



## Research Article

# EFFECT OF MILKING INTERVALS ON MILK PRODUCTION, COMPOSITION AND SOMATIC CELL COUNTS IN SAHIWAL COWS

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**Abstract-** The present study was conducted to find out the effect of milking intervals on milking attributes like milk let down time, milking time, milk flow rate, milk yield, composition and somatic cell count in Sahiwal cows. The experiment was carried out on 88 lactating healthy Sahiwal cows in hot- humid (n=38) and winter (n=50) season. All the animals were managed in loose housing system and were machine milked during morning, noon and evening time. Milking attributes like milk letdown time, milking time and milking rate was determined during milking time in each season. The aliquots of milk samples from individual animal were composited and fat, protein, lactose, SNF and total solids were measured. Somatic cells present in the pooled milk samples from individual animals were estimated. Milk let down time was significantly lower ( $P<0.05$ ) in morning milking as compared to evening milking in hot humid season. Milking time and total milking time was significantly higher ( $P<0.05$ ) in morning milking as compare to noon and evening milking in winter season. Milk flow rate was significantly higher ( $P<0.05$ ) in morning milking as compare to noon and evening milkings in both summer and winter season. Milk yield was significantly higher ( $P<0.05$ ) in morning milking as compare to noon and evening milking in both hot-humid and winter season in Sahiwal cows milked three times in a day. Fat % was significantly lower in morning milking than the evening milking in both hot-humid ( $P<0.01$ ) and winter season ( $P<0.05$ ) in Sahiwal cows milked three times a day. SNF content was higher ( $P<0.05$ ) in morning milking as compare to noon milking in both hot-humid and winter season. However, fat. % of noon milking was higher ( $P<0.05$ ) than the morning milking and lower than evening milking but the difference was non-significant in both seasons in Sahiwal cow milked three times in a day. Variation of TS % was non-significant between morning, noon and evening milking in hot-humid season but TS % was significantly ( $P<0.05$ ) higher in evening milking as compare to noon milking in winter season. Protein content was higher in evening milking as compare to morning and noon milking in both hot-humid ( $P<0.01$ ) and winter season ( $P<0.05$ ). Lactose % varied non-significantly between different milking intervals in the cows milked three times a day. SCC was lower ( $P<0.05$ ) in morning milking as compared to noon and evening milking in hot-humid season. In winter season SCC was significantly ( $P<0.05$ ) lower in morning milking as compared to noon milking but varied non-significantly ( $P<0.05$ ) with evening milking. Milking intervals had significant impact on milk let down time, milk flow rate, milk yield, fat %, SNF %, TS %, protein % and SCC.

**Keywords-** Sahiwal, milking intervals, Milk let down time, Milking time, Milk flow rate, Milk production and composition

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## Introduction

Dairying is acknowledged as one of the major instruments in bringing about socio-economic transforming of rural people in India [9]. The milking management is considered as one of the most important and crucial activities at dairy farm having a profound bearing on the farm production efficiency and profitability[11]. Proper milking routine should provide unstressful environment for the cow and ensure that the pre-milking teat preparation is performed in the same sequence of events to facilitate milk ejection before the milking and to minimize the amount of milk that should be removed by stripping[10]. Previous studies have reported that when the interval between milkings is equal, morning milk yield tends to be higher because of natural diurnal variation. The protein percentage has less day-to-day than milking-to-milking variation, with protein percentage higher in the evening. The milk and component yield variations were dependent on environmental conditions. There is inverse relationship between milk yield and component percentages, with summer milk production being higher but percentages of fat and protein being lower compared with production in the fall and winter months [7]. Seasonal variation influences the quality of milk and milk products depending on its

composition which in turn varies including to lactation stage, location, breed and species, milk system, animal age and size, environment, climate, temperature and diet composition thus influence the quality of milk products[3]. Different factors, such as race of cows, genetic variants, stage of lactation and environmental factors which can significantly affect on milk component and properties of milk. Somatic cell counts can indicate subclinical mastitis in herds or individuals. Whilst the greatest variation in SCC is considered to be caused by the presence or absence of a bacterial infection within the mammary gland, other variability has also been attributed to parity, stage of lactation, metabolic or physiological "stress", diurnal variability, innate differences between quarters and cows, and technical error in measurement[5]. Diurnal variation consists of higher SCC in the evening than in the milking and the difference is assumed to be due to the interval between milkings. The body condition score of cows during different stages of production and pregnancy is useful for assessing health and nutritional status of cows to take corrective measures or for culling. BCS at dry-off and calving may have more effect on milk yield in the following lactation than milk fever, retained placenta, ketosis and displaced abomasums.

A number of studies have been carried out in exotic cows and buffaloes revealing that milking intervals influence different milking attributes and other production performance of animals. Though considerable information is available in exotic cows and buffaloes however in Sahiwal the information is limited [6] and the effects of milking interval, season in relation to SCC have not been studied[4]. Keeping in view, the present study was designed to determine the effect of milking intervals on milk production, composition and somatic cell counts in sahiwal cows.

### Materials and Methods

The plan of experiment was duly approved by the Institutional Animal Ethical Committee. The experiment was conducted on 38 lactating healthy Sahiwal cows in hot humid and 50 cows during winter season. The cows were managed in loose housing system and were fed as per the feeding practices of the herd. The shady trees in the paddocks provided additional shelter for the animals. Free choice fresh tap water was available throughout the day. All the experimental animals were subjected to machine milking supported by expert milkers. The low yielder docile cows ( $5.94 \pm 0.72$  kg) and restless ( $4.88 \pm 0.63$  kg) were milked twice daily in the morning (6:00am) and evening (6:00 pm) and the high yielder docile cows ( $8.43 \pm 0.59$  to  $10.68 \pm 0.72$  kg) and restless cows ( $7.54 \pm 0.93$  to  $9.18 \pm 0.61$  kg) were milked thrice daily in the morning (6:00 AM), noon (12:00 PM) and evening (6:00 PM). Parity of the selected animals was on an average 3 in both the seasons. Stage of lactation were  $125.17 \pm 6.20$  in summer and  $113.45 \pm 8.52$  in winter.

Prior to milking the hindquarters, udders and teats of the cows were cleaned with duster soaked in lukewarm antiseptic solution. The teats were dried using a clean cotton cloth. Before applying teat cups 4 to 5 strips of milk from each teat were removed to clean the teat opening and to examine the status of udder health. In the last phase of milking the stripping was done to remove milk present in corners of cisterns for complete evacuation of udder. An antiseptic solution was applied over the teats with the help of teat dip after every milking. During milking time, the disturbances like unusual sound, noise, and presence of strangers were kept minimum and care was taken to keep the surroundings clean and quiet. The experiment was carried out during the summer (Hot-humid) and winter (Dec. – Jan.) seasons. During hot-humid season humidity was more than 85% and temperature ranged from  $36^\circ\text{C}$  -  $37^\circ\text{C}$  than the winter season temperature from  $13^\circ\text{C}$ - $15^\circ\text{C}$  (min.) and  $20$ - $24^\circ\text{C}$  (max.). Milk samples were collected at each milking and aliquots of milk samples from individual animal were composited in proportion to their milk yield. Milk fat, protein, lactose, SNF and total solids were measured using Milkoscan. The observations on let down time, milking time, total milking time was recorded by a stop watch. Body condition score was also recorded as described by [1] in each season. Milk SCC was determined by an Ekomilk scan (somatic cell analyzer).

### Statistical analysis

The statistical analysis of the data was carried out by 2-way least square analysis (SPSS 20.0 computer software) and the mean and standard error were calculated. The significance of the differences between the means of various parameters was tested for significance.

### Results and Discussion

Milk let down time was significantly lower ( $P < 0.05$ ) in morning milking as compared to evening milking in hot humid season [Table-1] Milking time and total milking time was significantly higher ( $P < 0.05$ ) in morning milking as compared to noon and evening milking in winter season. [Table-1] The lower milk let down time in morning milking was mainly due to higher milk yield in morning milking of cows milked thrice a day. The increased milking time and total milking time in morning milking was due to higher morning milk yield in Sahiwal cows milked thrice a day. Further high milk flow rate in morning milking is attributed to higher milk yield in the morning milking. The high milk yield in morning milking was due to longer milking intervals and corroborates the high yield reported by [8]. Average milk flow rate was significantly higher ( $P < 0.05$ ) in the morning milking as compared to noon and evening milking in both summer and winter season. [Table-1] Milk yield was significantly higher ( $P < 0.05$ ) in morning milking as compared to

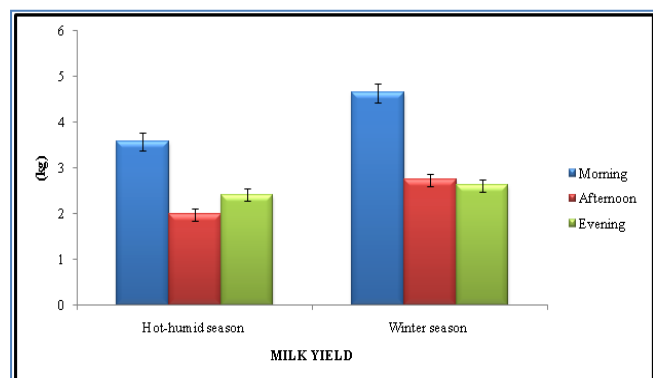
noon and evening milking in both hot-humid and winter season in Sahiwal cows milked three times in a day viz. Milk yield was lower being  $3.58 \pm 0.18$ ,  $1.99 \pm 0.11$  and  $2.42 \pm 0.12$  kg in hot-humid season and was higher  $4.64 \pm 0.23$ ,  $2.74 \pm 0.15$  and  $2.62 \pm 0.13$  kg in winter season, respectively in the morning, noon and evening milkings [Fig-1]. The significantly higher ( $P < 0.05$ ) milk flow rate in morning as compared to noon and evening milking in both seasons were due to high milk yield [12,2]. [7] also reported similar values of higher ( $P < 0.05$ ) milk yield observed in this study as cows were milked at 6am, 12noon and 6pm.

**Table-1** Effect of milking intervals on milking attributes and milk composition in Sahiwal cows milked thrice a day in two different seasons

| Time of milking                     | Hot-humid season (n=38)      | Winter season (n=50)         |
|-------------------------------------|------------------------------|------------------------------|
| <b>Milking attributes</b>           |                              |                              |
| <b>Milk let-down time (seconds)</b> |                              |                              |
| Morning                             | $17.64^{\text{A}} \pm 1.24$  | $36.30 \pm 2.64$             |
| Noon                                | $19.37^{\text{AB}} \pm 1.83$ | $39.73 \pm 3.37$             |
| Evening                             | $21.22^{\text{B}} \pm 1.66$  | $35.06 \pm 2.76$             |
| <b>Milking time (Min.)</b>          |                              |                              |
| Morning                             | $6.07 \pm 0.22$              | $6.21^{\text{A}} \pm 0.32$   |
| Noon                                | $6.26 \pm 0.24$              | $5.00^{\text{B}} \pm 0.25$   |
| Evening                             | $7.14 \pm 0.27$              | $5.01^{\text{B}} \pm 0.22$   |
| <b>Total milking time (Min.)</b>    |                              |                              |
| Morning                             | $6.31 \pm 0.22$              | $6.57^{\text{A}} \pm 0.32$   |
| Noon                                | $6.52 \pm 0.26$              | $5.39^{\text{B}} \pm 0.27$   |
| Evening                             | $7.46 \pm 0.29$              | $5.37^{\text{B}} \pm 0.23$   |
| <b>Milk flow rate (kg/min.)</b>     |                              |                              |
| Morning                             | $0.61^{\text{A}} \pm 0.04$   | $0.73^{\text{A}} \pm 0.05$   |
| Noon                                | $0.33^{\text{B}} \pm 0.03$   | $0.52^{\text{B}} \pm 0.04$   |
| Evening                             | $0.35^{\text{B}} \pm 0.03$   | $0.50^{\text{B}} \pm 0.03$   |
| <b>Milk composition</b>             |                              |                              |
| <b>Fat (%)</b>                      |                              |                              |
| Morning                             | $4.53^{\text{A}} \pm 0.07$   | $3.96^{\text{A}} \pm 0.08$   |
| Noon                                | $4.62^{\text{AB}} \pm 0.07$  | $4.07^{\text{AB}} \pm 0.12$  |
| Evening                             | $4.77^{\text{B}} \pm 0.07$   | $4.30^{\text{B}} \pm 0.10$   |
| <b>SNF (%)</b>                      |                              |                              |
| Morning                             | $9.46^{\text{A}} \pm 0.05$   | $9.97^{\text{A}} \pm 0.06$   |
| Noon                                | $9.39^{\text{B}} \pm 0.04$   | $9.61^{\text{B}} \pm 0.06$   |
| Evening                             | $9.46^{\text{AB}} \pm 0.04$  | $9.82^{\text{AB}} \pm 0.06$  |
| <b>TS (%)</b>                       |                              |                              |
| Morning                             | $13.87 \pm 0.08$             | $13.96^{\text{AB}} \pm 0.09$ |
| Noon                                | $14.01 \pm 0.07$             | $13.68^{\text{A}} \pm 0.11$  |
| Evening                             | $14.21 \pm 0.07$             | $14.11^{\text{B}} \pm 0.10$  |
| <b>Protein (%)</b>                  |                              |                              |
| Morning                             | $3.13^{\text{A}} \pm 0.03$   | $3.10^{\text{A}} \pm 0.03$   |
| Noon                                | $3.02^{\text{B}} \pm 0.02$   | $2.95^{\text{B}} \pm 0.03$   |
| Evening                             | $3.25^{\text{C}} \pm 0.03$   | $3.21^{\text{C}} \pm 0.04$   |
| <b>Lactose (%)</b>                  |                              |                              |
| Morning                             | $4.58 \pm 0.03$              | $4.76 \pm 0.03$              |
| Noon                                | $4.52 \pm 0.03$              | $4.71 \pm 0.03$              |
| Evening                             | $4.79 \pm 0.54$              | $4.66 \pm 0.03$              |

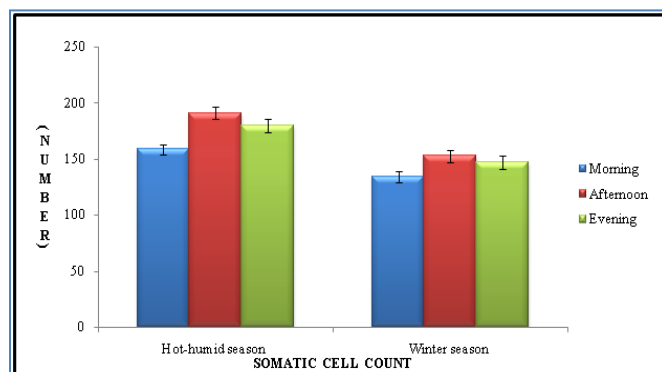
In Sahiwal cow's fat % ranged from 3 to 6.8, 2.8 to 6.7, 3.2 to 6.5 during hot-humid season and 2.13 to 5.2, 2.17 to 6.2, 2.8 to 6.1 during winter season in morning, noon and evening milking respectively. Fat % was significantly lower in morning milking than the evening milking in both hot-humid ( $P < 0.01$ ) and winter season ( $P < 0.05$ ). However milk fat % of noon milking was higher ( $P < 0.05$ ) than the morning milking and was lower than evening milking but the difference was non-significant in both seasons. [Table-1] Mean SNF (%) varied from 8.6 to 10.3, 8.42 to 10.08, 8.5 to 10.2 during hot humid and 9.04 to 10.98, 8.56 to 10.54, 8.98 to 10.78 during winter season in morning, noon and evening milking, respectively [Table-1] Mean total solids ranged from 10.52 to 16.27, 12.46 to 16.17 and 12.84 to 15.97 during hot-humid season vs. 12.43 to 15.5, 10.86 to 15.38 and 12.21 to 15.52 during winter season in morning, noon and evening milking respectively. Mean protein content ranged from 2.5 to 3.6, 2.5 to 3.4 and 2.4 to 3.9 during hot-

humid season vs. 2.56 to 3.4, 2.46 to 3.4 and 2.67 to 3.7 during winter season in morning, noon and evening milking, respectively. Lactose content varied from 4 to 5, 3.5 to 4.9, 3.6 to 4.6 in hot-humid season and in winter season 4.12 to 5.29, 4.1 to 5.29 and 4.01 to 5.11 in morning, noon and evening milking, respectively. Lactose content varied non-significantly between different milking intervals in the cows milked 3 times a day [Table-1].



**Fig-1 Effect of different milking intervals on milk yield in Sahiwal cows milked thrice a day in two different seasons**

Mean Somatic cell count was  $158.55 \pm 4.84$ ,  $190.81 \pm 5.23$  and  $179.44 \pm 5.84$  ( $\times 10^3$  cells/ml) during hot-humid season and  $134.27 \pm 5.57$ ,  $152.57 \pm 6.41$  and  $147.289 \pm 6.12$  ( $\times 10^3$  cells/ml) during winter season in morning, noon and evening milking, respectively. Somatic cell multiplies at faster rate due to higher temperature in noon and evening in both season as compared to morning milking which leads to higher SCC in noon and evening milking [Fig-2]. Similar to our finding [7] also reported lower SCC ( $P < 0.01$ ) in morning milking as compared to evening milking in cows milked twice a day. In case of thrice milking also SCC was significantly lower ( $P < 0.05$ ) in morning milking as compared to noon and evening milking in hot-humid season. In winter season SCC was significantly ( $P < 0.05$ ) lower in morning milking as compared to noon milking but varied non-significantly ( $P < 0.05$ ) with evening milking.



**Fig-2 Effect of milking intervals on SCC ( $\times 10^3$  cells/ml) in Sahiwal cows milked thrice a day in two different seasons**

## Conclusion

Milking intervals had significant impact on milk let down time, milk flow rate, milk yield, fat %, SNF %, TS %, protein % and SCC however, parameters like milking time, total milking time and lactose % remained unaffected by milking intervals.

**Conflict of Interest:** None declared

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