J. Dairy Sci. 99:1–14
http://dx.doi.org/10.3168/jds.2015-10186

Effects of prepartum diets supplemented with rolled oilseeds on calf birth weight, postpartum health, feed intake, milk yield, and reproductive performance of dairy cows

R. Salehi,* M. G. Colazo,† M. Oba,* and D. J. Ambrose*†[1]
*Department of Agricultural, Food and Nutritional Science, University of Alberta, Edmonton, AB, T6G 2P5, Canada
†Livestock Research Branch, Alberta Agriculture and Forestry, Suite 307, 7000 - 113 Street NW, Edmonton, AB, T6H 5T6, Canada

ABSTRACT

The objectives were to determine the effects of supplemental fat (no oilseed vs. oilseed) during late gestation and the source of fat (canola vs. sunflower seed), on dry matter intake (DMI), plasma metabolite concentrations, milk production and composition, calf birth weight, postpartum health disorders, ovarian function and reproductive performance in dairy cows. Pregnant Holstein cows, blocked by body condition and parity, were assigned to 1 of 3 diets containing rolled canola seed (high in oleic acid; n = 43) or sunflower (high in linoleic acid; n = 45) at 8% of dry matter, or no oilseed (control; n = 43), for the last 35 ± 2 d of pregnancy. After calving, all cows received a common lactation diet. Blood samples were collected at wk −3 (i.e., 2 wk after initiation of prepartum diets) and at wk +1, +2, +3, +4 and +5 postpartum to determine the concentration of fatty acids (mEq/dL), β-hydroxybutyrate (mg/dL), and glucose (mg/dL). Ovarian ultrasonography was performed twice weekly to determine the first appearance of dominant (10 mm) and preovulatory-size (≥16 mm) follicles, and ovulation. Uterine inflammatory status based on the proportion of polymorphonuclear leukocytes (PMN; subclinical endometritis: >8% PMN) was assessed at d 25 ± 1 postpartum. Significant parity by treatment interactions were observed for DMI and milk yield. Prepartum oilseed supplementation, more specifically sunflower seed supplementation, increased postpartum DMI in primiparous cows without affecting prepartum DMI or milk yield. Contrarily, in multiparous cows, prepartum oilseed supplementation decreased both prepartum and postpartum DMI and milk yield during the first 2 wk. Regardless of parity, prepartum feeding of canola reduced postpartum DMI compared with those fed sunflower. Mean fatty acids concentrations at wk −3 were greater in cows given supplemental oilseed than those fed no oilseeds. Gestation length and calf birth weight were increased in cows given supplemental oilseed prepartum compared with cows fed no oilseeds, and a disproportionate increase in the birth weight of female calves was evident in cows fed oilseed. Total reproductive disorders tended to be greater in cows fed supplemental oilseed than those fed no oilseed (42 vs. 23%). Furthermore, cows fed sunflower seed had greater incidences of dystocia (35 vs. 18%) and total health disorders (52 vs. 32%) than those fed canola seed. Added oilseed and type of oilseed did not affect uterine inflammation at 25 ± 1 d postpartum. Oilseed supplementation did not alter the intervals from calving to establishment of the first dominant follicle, preovulatory-size follicle, and ovulation, nor did it affect fertility (conception rate to first artificial insemination and proportion of pregnant cows by 150 d after calving). In summary, prepartum oilseed supplementation (6.2 to 7.4% ether extract, % of dietary dry matter) decreased DMI during the entire experimental period (pre- and postpartum), decreased milk yield during early lactation in multiparous cows, and increased calf birth weight with no significant improvement in ovarian function and reproductive performance.

Key words: prepartum diets, oilseeds, calf birth weight, reproductive performance

INTRODUCTION

Plasma fatty acids concentrations usually increase early postpartum due to mobilization of adipose tissue because high-producing cows often cannot consume enough energy to meet requirements for milk production and maintenance (Bell, 1995; Drackley, 1999). An elevated concentration of fatty acids in the periparturient period is the major factor contributing to postpartum accumulation of lipids in the liver (Bell, 1981). Cow performance is negatively affected when lipid accumulation in the liver is excessive (Herdt, 1988). Therefore, management strategies that minimize

Received July 30, 2015.
Accepted January 20, 2016.
[1]Corresponding author: divakar.ambrose@gov.ab.ca

adipose tissue mobilization postpartum may be beneficial to improve cow performance. Whereas postpartum fat supplementation is a common practice in the dairy industry (reviewed by Santos et al., 2008), prepartum fat supplementation is less common. Although plasma fatty acid concentrations increase when fat is supplemented to the diet of lactating dairy cows (Grummer and Carroll, 1991), this response is not unequivocal. Grum et al. (1996) reported that feeding fat (6.5% of dietary DM; Qual-Fat mainly high in palmitic and oleic acids, National By-products Inc., Mason City, IL) to dairy cows during the dry period (from 60 to 7 d before expected calving date) essentially abolished accumulation of triacylglycerol in the liver during the postpartum period immediately after calving. Drackley (1999) has proposed that alterations in liver metabolism through fatty acid supplementation might adapt the ruminant liver to contend with the large peripartal increases in blood fatty acids and minimize the risk for the development of fatty liver. Importantly, the type of fatty acid supplements may affect plasma concentrations of fatty acids. Cows fed linseed oil (high in α-linolenic acid; 1.35% of dietary DM prepartum and 1.5% of dietary DM postpartum) had greater plasma concentrations of fatty acids at 2 and 5 wk postpartum and greater hepatic concentrations of fat at 2 wk postpartum compared with cows fed a high linoleic acid fat formulated at the same fatty acid concentrations (Amaral, 2008). These results collectively indicate that, in dairy cattle, the effect of prepartum fat supplementation on plasma metabolite concentration during calving transition period is not consistent.

In a previous study, Colazo et al. (2009) reported that dry cows fed diets supplemented with linola (high in linoleic acid) or flax seed (high in α-linolenic acid) had a numerically lower incidence of ovarian cysts and ovulated sooner after calving compared with those cows fed diets supplemented with canola (high in oleic acid). Prepartum dietary treatments did not affect calf birth weight, postpartum health disorders, energy balance, or fertility (Colazo et al., 2009); however, a control diet without supplemental fat was not included in that study. As canola seed is a common ingredient in dairy cattle rations, we wanted to confirm our previous observations and further investigate the effect of dietary canola seed on reproductive function. We hypothesized that cows given a prepartum diet supplemented with canola seed will have a longer interval from calving to first ovulation, as observed previously, compared with those fed diets supplemented with no oilseed or with sunflower seed. Our objectives were to determine the effects of supplemental fat (no oilseed vs. oilseed) during late gestation and the source of fat (canola vs. sunflower seed), on DMI, plasma metabolite concentrations, milk production and composition, calf birth weight, postpartum health disorders, ovarian function, and reproductive performance in dairy cows.

MATERIALS AND METHODS

Animals and Diets

One hundred thirty-one dry pregnant Holstein cows, parity 1 to 5 (46 primiparous and 85 multiparous), were used in the study. Thirty-five days (35 ± 2 d) before the expected calving date (wk −5), cows were blocked by BCS and parity, and assigned to 1 of 3 dietary treatments: sunflower seed (high in linoleic acid), canola seed (high in oleic acid), or no oilseed (control), with rolled oilseeds added at 8% on a DM basis. Oilseeds were rolled as described previously (Ambrose et al., 2006) before incorporation in the diet. Diets were offered ad libitum as a TMR containing barley silage, alfalfa hay, and concentrates. Upon calving, cows were placed on a common lactation diet. The ingredients and nutrient composition of both pre- and postpartum diets are presented in Table 1. The crude fat content and fatty acid profile of oilseeds are presented in Table 2. The study was conducted at the Dairy Research Unit of the University of Alberta, with all animal experimental procedures approved by the University of Alberta's Animal Care and Use Committee for Livestock (Protocol # AUP00000131), and animals were cared for according to the Canadian Council of Animal Care Guidelines (Olfert et al., 1993).

Cows were housed individually in tiestalls during pre- and postpartum periods, were fed once daily at 0800 h, and had unrestricted access to water. Postpartum cows were allowed 1 to 2 h of exercise on weekdays, and milked twice daily in their stalls between 0400 and 0600 h (a.m.) and between 1530 and 1730 h (p.m.). Milk production was automatically recorded at each milking. Feed intake was recorded daily and weekly feed samples were taken from forages and concentrates to determine feed DM and diet composition (Sun and Oba, 2014). Ratios of feed ingredients (as-fed basis) for rations were adjusted weekly based on each feed's DM values. Body condition scoring was performed on all cows at wk −5 to block the cows for treatment assignment. Body condition score and BW were also recorded for a subset of cows (n = 22 cows per treatment including 12 cows per treatment used for milk and blood sampling) at wk 0 (calving time) and wk +5. The same technician assigned BCS to each cow on a scale of 1 (emaciated) to 5 (overconditioned) (Edmonson et al., 1989).

Cow health status was monitored and recorded daily. Dystocia was defined as calving with assistance (easy pull), hard pull, or surgery (Sewalem et al., 2008).