours

Post-milking behavioural studies was done with the help of camera recordings and manual methods.

Post milking standing period after milking

It was evaluated by time interval between the milking and 1stobserved lying down on the floor after returning to their respective sheds. Activities of Post milking behaviour was studied for 60 minutes just after the milking operations were completed. It was recorded weekly intervals.

Post milking feeding behaviour

Animal's frequency and duration of visiting feeding troughs for eating feeds and frequency of visiting water troughs, respectively during those 60 minutes periods after milking. It was recorded on weekly basis.

Post milking lying time and duration

Post milking lying is the duration (minutes) for which animals are lied down on the floor during the 60 minutes time interval after milking whereas post milking duration for lying is after how much time (minutes) animals showed the lying down behaviour during those 60 minutes post milking time interval.

Statistical Analysis

The effect of parity, seasons, stage of lactation and time of milking on post milking behaviours and milk yield were analyzed. The duration of study was 9 months (September to May). The study period was divided into 3 season's viz. rainy (September-October), winter (November-February) and summer (March-May). The data were analysed using SPSS software (SPSS Inc, 2007) [17]. The statistical methods used to analyse each parameter was General Linear Model. The significant difference levels were set at 1% ($P<0.01$).

Results

Overall post-milking behavioural features of Jersey crossbred cows

Post-milking behaviours were studied for 60 minutes after the milking operation was completed. After milking, it took about 30 minutes to close the teat sphincter and thus as per standard mastitis management practices animals should remain standing at least for 30 minutes after milking to decrease the incidence of intra mammary infection (IMI) in lactating dairy cows. This practice is done to increase the chances that the teat canals will have closed prior to the udder contacting the surface substrate of shed when the cow lies down as a result decreasing the chances of bacterial penetration of the teat and by association results in a decreased risk of IMI. The main aim of this study was to record the voluntary standing time after the milking operation and to find out the factors influenced the post milking behavioural features in Jersey crossbred cows. On overall basis (Fig. 1) in 96% of observations cows did not show lying down behaviour within 60 minutes post milking. About 0.42% observation showed lying down behaviour within 0-5 minutes after return to shed, 1.30% within 5-30 minutes, 2.06% within 30-60 minutes, thus about 4% observations (Fig. 1) showed lying down within 60 minutes. Thus, cows lying down within 60 minutes were considered for calculation of intervals between milking and 1st

observed lying down after milking. Statistically analysed data revealed that overall mean \pm SE value of interval between milking and 1st lying down (Post milking standing duration)

was 31.72 ± 1.30 minutes and overall mean \pm SE duration of 1st lying down was 23.21 ± 0.97 minutes.

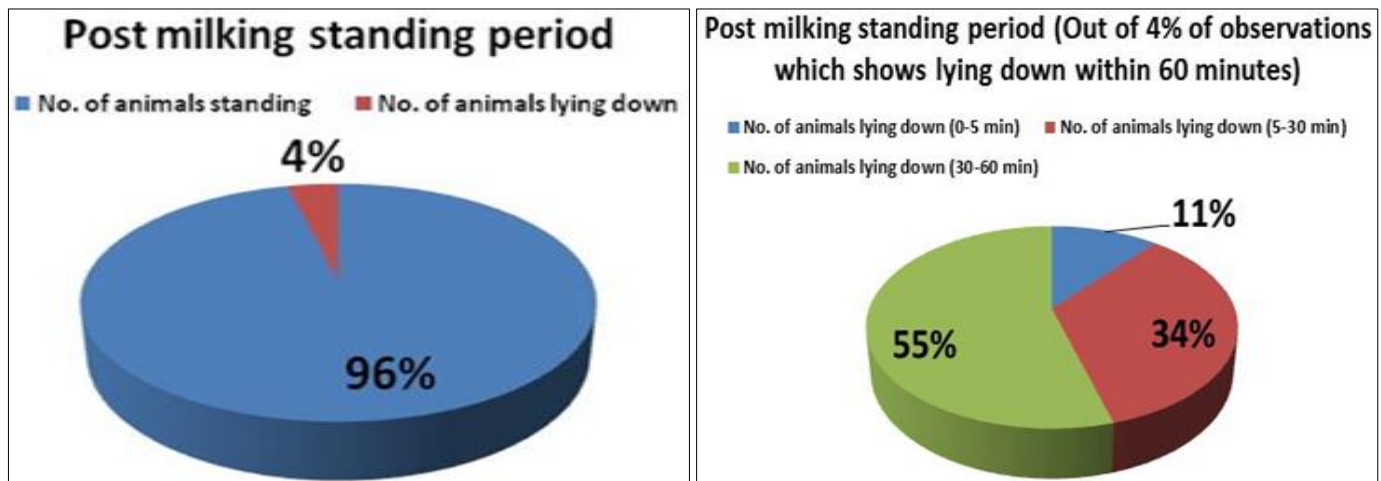


Fig 1: Pie-chart of animals showing lying down behaviours post 60 minutes of milking

Factors affecting post-milking behavioural features (60 minutes post-milking) of Jersey crossbred cows

Post-milking behaviours of Jersey crossbred cows was analysed to see how these traits were influenced by the factors such as parity, stage of lactation, season, and time of milking.

Post-milking behavioural parameters of primiparous vs. multiparous

All the animals under study were grouped into primiparous and multiparous and data analysis was done to see the effect of parity on post-milking behavioural features (60 minutes post-milking). Mean \pm SEM value of post-milking behavioural

parameters (Table 1) revealed that, there was no significant difference between multiparous and primiparous animals regarding their post-milking behavioural features but total time for eating fodder was more in multiparous as compared to primiparous animals (23.72 ± 0.37 vs. 22.78 ± 0.60), while data analysis revealed that primiparous animals had more voluntary standing period after milking as compared to multiparous animals (51.50 ± 3.74 vs. 34.25 ± 2.19) that differed significantly ($P < 0.01$). As expected, milk yield was significantly ($P < 0.01$) higher in multiparous animals (8.90 ± 0.09) than primiparous animals (7.48 ± 0.14) which is nearly 19% more milk production.

Table 1: Least squares mean (\pm SE) of post-milking behaviours (60 minutes post-milking) and post milking standing time of Jersey crossbred Primiparous and Multiparous cows

Parameters	Primiparous cows (n=1084)	Multiparous cows (n=2454)
Total time eating fodder (minutes)	22.78 ± 0.60	23.72 ± 0.37
Total time standing (minutes)	36.05 ± 0.61	35.08 ± 0.38
Total time of lying (minutes)	1.17 ± 0.18	1.21 ± 0.11
Post-milking standing period (minutes)	$51.50^A \pm 3.74$	$34.25^B \pm 2.19$
Duration for lying down (minutes)	$9.50^A \pm 3.09$	$18.74^B \pm 1.81$
Total Milk yield (Kg)	7.48 ± 0.14^A	8.90 ± 0.09^B

Row-wise means with different superscripts differ significantly (Significant $P < 0.01$)

Post-milking behavioural parameters of Jersey crossbred cows in different stages of lactation

The lactation period was divided into 3 stages i.e., early stage (1-90 days), mid stage (91-210 days) and late stage (>210 days). Mean \pm SE value of post-milking behaviours in different stage of lactation revealed that (Table 2) total time eating fodder declined (26.77 ± 0.55 , 22.32 ± 0.50 and 20.66 ± 0.47 respectively) as the lactation stage progresses from early to late lactation, subsequently total time standing increases (32.43 ± 0.56 , 36.49 ± 0.52 and 37.76 ± 0.48 in

early, mid and late stage of lactation, respectively) that differed significantly ($P < 0.01$). Data analysis revealed that (Table 2) voluntary standing time after milking was higher in mid lactation stage as compare to early and late stage of lactation but the difference was not significant. Duration of lying down was more in late lactation stage as compare to early and mid-lactation stage, however, differences were not significant. Total milk yield also declined as the lactation stage progresses and differs significantly ($P < 0.01$).

Table 2: Least squares mean (\pm SE) of post-milking behaviours (60 minutes post milking) and post milking standing time of Jersey crossbred cows in different stages of lactation

Parameters	Early lactation (1-90 days)	Mid lactation (91-210 days)	Late lactation (>210 days)
Total time eating fodder (minutes)	26.77 ^A \pm 0.55	22.32 ^B \pm 0.50	20.66 ^C \pm 0.47
Total time standing (minutes)	32.43 ^A \pm 0.56	36.49 ^B \pm 0.52	37.76 ^B \pm 0.48
Total time of lying (minutes)	0.80 ^A \pm 0.17	1.19 ^B \pm 0.15	1.57 ^B \pm 0.14
Post-milking standing period (minutes)	43.19 \pm 3.07	44.15 \pm 2.60	41.30 \pm 2.93
Duration for lying down (minutes)	12.91 \pm 2.54	13.19 \pm 2.16	16.25 \pm 2.43
Total Milk yield (Kg)	11.14 \pm 0.13 ^A	7.99 \pm 0.12 ^B	5.44 \pm 0.11 ^C

Row-wise means with different superscripts differ significantly (Significant $P < 0.01$)

Post-milking behavioural parameters of Jersey crossbred cows in different seasons

The study period was divided into 3 seasons i.e., rainy (July-October), winter (November-February) and summer (March-May) and data analysis was done to see the effect of seasons on post-milking behavioural features. Findings from the study revealed that total time eating fodder was high in winter season (24.33 \pm 0.41) as compared to rainy and summer seasons (22.49 \pm 0.61 and 22.93 \pm 0.51 respectively) (Table

3) and that differed significantly ($P < 0.01$). Total time standing was more in summer season (36.79 \pm 0.53) as compared to rainy and winter seasons (34.83 \pm 0.63 and 35.06 \pm 0.42 respectively) and that varied significantly ($P < 0.01$). Simultaneously, post-milking standing time (Table 3) was more in summer season (53.79 \pm 3.74) followed by winter and rainy seasons (43.21 \pm 2.74 and 31.63 \pm 2.36), also milk yield was higher in winter season as compared to summer and rainy seasons and varied significantly ($P < 0.01$).

Table 3: Least squares mean (\pm SE) of post-milking behaviours (60 minutes post milking) and post milking standing time of Jersey crossbred cows in different seasons

Parameters	Rainy	Winter	Summer
Total time eating fodder (minutes)	22.49 ^A \pm 0.61	24.33 ^B \pm 0.41	22.93 ^A \pm 0.51
Total time standing (minutes)	34.83 ^A \pm 0.63	35.06 ^A \pm 0.42	36.79 ^B \pm 0.53
Total time of lying (minutes)	2.68 ^A \pm 0.19	0.60 ^B \pm 0.13	0.28 ^B \pm 0.16
Post-milking standing period (minutes)	31.63 ^A \pm 2.36	43.21 ^B \pm 2.74	53.79 ^C \pm 3.74
Duration for lying down (minutes)	21.54 ^A \pm 1.95	13.91 ^B \pm 2.27	6.90 ^C \pm 3.10
Total Milk yield (Kg)	6.63 \pm 0.13 ^A	9.36 \pm 0.11 ^B	8.58 \pm 0.13 ^C

Row-wise means with different superscripts differ significantly (Significant $P < 0.01$)

Post-milking behavioural parameters of Jersey crossbred cows at different time of milking

All the available records were grouped into time of milking i.e., morning and evening and data analysis was done to see the effect of time of milking on post-milking behavioural features. Data analysis from the study depicted (Table 4) that total time eating fodder was more in evening time (40.44 \pm 0.40) as compared to morning time (6.06 \pm 0.44) and it differed significantly ($P < 0.01$). This variation in time spent for eating was more attributed to workman management factors, because feed was not delivered immediately after milking during morning. Standing time was more in morning time (51.89 \pm 0.45) as compared to evening time (19.23 \pm 0.41) and it contrasted significantly ($P < 0.01$), while post-milking standing time was more in evening time as compared to morning but did not differ significantly. Duration of lying down was more in morning time (17.87 \pm 1.40) as compared to evening (10.36 \pm 3.15) and difference was significant ($P < 0.01$).

Table 4: Least squares mean (\pm SE) of post-milking behaviours (60 minutes post milking) of Jersey crossbred cows at different time of milking

Parameters	Morning	Evening
Total time eating fodder (minutes)	6.06 ^A \pm 0.44	40.44 ^B \pm 0.40
Total time standing (minutes)	51.89 ^A \pm 0.45	19.23 ^B \pm 0.41
Total time of lying (minutes)	2.05 ^A \pm 0.13	0.33 ^B \pm 0.12
Post-milking standing period (minutes)	41.40 \pm 1.67	44.35 \pm 3.81
Duration for lying down (minutes)	17.87 ^A \pm 1.40	10.36 ^B \pm 3.15
Milk yield (Kg)	5.48 \pm 0.05 ^A	2.78 \pm 0.07 ^B

Row-wise means with different superscripts differ significantly (Significant $P < 0.01$)

Discussion

McDonald (1975) [12] in their investigation suggested that there are 2 periods of time whereby teat canal diameter may be expanded and thus more susceptible to bacterial penetration i.e., following milking immediately after removal of the milking machine and 2 to 4 h after milking which corroborated with findings of our study. There is some evidence from epidemiological studies that promoting longer standing time of cows following milking is associated with a lower herd SCC. In a study of French dairy herds, Barnouin *et al.* (2004) [11] found that those herds that locked up cows at the feed-line after milking, and thus prevented them from lying after milking were more likely to be having very low SCC. In a survey of low -SCC herds in Britain, Peeler *et al.* (2000) [13] found that the incidence of clinical mastitis was lower on farms that offered fresh feed after both the morning and evening milking. Recent research on the effects of farm management on lying behaviour and the incidence of IMI also provides some evidence of a relationship between incidence of IMI and post-milking standing duration (PMSD) (DeVries *et al.* .2010; DeVries *et al.* .2011) [5] which are further corroborated by our findings.

According to Watters *et al.* (2013) [20], their investigation was the first to report the association between post-milking standing duration and udder health of free-stall housed cows that are parlour milked 3x/d. They found that over the study period, the mean herd incidence rate of 0.91 elevated somatic cell count (eSCC)/cow-year at risk for all study herds. A non-linear relationship between post-milking standing time and eSCC incidence was found. They suggested that, compared to those cows that lie down <90 min after milking than cows that lie down for the first time >90 min after milking had a lower

risk of acquiring a new elevated somatic cell count (eSCC). According to a study on tie-stall housed cows observed that cows that laid down on average between 40 and 60 min after milking, tended to have a decreased risk of acquiring a new environmental intra-mammary infection (IMI) compared to those cows that laid down within 40 min after milking (DeVries *et al.* 2010) [5].

Enhancement in microenvironment of the shed through false roof reduced heat loads and assisted in maintaining standard physiological indices of cows and thereby showed more daily milk yield (DMY) per cow (Mandal *et al.* 2018; Sahu *et al.* 2018; Sahu *et al.* 2019) [11, 14, 15]. In tropical climatic conditions environmental features are the most important elements to declined milk yield of cows. The mean values of DMY observed in the present study were alike to others reported in Jersey crossbred cows under tropical climate (Mandal *et al.* 2016, 2018, 2021; Kumar *et al.* 2020; Singh *et al.* 2020) [9, 10, 11, 8, 16].

Association of time of feeding and animal factors with PMSD

A long-accepted practice to promote post-milking standing duration (PMSD) has been to deliver fresh feed to cows following milking. DeVries *et al.* (2010) [5] described that the provision of fresh feed at multiple time points throughout the day may tempt cattle to go for feed and remain standing following milking rather than lie down this also is beneficial for udder health. Tyler *et al.* (1997) [18] observed a 20 min increase in PMSD when free-stall cows were provided with access to fresh feed following milking. DeVries and von Keyserlingk (2005) [4] also observed a similar increase for PMSD when cows were provided with fresh feed. Watters *et al.* (2013) [20] found non-linear relationship between duration of post-milking standing time and interval between milking time and feed manipulation time. Delay between milking time and feed manipulation time was a predictor of post-milking standing time. The longest post-milking standing times were observed when feed was manipulated in the hour before milking or in the immediate time period after milking. During early lactation milk yield was higher and to meet the requirement usually animals take more dry matter. For this reason, time spent on eating fodder was more by the animals during early lactation. In late lactation stage usually, pregnancy coincides and might have chances to enhance lying duration.

DeVries *et al.* (2011) [6] investigated in their study that longest post-milking standing times were observed when feed manipulation occurred anywhere between 60 min before to 120 min after milking with mean post-milking standing period of 85 ± 4.18 min. while shortest post-milking standing times were observed when the closest feed manipulation occurred over 240 min after milking with the mean of 51.1 ± 4.49 min. In other study delay between milking and feed delivery was a significant predictor of post-milking standing time. The longest post-milking standing time was obtained from cows fed 30 min before to 60 min after milking with the mean of 86.5 min. and the shortest post-milking standing time observed when feed manipulation was done 120 min. before milking (DeVries *et al.* 2010) [5].

Watters *et al.* (2013) [20] observed in their study that parity was associated with both pre- and post-milking standing time; cows of parity ≥ 3 spent more time standing after milking less than lesser parity cows. DeVries *et al.* (2010) [5] studied on the association of animal factors with the post-milking standing

duration and found that there was no significant relationship ($P > 0.05$) of parity & cow's milk production with post-milking standing time. In another study on the association of parity with post-milking standing duration, a significant association of parity with the standing time after milking was found (Deming *et al.* 2013) [3].

Conclusions

This investigation revealed that seasons, parity and time of milking significantly influenced post milking behavioural features. Also post milking standing durations depend on various factors like whether feeds are offered to dairy cows after milking or not, micro climatic factors of the environment are comfortable for the dairy animals or not. So, post milking behavioural study is having economic importance as maximum loss suffered by dairy farmers are due to mastitis so, if PMSD can be made optimum and favourable post milking behavioural features are attained then one can prevent farmers from suffering from severe economic losses as well as milk quantity and quality both will be enhanced.

Statement of animal rights (Ethical approval)

The usage of cattle in this trial (experiment) was permitted by the local institutional animal ethical committee vide institute approved project-NDRI/IRC Project code B-40 and it is an observational study.

Conflict of interest: The authors declare no conflict of interest.

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