EFFECTS OF VARYING FAT OR NFC IN DRY COW DIETS FED AT DIFFERENT LEVELS

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TAKE HOME MESSAGES

- Dry matter intake (restricted versus ad libitum) during the dry period has more of an effect on post-calving dry matter intake and liver fat accumulation than diet composition.
- Overfeeding dry cows, even if cows are not over conditioned, can increase the risk of metabolic problems after calving due to decreased feed intake and increased blood concentrations of NEFA.

INTRODUCTION

Fatty liver most commonly occurs around calving when cows are mobilizing large amounts of body tissue from adipose and muscle to offset the negative energy balance imposed by initiation of lactation and decreased feed intake. The liver takes up the mobilized non-esterified fatty acids (NEFA) from the blood in proportion to their concentration in blood. However, ruminant liver lacks the ability to export lipid to the same degree as uptake of NEFA. Hence, large amounts of NEFA in the blood, as seen around calving and early lactation, can predispose the cows to fatty liver. Cows with moderate to severe fatty liver are at risk for ketosis and other disorders. Moreover, cows with fatty liver exhibit decreased liver function leading to decreased reproductive performance and an inability to respond to treatments for other disorders. Treatments for fatty liver have not been effective and prevention should be the goal. Cows are at risk for fatty liver if they calve at body condition scores of greater than 4.0 on a 1 to 5 scale (1= thin and 5 = obese) and if they encounter stresses from lack of cow comfort and/or poor nutrition. Efforts should be made to maximize dry matter intake and decrease stress during the transition period to decrease excessive mobilization of NEFA.

Currently, the National Research Council recommends that cows should calve with the same body condition as at dry-off. Previous research from our group attempted to replenish condition of cows during the dry period that were dried-off at suboptimal body condition (< 3.5). Diets were formulated to meet (NE_L ~0.58 Mcal/lb) or exceed (NE_L ~0.65 Mcal/lb) current dry cow recommendations for energy and contained concentrate supplied as grain or grain plus supplemental fat. Moreover, little is known of the effects of feeding supplemental fat during the dry period. Although the original goal of recovering body condition during the dry period was not met, feeding supplemental fat was associated with decreased liver triglyceride accumulation 1 day after calving. However, dry matter intake was lower for cows fed supplemental fat than for cows fed diets supplemented with grain only. The factor(s) responsible for decreased

accumulation of liver fat could not be determined because lower intakes for cows fed supplemental fat confounded the effects of energy source in the diets.

The objectives of this research were 1) to discern whether source of energy (grain or fat) supplementation) or amount of energy consumption (higher vs. lower dry matter intake) was responsible for the decreased liver fat accumulation at calving and 2) to measure postpartum performance of cows fed grain or fat-supplemented diets at different levels of intake during the dry period.

MATERIALS AND METHODS

Sixty days before dry-off, 60 cows were assigned to one of five dietary treatments. Cows were chosen on the basis of a BCS of <3.5 at dry-off. Ingredients and chemical composition of the diets is shown in Tables 1 and 2, respectively. Diets were formulated to replenish body condition during the dry period when fed for ad libitum intake. Diets formulated to contain the same energy density from grain or fat plus oat hulls were fed for either ad libitum or restricted consumption throughout the dry period. Therefore, treatments consisted of high grain ad lib, high grain restricted, high fat ad lib, and high fat restricted. Cows that were restricted were fed to consume 80 % of the calculated National Research Council recommendation for net energy. A fifth dietary treatment consisted of the high grain diet supplemented with fat on the premise that supplemental fat fed during the dry period may increase body condition score and may offset metabolic problems during the transition period. Addition of fat increased the energy density of this diet compared to the isocaloric high grain and high fat diets and was fed for ad libitum intake only.

Cows were moved from individual tie stalls to maternity box stalls 2 weeks before expected calving date. During this time cows were fed their respective treatment diets with the addition of a premix containing anionic salts at 10 % of dry matter. Immediately after calving, cows were fed the lactation diet and performance was measured for 105 days. Liver samples were obtained by biopsy under local anesthesia from each cow 5 days before dry-off, 21 days before expected calving, and at 1, 21, and 65 days after calving. Blood was sampled from the tail vein once per week before and after calving, and was sampled more frequently during the transition period (4 weeks before and after calving).

RESULTS AND DISCUSSION

Optimal BCS may reduce risks for metabolic problems and would maximize profits from increased milk production and decreased veterinary care. Increasing energy density of the dry ration with supplemental fat may facilitate recovery body condition in high producing herds where it is difficult to achieve optimal body conditioning (3.50 - 3.75) before dry-off. In our study, regardless of concentrate from grain or supplemental fat, body condition score was increased about 0.2 score units on a 1 - 5 scale for cows fed ad libitum during the dry period. However, restricted-fed dry cows lost about 0.5 units of body condition. Restricted-fed cows mobilized body tissues because they consumed significantly less dry matter (Figure 1). These cows had increased plasma concentrations of NEFA when compared to dry cows fed ad libitum. Cows fed the high grain plus fat diet (that contained the highest concentration of energy) lost

significantly more body condition during the first weeks after calving. Interestingly, cows restricted-fed during the dry period exhibited increased dry matter intake (Figure 1) and hence, decreased concentrations of NEFA during the first 21 days after calving when compared to cows fed ad libitum while dry.

Increased NEFA should predispose cows to fatty liver development. Remarkably, cows that were restricted-fed while dry had less triglyceride (Figure 2) 1 day after calving than cows fed ad libitum-fed while dry, even though plasma NEFA concentrations were significantly increased during the dry period with restricted feeding. The cause for the decreased total lipid and triglyceride cannot be determined yet because all laboratory assays have not been completed. Previous research from our laboratory has shown that metabolic mechanisms within the liver may adapt to increased exposure to blood NEFA.

Milk production and composition did not differ significantly between treatment groups. Interestingly, the number of metabolic problems encountered during the early postpartum period was less for cows that were restricted-fed the high fat diet while dry. Inferences must be made with caution because of the small number of cows per treatment group.

CONCLUSIONS

Our data suggest that feeding supplemental fat to dry cows does not increase the risk for fatty liver around calving. These data confirm previous data from others that overfeeding cows during the dry period is a detriment to subsequent lactation performance. This was true even though our cows were not over conditioned. Recent data from Wisconsin has shown that cows that consume more dry matter just before calving are more likely to consume more dry matter during early lactation. Our data do not disagree with these data because the stimulus for feed intake was present in our restricted-fed cows before calving even though they were not allowed to consume feed ad libitum. Data from Great Britain and Switzerland have also shown that feed restriction during the dry period results in greater feed intake after calving. Although the full consequences of feed restriction of dry cows are not completely known, this discovery has the potential for opening new frontiers in management of dry and transition cows to avoid metabolic problems. Watch for further updates on this project!

Table 1. Ingredient composition of dry cow and lactation diets. Diets are high grain plus fat (HGF), high grain (HG), fat supplemented (HF), and lactation.

	Diet			
Ingredient	HGF	HG	F	Lact.
	% of DM			
Alfalfa silage	50.00	50.00	50.00	26.00
Corn silage	25.00	25.00	25.00	26.00
Ground shelled corn	12.15	15.00	3.15	24.75
Soybean meal	2.50	1.65	4.00	14.50
Soy hulls	6.00	8.00	1.5	4.00
Oat hulls	..	..	12.00	..
Liquid fat	4.00	..	4.00	2.00
Mineral-vitamin mix	.15	.15	.15	.15
Limestone	..	..	..	1.00
Na Bicarbonate	..	..	..	.75
Mg oxide	..	..	..	.15
Dicalcium phosphate	..	..	..	.50
Salt (plain)	.20	.20	.20	.20

Table 2. Chemical composition of dry cow and lactation diets. Diets are high grain plus fat (HGF), high grain (HG), fat supplemented (HF), and lactation.

	Diet			
Component	HGF	HG	F	Lact.
	% of DM			
DM %	60.21	63.65	60.56	66.34
CP	13.11	13.26	12.87	16.89
ADF	30.93	31.98	33.37	20.40
NDF	42.70	44.10	48.09	29.99
NFC	31.75	33.88	21.11	39.24
Ether Extract [1]	6.91	3.08	6.60	4.87
NE_L	1.61	1.46	1.47	1.71
Ca	1.09	1.10	1.08	.94
P	.36	.35	.36	.42
Mg	.22	.22	.21	.28
K	1.72	1.74	1.71	1.49

[1]Feed library (Feedstuffs, 1994)

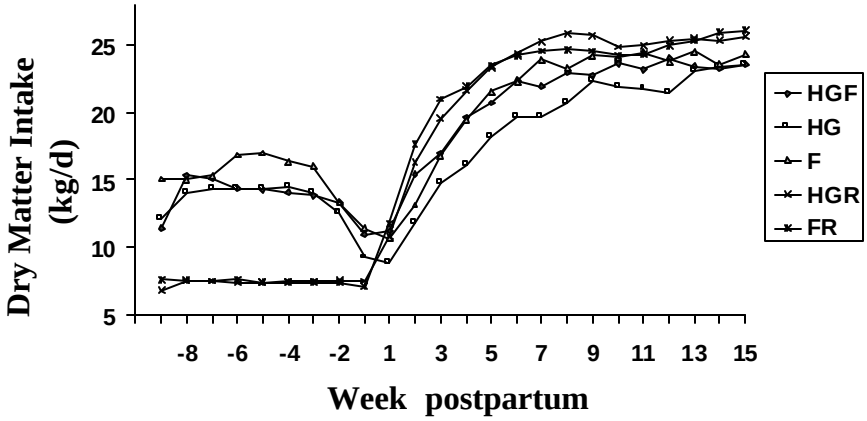

Figure 1. Dry matter intake of cows during the dry period and through 15 weeks of lactation. Dietary treatments are high grain plus fat (HGF), high grain, ad libitum-fed (HG), fat supplemented, ad libitum-fed (F), high grain, restricted-fed (HGR), and fat supplemented, restricted-fed (FR).

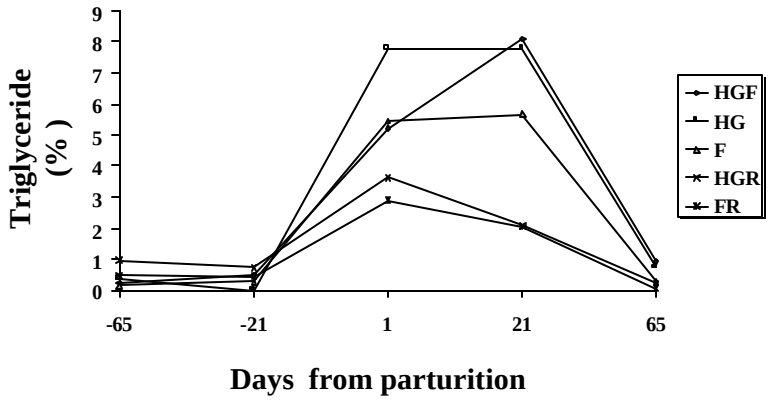

Figure 2. Liver triglyceride content of cows during the dry period through 15 weeks of lactation. Dietary treatments are high grain plus fat (HGF), high grain, ad libitum-fed (HG), fat supplemented, ad libitum-fed (F), high grain, restricted-fed (HGR) and fat supplemented, restricted-fed (FR).