Effect of dry period length on reproductive measures, health, and production of Holstein cows during the subsequent lactation.

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Take-home Messages

- Reducing the duration of the dry period from 55 to 34 days improves reproductive efficiency based on fewer days open and more cows confirmed pregnant at 150 days in milk (DIM).
- There is no negative effect of shortening the dry period on cow health.

Introduction

Milk production has increased at a very rapid rate for decades because of genetic selection, nutrition and management practices like the dry period. Recent progress in the technology and science behind the dry period has led many to look at an alternative to non-lactating management practices. The dry period for years has been thought of as a time of rest that allows the mammary epithelial components to regress, proliferate, and differentiate with the ultimate goal of maximizing milk production during the subsequent lactation (Capuco et al., 1997). It has been widely accepted that a dry period length around 60 days is needed to achieve maximal milk production. If maximizing milk production is the reason to have a dry period and the length of the dry period at 60 days is not the correct length to maximize milk production then substantial economic advantages may be missed during the present and subsequent lactation.

There are many studies that have been designed to look at the impact of the dry period length on milk production (Rastani et al., 2005; Annen et al., 2004). A recent summary of eight studies showed that cows with a short dry period during their second gestation produced 89.1% as much milk as cows with a 60-d dry period and that cows in their third or greater gestation produced 95.1% as much milk as cows with a 60-d dry period (Rastani & Grummer, 2006).

It is believed that manipulation of the length of the dry period may have positive effects on the health and reproductive status of the dairy cow at parturition. Incidences of reproductive disorders is one method that the dairy industry currently utilizes to measure reproductive efficiency within a dairy herd. More recently there has been much interest in shortening the dry period and monitoring its effects on the reproductive performance of the cow. To date only a few studies have looked at reproductive impacts and metabolic disorders related to a shortened dry period. One study has been completed that has looked at the impact of the dry period length on reproductive parameters such as days to first ovulation, but this study lacked the numbers necessary to provide reliable reproductive efficiency data (Gumen et al., 2005). The level of negative energy balance is correlated to first post partum ovulation (Butler et al., 1981), with greater negative energy balance being associated with greater time to first post partum ovulation. Butler, Everett and Coppock (1981) found that ovulation did not take place until 10 days after energy balance reached the lowest point of negative energy balance.

Animals and Treatments
Seven hundred and seventy-two multiparous Holstein cows were selected from a large commercial dairy in northeastern Wisconsin for this experiment. The first animal calved in late December, 2004 while the last animal calved in July, 2005. Animals were assigned to one of two treatments if they met the following criteria: 1) milk production greater than or equal to 18 kg milk per day at 180 days carried calf, 2) less then 300 days in milk at 180 days carried calf. Cows received bST and the administration of bST was terminated at 180 days carried calf. Cows were randomly assigned to either a conventional 55 day dry period (C; n=382) or a 34 day dry period (S; n=390). From 55 days to 35 days prepartum the C cows were fed a low-energy diet. At 34 days prepartum both the C and S cows were fed a moderate-energy transition diet until calving. All cows were fed a high-energy diet after calving. Cows were milked 4X/d for the first 28 DIM and 3X/d there after. Average days dry for C and S were 55.5 and 34.0. For treatment C, 90% of the cows had a dry period that ranged from 44 to 65 days, while treatment S, 90% of the cows had a dry period that ranged from 20 to 45 days.

Colostrum samples were taken at the morning milking immediately following calving and analyzed for IgG content. Milk production was measured two days each month for the first 150 DIM. The milk data was compiled monthly so that there was one value for each month. Milk composition was also measured once a month for the first 100 DIM. The incidences of health disorders were recorded during the duration of the trial and compared between treatments. Records were kept for displaced abomasum, ketosis, metritis and retained placenta as defined by LeBlanc (2002).

Cows in a commercial herd were observed for days to first ovulation, days to first AI, first service conception rate, days open, and percentage of cows pregnant at 150 DIM. Blood samples were taken weekly starting at 14 DIM for progesterone which was used to determine days to first ovulation. Once an animal had ovulated as determined by blood progesterone being >1ng/ml of blood no more blood samples were taken. At 70 DIM blood sampling was terminated due to the fact that the Ovsynch protocol was initiated. If a cow did not ovulate by 70 DIM it was considered anovular. The voluntary waiting period was set at 45 days and all animals were bred off tail chalk with a split straw AI method. Ovsynch and timed AI took place at 80 DIM, which represented 37% of the first breedings. Body condition score (BCS) was recorded once weekly for each animal starting at 4 weeks prior to expected calving and was terminated after nine weeks after calving.

Results and Discussion

Milk production was greater for C cows (96.6 lbs/d) compared with S cows (92.1 lbs/d) for the duration of the post partum trial (Figure 1).

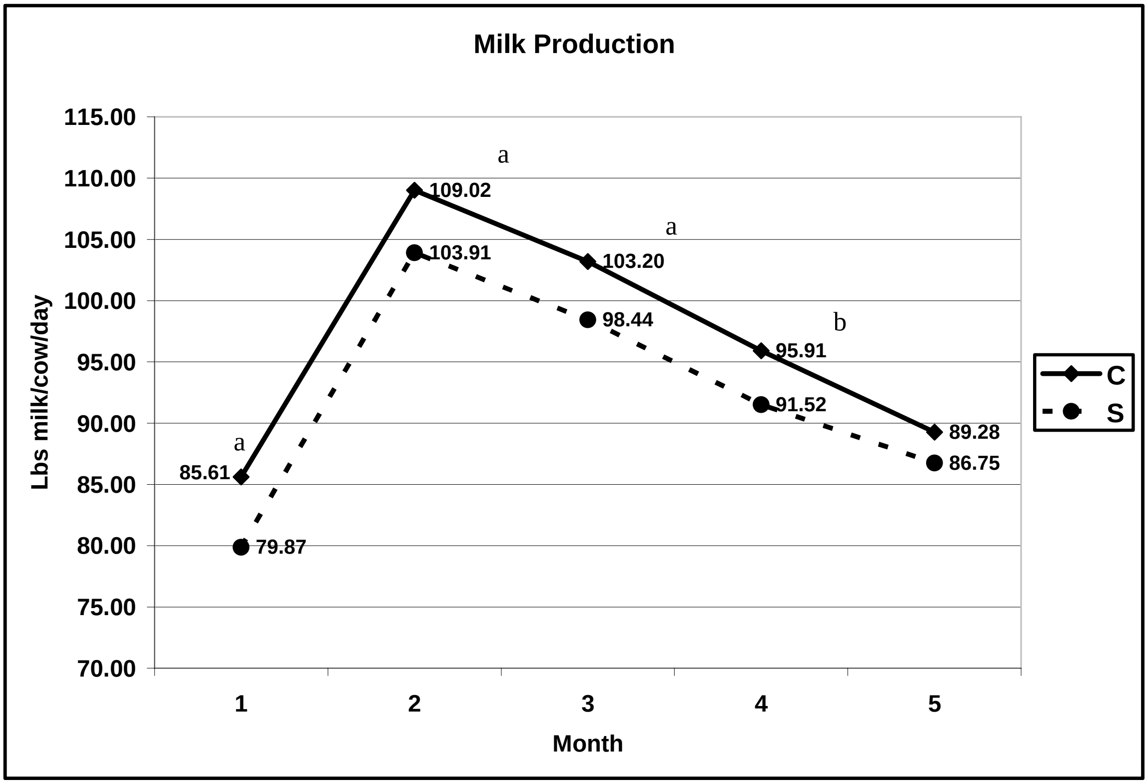

Figure 1. Level of milk production between treatments through 150 DIM.
a differ at P < 0.01
b differ at P < 0.05

Cows in their third lactation produced (91.45 lbs/d) while cows in their second lactation produced (97.25 lbs/d). There was no treatment by time or treatment by parity interaction for milk production. The lower level of milk production by cows on S as compared to C along with the lower production of cows in their second versus third lactation has been reconfirmed by this trial (Rastani, et al., 2005; Annen et al., 2004; Wilton et al., 1967). Milk fat percentage was not affected by treatment with C producing 3.42% and S producing 3.52% milk fat ($P < 0.10$) (Table 1). Parity had an effect on fat percent with the third lactation and greater producing a higher percent fat than the second lactation animals (3.52 vs. 3.42). The overall fat yield was not affected by treatment, but there was a parity effect for fat yield with levels of 3.18 lbs/d for second lactation and 3.51 lbs/d for third and greater lactation ($P < 0.0001$). There was a treatment effect for protein percent with C cows at 2.67 percent while S cows were at 2.81 percent ($P < 0.0001$). Parity had an effect on the percent of protein produced with second lactation cows producing milk with 2.81 percent protein while animals in their third or greater lactation produced milk with 2.68 percent protein ($P < 0.0001$). Again as with fat there was no treatment effect for protein yield, but there was a parity effect with second lactation animals producing 1.17 kg/d while third and greater lactation produced 1.20 kg/d of protein.

Milk quality data was gathered for each animal three times during the first 100 DIM. The linear somatic cell score (SCS) is another means of expressing the somatic cell count (SCC). The linear SCS increase by one full point when the SCC doubles and a SCS of 1 is equal to a SCC of 25,000. The linear SCS which did not differ statistically was 3.18

and 3.08 for treatments C and S. There was a difference by lactation for linear SCS with second lactation cows having a lower score than third or greater lactation animals (2.88 vs. 3.39). Mastitis was also gathered for each treatment with there being no differences in intramammary infections between treatments or lactation.

	Treatment			Parity		
	C	S	*P*-value	2	3+	*P*-value
n	382	390		420	352	
Fat %	3.42	3.52	P < 0.10	3.42	3.52	P < 0.05
Protein %	2.67	2.81	P < 0.0001	2.81	2.68	P < 0.0001
SCS (linear score)	3.18	3.08	NS	2.88	3.39	P < 0.001
Mastitis (incidence/n)	147	153	NS	148	152	NS
IgG (mg/dl)	5849.6	5615.1	NS			

Table 1. Milk composition for fat and protein through 100 DIM and SCS through 150 DIM

Concern has been raised about the quality of colostrum based on the level of IgG in milk for animals with a shortened dry period. Data has shown that cows with no dry period produce lower levels of protein in colostrum as compared to animals with a shorter dry period (Rastani et al., 2005). This has lead many to believe that reducing the dry period length has a negative effect on the quality of the colostrum. The issue is not the level of IgG in milk but the dilution that is seen when more milk is produced while the levels of IgG stay the same. It then becomes apparent that lower level of immunogloulins are getting into the calf. The IgG levels that were obtained from this trial did not differ between treatments (Table 1). Previous data by Rastani (2005) indicated that the level of IgG's in colostrums from cows with no or a shortened dry period contains sufficient levels of immunoglobulins for the calf.

Level of milk production prepartum is an area that may impact the length of the dry period. Low producing dairy cows tend to voluntarily dry themselves off or have reduced lactational days in milk, thus increasing the days dry. Mammary epithelial cell activity and quantity are two factors that can be attributed to the amount of milk that is secreted during a lactation. It is important to note that the mammary gland of a dairy cow undergoes changes in secretory status rather than stages of tissue regression during the dry period (Capuco et al., 1999). Within two weeks of milk cessation there is a noticeable reduction in the secretory capacity of the mammary gland (Capuco et al., 1999). Even though some mammary epithelial cells undergo apoptosis which does not lead to tissue regression (Wilde et al., 1997), there seems to be no apparent sloughing of epithelial cells during the dry period leaving one to believe there is little reduction in epithelial cell numbers (Capuco et al., 1997; Hurley et al., 1989).

One may also believe that feeding one diet prepartum to the animals on treatment S may improve energy balance around calving. It has been hypothesized that a reduction in incidences of metabolic disorders may be seen if the level of negative energy balance is less negative. All cows from calving until 30 DIM are checked once daily in the AM for health disorders. There was no difference between treatments for the incidences of displaced abomasum, ketosis, metritis and retained placenta (Figure 2).

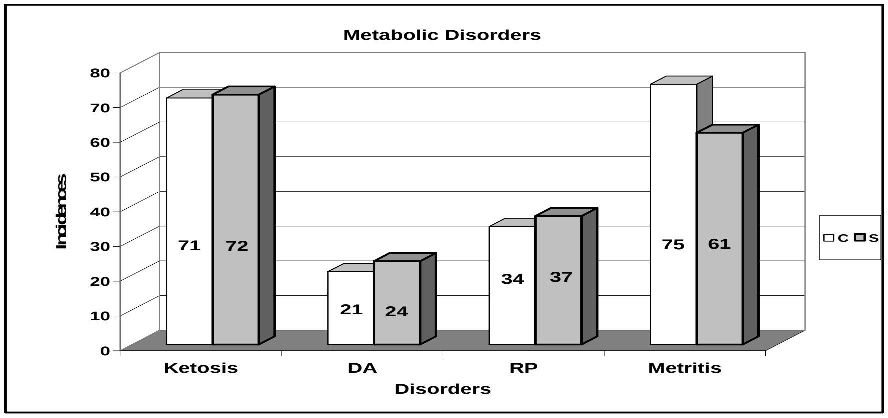

Figure 3. Incidences of metabolic disorders by treatment. Treatment: C; n=382 and S: n=390.

Reproductive Measures

After reviewing the reproductive data from a previous study (Gumen et al., 2005) with reduced dry period length it appeared to improve reproductive efficiency, although too few cows were evaluated to provide reliable data on reproduction efficiency.

Much emphasis as of late has been placed on the body condition score of the cow at breeding time. Two main areas have been focused on with one being the overall BCS of the cow at breeding time. It is well known that cows with low BCS, <2.5 have an increased chance of being anovular (Lopez et al., 2005; Gumen et al., 2003). Another point to consider is the change in BCS from calving to time of breeding. Many researchers recommend that a cow enter the dry period with a BCS between 3.25 and 3.75. It is not uncommon for an animal to lose up to one point in BCS prior to breeding. Making sure the animal does not lose more than one point is important because of the increased chance of the cow being anovular. The BCS was not different between treatments but there was a treatment by week interaction (Table 2). Body condition score can be used as an indicator of the level of body reserves that a cow has.

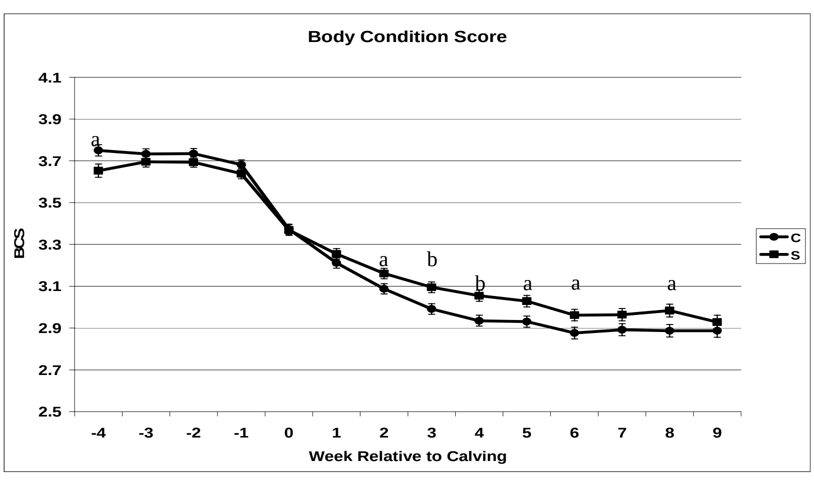

Table 1. BCS by treatment starting at -4 weeks prior to expected calving until 9 weeks in milk. Week 0 is week of calving. [a] differ at $P < 0.05$, [b] differ at $P < 0.01$

Postpartum days to first ovulation for treatment C averaged 43 days (range 18 to 67) with 11% (34 out of 318) of the animals being classified as anovular at 70 DIM. Treatment S had an interval to first postpartum ovulation of 35 days (range 14 to 69) with 5% (15 out of 286) being classified as anovular (Figure 3). Previous data has shown that no dry period leads to a shorter days to first ovulation as compared to a shortened (28d) or traditional (56d) dry period (Gumen et al., 2005). It is interesting to note that days to first service only differed by 5 days (C = 72 vs. S = 67) given the fact that days to first ovulation occurred sooner in the S group. First service conception rate did not differ statistically between the two groups (C = 29.8 vs. S = 32.0 %).

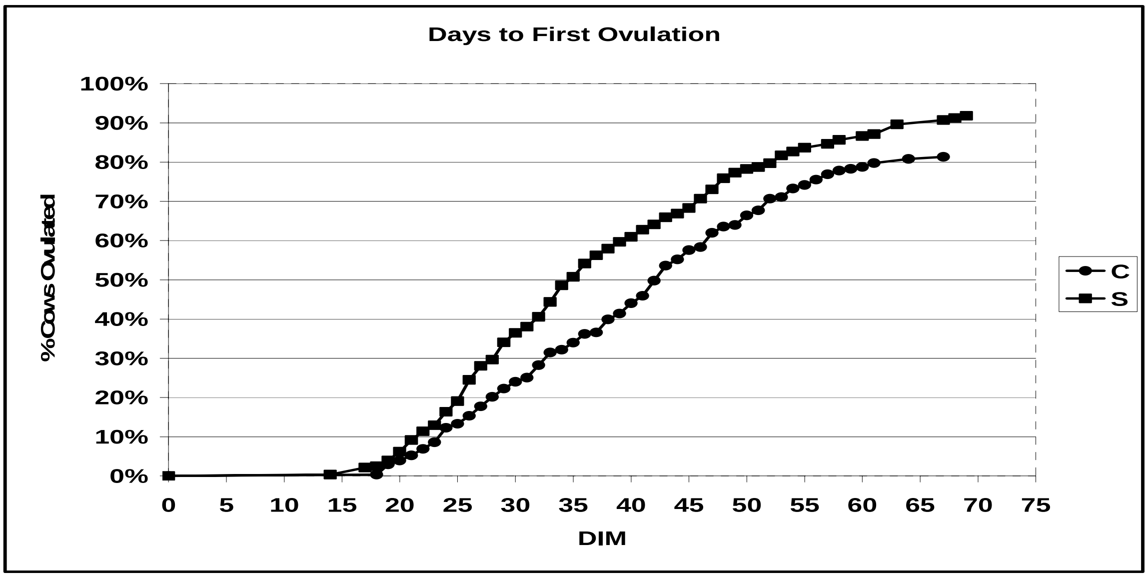

Figure 4. Days to first ovulation by treatment

The proportion of cows pregnant at 150 DIM is another reproductive parameter that can be measured and related to reproductive efficiency of dairy cattle (Table 3). The proportion of cows pregnant in group C at 150 DIM was 43.9 vs. 51.8% for group S. The difference of 7.9% can be viewed as 30 more cows pregnant in group S while on this trial. Days open is was also analyzed by survival analysis that group C cows had a median days open of 166 days and group S cows had a median days open of 130.

	C	S
n	342	252
Days to 1st Ovulation	35	43
Days to 1st AI	67	72
1st Service CR	32.0 %	29.8%
Proportion of cows Pregnant at 150 DIM	51.8%	43.9%
Days Open	130	166

Table 2. Reproductive performance of cows with a short vs. conventional dry period

Summary

With the increase in milk production over time it may become increasingly more common to see dry periods less than the conventional 60 days. Shortening the dry period has been observed for many decades in relation to the level of milk produced during the subsequent lactation. The initial data on dry periods utilized animals that did not have a planned or managed shortened dry period instead they utilized the records from animals that calved early due to twins, aborted or had an incorrect breeding date. In relation to milk production there have been recent studies that dealt with the impact of the dry period length on milk production (Rastani et al., 2005; Annen et al., 2004). Records from this trial show that there is no negative effect on health when the dry period. Reproduction and shortened dry periods have only recently received attention in a research setting and although the results appeared to improve reproductive efficiency there were too few cows to provide reliable data (Gumen et al., 2005). Decreasing the dry period from 34 to 55 days improved reproductive efficiency by reducing the number of days open and increasing the proportion of cows pregnant at 150 DIM.

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