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Nutritional and dry period length modifications during dry period management in dairy cow: A review

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Abstract
A non-lactating/dry period before calving is necessary to maximize the milk production after parturition. Feeding strategies during dry period affects the milk production after calving. Therefore, improving the energy balance in transition period can reduce the incidence of periparturient disorders and decreases the mobilization of fat and reduces the negative energy balance. During dry period high yields provide an economical reason for modified dry periods and implementing short or omitted dry periods provides a better health conditions in animals. Continuous milking may keep the animal adapted to lactation and diet changes which further reduces the risk of development of periparturient disorders (Ketosis) as well as improve dry matter intake during this transition period. Conventional dry period (60 day) helps to adapt the cow to several acute changes in metabolic and physiologic states and diets. Therefore, there is reason to re-evaluate optimal dry period length and finding the shortest possible dry period that would allow maximum milk production after parturition is necessary.

Keywords: Dry period, long dry period length, milk production, short dry period length

1. Introduction
Dry period (DP) is also called as resting period in which cow udder is prepared for the next lactation. DP is necessary because the mammary gland of the dairy cow requires a nonlactating (dry) period prior to parturition to optimize milk production in the subsequent lactation. This resting period in between lactations has been commonly applied since the early 1900's.A DP of 6-8 weeks facilitates the regeneration of Mammary epithelium [1]and maximizes milk yield in the next lactation [2].DP plays an important role in restoring the body condition of the cow as well as for replacing senescent mammary epithelium cells. High-producing dairy cows experience a negative energy balance (NEB) during transition period therefore, a successful transition period is essential for better animal health and productivity of animals [3 & 4].Alteration in the DP length and improving energy status reduces the risk of metabolic imbalance during the transition period [5].Dry period length modification can reduce the incidence of periparturient diseases and decrease the mobilization of body fat reserves [6&7]. Busato *et al.* [8] while studying on feeding management during transition period indicated that feeding a high-forage, low-energy feed prior to calving improves metabolic status postpartum and reduced the risk of subclinical ketosis [9 & 10]. Nutritional strategies may alter the effect of DP durationon subsequent lactation. Dirksen *et al.* [11] observed that by using two different diets during the 60 day DP (a low-energy diet from 60 to 30 day before parturition and a moderate-energy diet from 30 day before parturition) does not allow optimal adjustment of the ruminal flora to the postpartum diet. It is observed that in penultimate period prior to calving, a rapid decrease in dry matter intake (DMI) generally occurs [12] which indicate that when a short DP is applied, cows will not have sufficient time for the development of appropriate ruminal flora during subsequent lactation.
Several hypotheses have been proposed to explain the importance of dry period. It is necessary (1) for replenishment of body reserves, (2) To regenerate the mammary gland for the next lactation, (3) To maximize milk production (4) To Minimize metabolic disorders during transition period and (5) for optimization of benefits from endocrine events around the time of calving.

2. Management of Dry Period

2.1Nutritional Management

During dry period, feeding strategies affects the production of milk and milk constituents immediately after calving. In feeding management the first priority should be given to energy and protein intake. Balanced ration (including vitamins and minerals) should be provided to dry cows and care of animals should be done in such a way that they should not lose body condition during this time. Losing body conditions during the dry period makes the animal more susceptible toperiparturient disorders, such as fatty liver and ketosis, which can act as a main impetus in reducing milk production in the next lactation. Body condition score (BCS) should be optimum therefore in the early-dry period the primary focus is to achieve a BCS of 3.0 to 3.25 at dry-off. If BCS is correct at the time of dry-off, then animals should gain about 300 to 500 gm/day to increase BCS by 0.25 to 0.35 units during the early-dry period. During close-up period, animal should be provided more than 12 kg of ration cow/day and 16% crude protein on dry basis. Diet with energy density of 9-10 MJ ME/ kg DM is sufficient during dry period to fulfill the energy requirements of animal. Normally Holstein Friesian dry cows can eat 2% of their body weight as dry matter every day. NEB occurs during early lactation due to the practice being followed in high milk yielding animals that they are provided with limited feed after a conventional DP [13 & 14]. Shortening the DP (30 day) or omitting it altogether improves energy balance [13], metabolic status [15] and fertility [16].Studies have reported that overfeeding with high energy diets during the DP increases the mobilization of body fat reserves and renders the animal in the state of energy deficit along with lowering of feed intake in postpartum period. When a short DP is applied, it provides an opportunity for using one diet instead of separate far-off and close-up diets during the dry period. This reduces the switching diets and therefore, may reduce adaptation stress which occurs mainly in association with diet change and increase feed intake [13 & 17]. Glucogenic diet may decrease fat mobilization and improve metabolic status in older cows and cows with severe negative energy balance. Lipogenic diet has more useful effect as it improves metabolic status as compared to Glucogenic diet during lactation [15]. Glucogenic diet increases milk yield but on the same side reduces milk fat yield when comparing with Lipogenic diet (high-fiber and high-fat) in mid-lactation cows [18]. Glucogenic diet tended to increase milk yield in the first 9 weeks but Fat protein corrected milk (FPCM) yield is not found to be altered between diets. The influence of feeding glucogenic diet is found to be more pronounced in young cows during early lactation as compared to older cows [19]. Generally, feeding of concentrate 2kg/day immediately after calving to dry cows during dry period along with dietary protein content of 13-14% (130- 140g/kg) in the dry matter shows good results in dry cows at any stage of the dry period.

2.2Dry Period Length Modification

Every large dairy producer wants that their cows produce milk as much as possible throughout the year. During the DP, cows do not produce milk therefore; to achieve maximal milk yield during the subsequent lactation with the craving of least number of dry days. Identification of optimum length of the dry period is critical to maximize the milk production during the next lactation. Dry period is one of the important management strategies. Generally a conventional DP (50 to 60 day) is necessary to maximize the milk yield in the next lactation in dairy cows [20].It is observed that milk production is lower for cows with short DP length as compared to cows with long DP length. When different preplanned DP lengths have been applied on dairy herds, it results in lowest milk production for cows with a DP of 0 to 20 day, compared with cows with a DP more than 35day [21]. After implementation of different DP length treatments it is found that average milk losses are 4.5% in cows with a shortened DP (28-35 d) and 19.1% in cows with a omitted DP compared with a conventional DP (49-63 d) in the first lactation [22] and these losses of milk yield post-calving observed after shortening or omitting the DP has been found to be completely compensated by additional milk yield pre calving in several studies [23,7&13]. When the additional milk yield from pre calving period are taken into account it reduces the 305 day milk yield losses from 16% to 6% after omitting the DP [24]because shortening or omitting the DP partially shifts milk yield from post calving to pre calving period and, therefore, improves energy balance in the early part of lactation.

Reduction of DP can improve productive (milk production and composition), reproductive performance (fertility) and metabolic status. Omission of dry period results in a lower FPCM yield, greater EB, and plasma concentrations of insulin and IGF-1, but decreased persistency of lactation compared when with a 30-d DP. Feeding low energy diet in cows with omitted DP do not affect FPCM yield or persistency of lactation but it reduces EB and weekly body weight gain, which implies a less chance for fattening of cows with a 0-d DP. Feeding a more glucogenic diet as compared to high Lipogenic diet do not affect EB or lactation persistency of cows with different dry period lengths, although milk yield, DMI, and plasma concentrations of insulin and IGF-1 has been found to be greater but plasma GH concentration has been observed to be lower [25].

3. Effects of Dry Period Length Modifications

3.1 Effect of DP length and parityon milk yield

Adoption of a shorter or no DP on commercial farms is hindered by uncertainty of the effect on milk yield over multiple lactations and differences in response between cows [26& 22]. The highest effective milk yield of fat-and protein-corrected milk (FPCM) observed for cows with a standard DP (27.6 kg per day); a daily decrease is found to be observed of 0.6 kg for a long DP, 1.0 kg for a short DP, and 2.0 kg for omitted DP. Milk losses after calving, however, have been compensated partly, sometimes completely by the additional milk yield before calving [22].To account for additional milk yield before calving and for differences in calving interval, the measure “effective lactation yield” have been developed to compare milk yield between cows with different DP lengths [27].The 305-d yield of young cows have been found to be reduced by 23% after no DP when compared with a standard DP, whereas the effective lactation yield has been found to be reduced by merely 12%. Kuhn *et al*. [28] observed that shortening the DP or omitting the DP reduces milk production.

Reduction in milk yield after shortening or omitting the dry period has been observed for young cows with second parity, however, it is not observed for older cows [23, 27&29].Greater reduction in milk yield in cows with second parity after omitting the DP may be related to greater requirements for both mammary gland development and regeneration of mammary epithelial cell between the first and second parity

when compared with later parities [30]. Annen *et al*. [23] and Pezeshki *et al*. [29] reported that shortening the DP decreases daily milk yield in primiparous cows, but it is not the case with multiparous cows. It has also been observed that the DP length in the second lactation must be between 44 and 76 d, but this duration can be reduced just like for older animals [31].It is observed that primiparous cows require a conventional DP (60-day), whereas the multiparous cows when subjected to a 30-d dry period no negative impacts [30].

3.2Effect of DP Length on Somatic Cell Count (SCC)

Studies reported that omitted DP length in cows have higher SCC in milk produced during early lactation as compared to the case when allowing a dry period of either 30 or 60 days. In multiparous Cows (third or greater parity) has been found to have higher SCC (321,000 cells/mL) than primiparous cows (124,000 cells/mL) [14].However, when different dry period lengths are implemented, no such differences in SCC in early lactation milk between cows are observed [24, 32, 13 & 7]. Pertaining to parity, Pezeshki *et al*. [29] reported that shortening the DP length of 42 days in multiparous cows shows higher milk SCC as compared to cows with 56-days and 35days dry periods. Santschi *et al*. [27] observed that in second-lactation cows with DP of 35 day, no effect on milk SCC has been found; whereas third-lactation cows tended to have lower SCC when compared with cows with a 60 days dry period.

3.3 Effect of DP Length on persistency of lactation

Several studies reported that there are significant effects of shortening or omitting the DP on lactation curve characteristics. It is observed that shortening or omitting the DP results in later time of peak yield (PT), lower peak yield (PY), lower FPCM305, and no effect on lactation persistency (LP) in two subsequent lactations after implementation of DP length treatments. Low Lactation persistency has been found in cows with a shortened or omitted dry period [33].Cow with 0-day DP greatly modifies the shape of the subsequent lactation curve, results in an earlier PT, lower PY, and lower LP as compared to these parameters in cows with a conventional DP [34]. Shortened DP (0 to 35 d) has been found to be associated with later PT, lower PY, and higher LP in a field study as compared to cows with a conventional DP (50 to 60 d) [35].

4. Advantages and Disadvantages of Short DP Length

4.1 Advantages

1. Shortening the DP may improve fertility.
2. It improves energy balance and reduces the risk of metabolic disorders.
3. Short DP is more suitable for multiparous cows as compared to younger cows.
4. Implementing shorter DP provides safety margins for early calving.

4.2 Disadvantages

1. Short DP reduces milk yield postpartum especially in heifers.
2. It Increases complexity in heifers.

5. Advantages and disadvantages of Long DP Length

5.1 Advantages

1. It maximizes milk production.
2. Long DP enables greater replacement of senescent mammary epithelial cells [36].
3. It provides cows enough time to rest.

5.2 Disadvantages

1. Longer DP decreases annual production of animal by increasing calving interval [38].
2. It decreases lifetime production of animals.

6. Conclusion

Shortening of DP (35-d) has been reported to bring attractive beneficial effects, namely additional milk at the end of lactation and improvement of energy status. Short dry period (30 d), no dry period, and a glucogenic ration can improve the energy balance of dairy cows in early lactation by reducing the amount of energy partitioned to milk. It is observed that shortening and complete omission of the DP reduces milk production in the subsequent lactations. Reduction in milk yield after shortening or omitting the dry period for young cows of second parity has been more pronounced as compared to older cows. Pertaining to the high producing population of dairy cow of improved genetic make-up, it is need of the hour to re-evaluate the optimal dry period length in dairy cows because of their increased producing ability and having improved persistency of lactation. Dry period length has been proposed to be shortened or omitted as far as economy of dairy farm is concerned. Lactation diets are comparatively more costlyas compared to expenditure of diets set for dry cows. Thus, for the economic reasons, income earned from increased milk yield and the cost of additional feed need to be determined carefully.

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