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Abstract	The current study was carried out to examine the effects of dry period duration on NEFA and IGF-I plasma concentrations and postpartum ovarian activity resumption in dairy cows. Twenty-five pregnant Friesian cows (second and third lactation) were randomly assigned to one (standard dry period, 9 weeks, group C, *n* = 12) of two (short dry period, 5 weeks, group T, *n* = 13) treatments. Blood samples for NEFA and IGF-I analyses were collected once a week during the last 5 weeks prepartum and the first 14 weeks of lactation. Milk whey collection (twice/week) for progesterone analysis began 2 weeks after parturition and was used to detect ovarian activity resumption (at least three consecutive samples with P4 # 300 pg/mL). The data obtained were analyzed by ANOVA for repeated data (mixed) and GLM of the SAS statistical package. Short dry periods reduced milk production (26.55 vs. 27.55 kg/day; *P* # 0.01), without modifying milk quality. The mean interval from calving to first postpartum cycle was shorter in group T than in group C (34.5 vs. 46.9 days, *P* # 0.01). No differences were found in NEFA plasma concentrations between groups either before or after calving, while IGF-I circulating concentrations were higher in group T than in group C during both the dry period and the first 14 weeks of lactation (*P* # 0.01). In conclusion, the reduction in the dry period had a positive impact on metabolic balance and time of postpartum resumption of ovarian activity.

Keywords (separated by '-')	Dairy cow - Dry period - IGF-I - NEFA - Ovarian activity

Chapter 4
Effect of Dry Period Length on NEFA and IGF-I Plasma Concentrations and Postpartum Ovarian Activity Resumption in Dairy Cows

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Abstract The current study was carried out to examine the effects of dry period duration on NEFA and IGF-I plasma concentrations and postpartum ovarian activity resumption in dairy cows. Twenty-five pregnant Friesian cows (second and third lactation) were randomly assigned to one (standard dry period, 9 weeks, group C, $n = 12$) of two (short dry period, 5 weeks, group T, $n = 13$) treatments. Blood samples for NEFA and IGF-I analyses were collected once a week during the last 5 weeks prepartum and the first 14 weeks of lactation. Milk whey collection (twice/week) for progesterone analysis began 2 weeks after parturition and was used to detect ovarian activity resumption (at least three consecutive samples with P4 $\geq$ 300 pg/mL). The data obtained were analyzed by ANOVA for repeated data (mixed) and GLM of the SAS statistical package. Short dry periods reduced milk production (26.55 vs. 27.55 kg/day; $P \leq 0.01$), without modifying milk quality. The mean interval from calving to first postpartum cycle was shorter in group T than in group C (34.5 vs. 46.9 days, $P \leq 0.01$). No differences were found in NEFA plasma concentrations between groups either before or after calving, while IGF-I circulating concentrations were higher in group T than in group C during both the dry period and the first 14 weeks of lactation ($P \leq 0.01$). In conclusion, the reduction in the dry period had a positive impact on metabolic balance and time of postpartum resumption of ovarian activity.

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Keywords Dairy cow • Dry period • IGF-I • NEFA • Ovarian activity

Abbreviations

CP	Crude protein
dm	Dry matter
EE	Ether extract
IGF-I	Insulin-like growth factor I
NDF	Neutral detergent fiber
NEFA	~~Nonesterified~~ fatty acids
NFC	~~Nonfiber~~ carbohydrate

4.1 Introduction

The choice of dry period length in dairy cows is mainly based on expectations of milk production; however, the effects on health and postpartum (PP) reproductive efficiency should not be underestimated. It is well known that the duration of dry periods has an influence on energy balance, which in turn affects reproductive efficiency (Watters et al. 2009). The first PP ovulation occurs 10–14 days after the energy balance has reached its nadir. Some studies (Rastani et al. 2005) have suggested that the reduction or the absence of a dry period results in a less-pronounced negative energy balance than does a traditional dry period.

Studies on the effects of a short dry period on PP reproductive performance have produced differing results (Gumen and Wiltbank 2005; Pezeshki et al. 2007). This study considers the impact of a short dry period on the PP resumption of ovarian cyclicity and on the energy balance in dairy cows by assessing NEFA and IGF-I plasma concentrations.

4.2 Materials and Methods

Twenty-five pregnant Friesian cows of second and third parity were divided into two groups (C, $n = 12$; T, $n = 13$) according to parity and lactation performance during the previous year (C: 25.5 kg/day, 3.6% fat, 3.3% protein, T: 26.5 kg/day, 3.6% fat, 3.15% protein). The dry period lasted traditionally (9 weeks) for group C and was short (5 weeks) for group T. Both experimental groups were fed the same ration (CP = 17.9% dm, EE = 3.2% dm, NDF = 41.3% dm, and NFC = 32.1% dm) containing: corn silage (40%), alfalfa hay (14.5%), alfalfa meal (14%), and

soybean meal (7.3%). Cows were fed 10 kg/cow/day during the dry period and 41 kg/cow/day during lactation.

Blood samples were collected weekly from the fifth week before parturition until the 14th week PP for the determination of plasma concentrations of NEFA (Accorsi et al. 2005) and IGF-I (Leman and Kinsella 1989; Devolder et al. 1993). Qualitative and quantitative characteristics of milk production were recorded for each cow. To evaluate the PP ovarian activity, milk whey concentrations of progesterone (P4) were determined twice per week starting ~~during~~ the third week after parturition (Comin et al. 2005).

The resumption of cyclicity was defined by the detection of three consecutive values of P4 $\geq$ 300 pg/mL (Comin et al. 2005). The data obtained were analyzed using ANOVA procedures for repeated data (mixed) and GLM of the SAS statistical package (SAS Institute 1994). Differences were considered significant for $P \leq 0.05$.

4.3 Results

The shortened dry period resulted in a significant decrease in milk production (26.55 vs. 27.55 kg/day, $P \leq 0.01$) without changes in fat (3.48 vs. 3.55%, $P = 0.19$) or protein (3.28 vs. 3.31%, $P = 0.52$) contents. Similarly, FCM (fat corrected milk) and FPCM (fat/protein corrected milk) production was significantly lower in group T than in group C ($P \leq 0.05$ and $P \leq 0.01$, respectively).

The NEFA profiles showed a similar trend in both groups, with increasing values from 340 and 358 μEq/L for group T and C, respectively. The maximum values were reached during the first week PP (957 and 908 μEq/L), followed by a gradual regression to concentrations of 318 (group T) and 294 μEq/L (group C) in the last sample (Fig. 4.1a). No significant differences ($P = 0.46$) were found between the two groups regarding NEFA plasma concentrations before or after parturition.

The IGF-I in group T declined to a nadir of 8.2 ng/mL in the first week PP, and then showed a positive trend until the end of the study (100.7 ng/mL). On the contrary, subjects in group C showed a decline in IGF-I levels from 58.9 to 9 ng/mL in the last weeks of pregnancy, and, after parturition, IGF-I returned to the initial levels (56.8 ng/mL) (Fig. 4.1b). The shortening of the dry period significantly raised the content of IGF-I in the final stages of the dry period and during early lactation ($P \leq 0.01$).

The resumption of ovarian activity, based on changes in milk whey P4, was recorded in 10 of 13 cows with short dry periods and 9 of 12 cows with traditional dry periods. Subjects in group T showed a significant decrease of the time interval required for the resumption of ovarian activity as compared to cows in group C (34.5 $\pm$ 3:55 vs. 46.9 $\pm$ 2.3 days, $P \leq 0.01$).

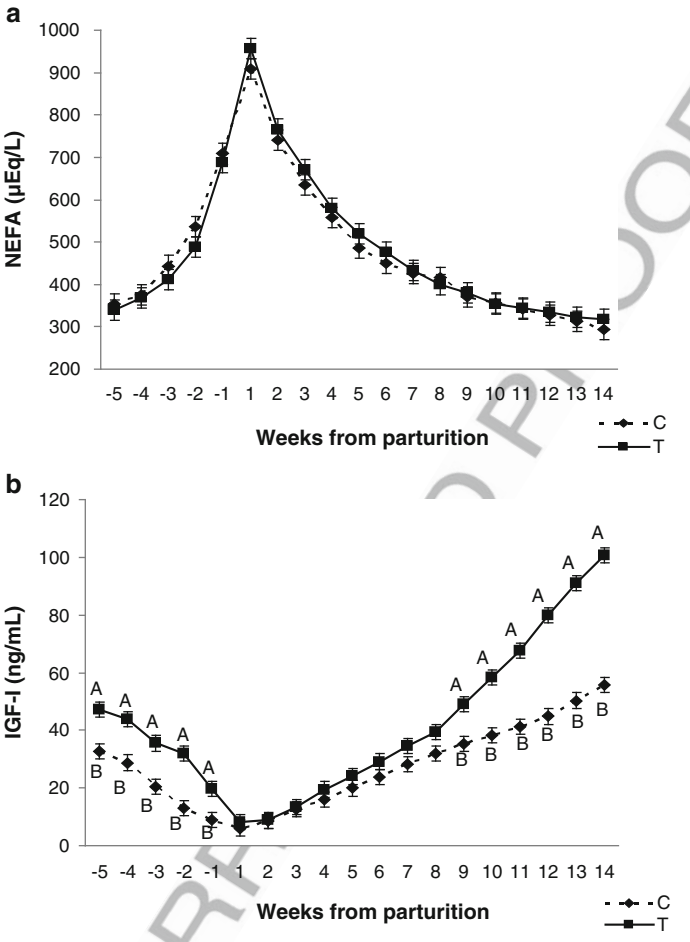

Fig. 4.1 (**a**) Mean (±SD) plasma concentrations of NEFA (µEq/L) in cows subjected to different dry period lengths. (**b**) Mean (±SD) plasma concentrations of IGF-I (ng/mL) in cows subjected to different dry period lengths. ($^{A,B}P \leq 0.01$)

4.4 Discussion

The reduction of the dry period to 5 weeks resulted in significant differences in the resumption of ovarian activity within 14 weeks PP in terms of time (34.5 vs. 46.9 days), but not numerically (76.9 vs. 75.0%). These results partially differ from data reported by Watters et al. (2009), who recorded, after a dry period of 34 days, a shorter interval between calving and first ovulation (35 vs. 43 days) and also a higher ovulation rate at 70 days of lactation (92 vs. 82%).

The pattern of NEFA plasma concentrations did not change significantly between the two treatment groups, which is in contrast to what was reported by

de Feu et al. (2009). The levels of IGF-I observed in group T were instead significantly higher during both the last part of the dry period and the first 14 weeks of lactation, displaying an improved energy balance as compared to the traditional dry period group.

Whole-milk production underwent a reduction of 4%, much lower than the 19% reported by de Feu et al. (2009), during the first 12 weeks of lactation. However, milk quality in terms of fat and protein content was not affected by the length of the dry period.

In conclusion, a reduction in the dry period resulted in a decrease in milk production, but improved the periparturient endocrine status, with a positive impact on both the metabolic balance and the time of postpartum resumption of ovarian activity.

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