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Effect of Supplemental Fat From Dried Distillers Grains with Solubles or Corn Oil on Cow Performance, IGF-1, GH, and NEFA Concentrations

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Effect of supplemental fat from dried distillers grains with solubles or corn oil on cow performance, IGF-1, GH, and NEFA concentrations[1]

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Summary

Research has demonstrated that supplemental fat and(or) changes in growth hormone (GH) or insulin-like growth factor-1 (IGF-1) concentrations may affect reproductive performance in beef females. Dried distillers grains with solubles (DDGS) contain approximately 10% to 15% fat; however, minimal research to date has investigated DDGS specifically as a supplemental fat source. The objective of this experiment was to investigate whether supplemental fat from either DDGS or raw corn oil impacts cow growth performance and plasma GH, IGF-1, or non-esterified fatty acid (NEFA) concentrations. Sixty open beef cows [body weight (BW) = 553.5 ± 38.7 kg; body condition score (BCS) = 5.4 ± 0.53] were stratified by BW and BCS and allotted to 15 pens (n = 4 per pen; 14.6 x 37.2 m). Pens were randomly assigned to one of three dietary treatments: 1) DDGS, 2) a combination of high-protein dried distillers grain, corn bran, and corn oil (OIL), or 3) a combination of high-protein dried distillers grain and corn bran (HPBRAN). The DDGS, OIL, and HPBRAN treatments each comprised 35% of the diet dry matter (DM). Thirty-five percent was selected based upon the sulfur (S) content of dietary ingredients in the DDGS treatment and water, estimated water intake, and the maximum tolerable S concentration for cattle on forage-based diets (0.5%). In addition to dietary treatments, cattle were provided grass hay [7.7% crude protein (CP)] and a pelleted supplement containing vitamins and minerals as part of a totally mixed ration. Cows were fed once daily, in the morning, for 60 d. All diets were iso-nitrogenous (15.3% CP from d 0 to 47 and 15.1% from d 48 to 60) and total fat concentrations were 5.1% for DDGS and OIL and 3.5% for HPBRAN. Weights and blood samples were recorded prior to feeding on d -1, 0, 28, 59, and 60. Dry matter intake, average daily gain, final BW, and gain:feed were not affected by treatment. Treatment had no effect on plasma GH, IGF-1, or NEFA concentrations. These results suggest that providing low concentrations of supplemental fat as DDGS or raw corn oil to a forage-based diet does not influence growth performance, plasma GH, IGF-1, or NEFA concentrations in open beef cows.

Introduction

Supplemental fat has been shown to increase serum growth hormone (GH) concentrations in beef cattle (Williams and Stanko, 2000). The increase in GH coincides with an increase in follicular fluid insulin-like growth factor-1 (IGF-1) concentrations, whereas peripheral IGF-1 levels are not affected. Accumulation of follicular fluid IGF-1 has been proposed as one of the mechanisms associated with follicle selection. Researchers have hypothesized that these changes in hormone concentrations may be associated with unsaturated fats (Williams and Stanko, 2000).

Dried distillers grains plus solubles (DDGS) are a co-product of the ethanol industry. Survey research suggests that distillers grains contain approximately 10.8% fat (Shurson, 2006). Furthermore, corn oil is high in unsaturated fatty acids (Griinari et al., 1998). Under normal circumstances, unsaturated fatty acids that are introduced into the rumen are biohydrogenated to more saturated fatty acids. However, recent research suggests that the fat contained in distillers grains may be somewhat protected from biohydrogenation in the rumen (Koger et al., 2004; Vander Pol et al., 2004). University of Nebraska

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researchers reported decreased feedlot performance when 5% fat was included as corn oil, but no affect was observed when 5% fat was included as wet distillers grains (Vander Pol et al., 2004). These data suggest that the lipids contained in corn oil or distillers grains may be metabolized differently and elicit different production responses. Researchers at South Dakota State University examined the effect of 20% or 40% wet or dry distillers grains on the fatty acid composition of the longissimus muscle of steers (Koger et al., 2004). The researchers found that muscle tissue from cattle fed either wet or dry distillers grains contained higher concentrations of unsaturated fatty acids. Together, these data suggest that the unsaturated fats contained in distillers grains may escape rumen biohydrogenation and may be absorbed in an unsaturated form.

The current experiment was designed to compare the effect of supplemental fat as either DDGS or raw corn oil on cow performance and plasma GH, IGF-1, and non-esterified fatty acid (NEFA) concentrations.

Materials and Methods

Sixty open beef cows were purchased from public auction markets and transported to the Southeast Research Farm located near Beresford, SD. Initial body weights (BW; 1220.5 ± 77.4 lb) were recorded and initial body condition score (BCS; 5.4 ± 0.53) were determined as the average of two experienced evaluators. Cows were stratified by BW and BCS and allotted to 1 of 15 pens. The cows were provided with medium-quality grass hay *ad libitum* for a minimum of 14 d prior to trial initiation; after which the pens were randomly assigned to one of three dietary treatments.

The first dietary treatment (DDGS) was comprised solely of DDGS and contained approximately 15% dietary crude protein (CP) and 5% dietary ether extract (EE). The second dietary treatment (OIL) contained high-protein dried distillers grains (HP DDG), corn bran, and corn oil to provide the same amount of CP and EE as the DDGS diet. The final treatment (HPBRAN) was formulated provide the same amount of protein, but no additional fat; dietary ingredients included HP DDG and corn bran (Table 1).

Table 1. Composition of treatment diets

	Treatments		
Item	DDGS	OIL	HPBRAN
	----------% of diet DM----------		
Hay	62.5	62.5	62.5
Supplement [a]	2.5	2.5	2.5
DDGS [b]	35	---	---
HP- DDG [c]	---	20.7	20.3
Corn bran	---	12.6	14.7
Corn oil	---	1.7	---
Analyzed nutrient composition			
Dry matter	84.5	84.1	83.7
Crude protein	15.1	15.1	15.1
Ether extract	5.1	5.1	3.5
Sulfur	0.5	0.5	0.5

[a] Provides vitamins and minerals to meet or exceed nutrient requirements (Nutrient Requirements of Beef Cattle, National Research Council, 2000).
[b] Dried distillers grains with solubles.
[c] High-protein dried distillers grains.

Dietary CP fed in this experiment (15%) is substantially more than these cows require; diets were formulated to provide the maximum amount of fat from distillers as possible without causing health problems due to sulfur (S) intake. Mineral Tolerances of Animals states the maximum tolerable S concentration for cattle on forage-based diets as 0.5%. Daily water intake was estimated to be 7 gal/d

and available water and all feed ingredients were analyzed to determine S content prior to trial initiation. Cows were fed a totally mixed ration which consisted of the dietary treatment, medium-quality grass hay and a vitamin/mineral supplement to meet or exceed the cows' mineral requirements as suggested by the NRC (2000).

Weights were recorded on 2 consecutive d prior to trial initiation and at trial termination and one day near the midpoint of the trial. Blood samples were collected on d 0, 28, and 60. Growth hormone and IGF-1 concentrations were analyzed using radioimmunoassay. Non-esterified fatty acid concentrations were analyzed using a colorimetric assay. Cow performance data were analyzed using the PROC GLM method of SAS with pen as the experimental unit. Plasma GH, IGF-1, and NEFA data were analyzed as repeated measures using the mixed procedure of SAS with pen as the experimental unit.

Results and Discussion

Cow performance data are presented in Table 2. Dietary treatments had no effect on animal performance. Cows consumed 2.4 to 2.6% of their body weight and gained 1.2 to 1.3 kg per head per day.

Table 2. Cow growth performance.

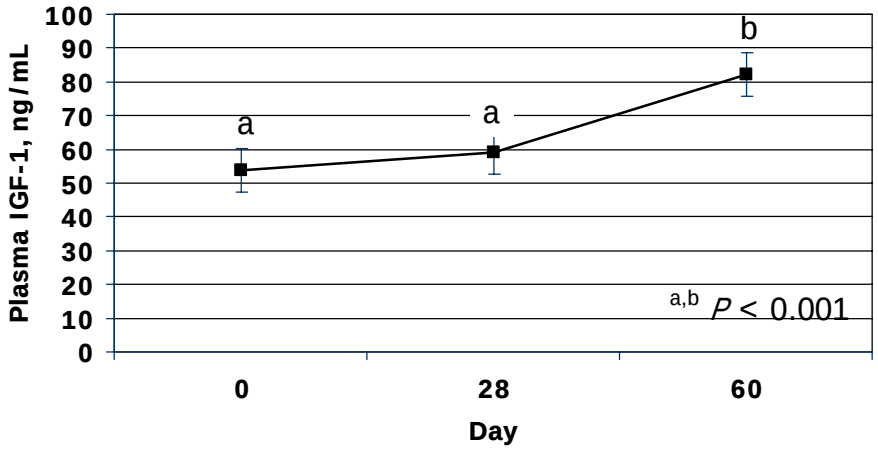
	Treatment				
Item	DDGS	OIL	HPBRAN	SEM	*P*-value
DMI, lb	34.4	36.2	34.2	2.9	0.87
ADG, lb	2.9	2.6	2.9	0.4	0.78
G:F	0.08	0.07	0.08	0.01	0.78

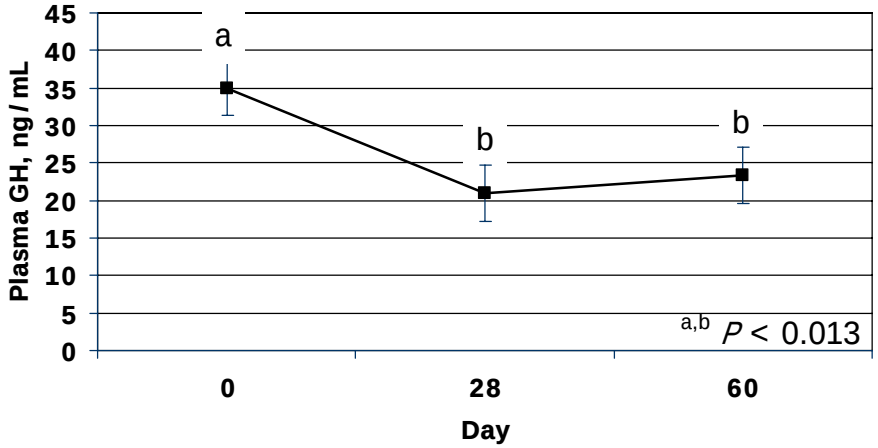
Table 3. Plasma GH, IGF-1, and NEFA concentrations.

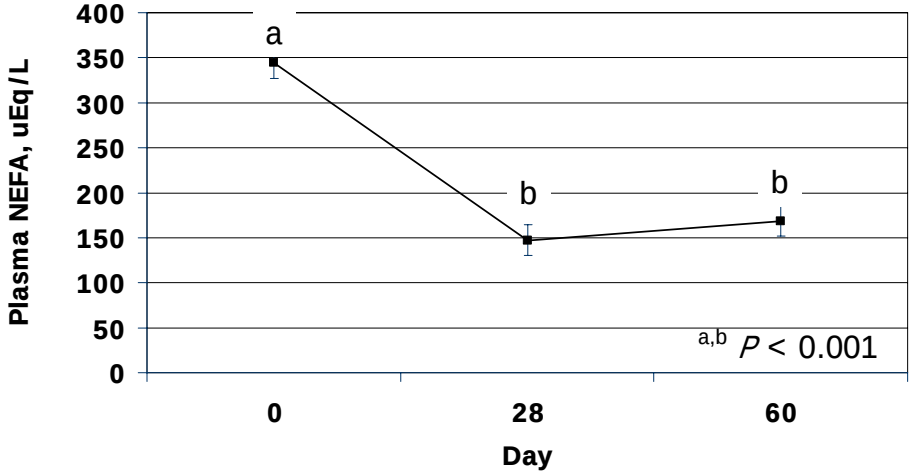
	Treatment				
Item	DDGS	OIL	HPBRAN	SEM	*P*-value
GH, ng/mL	32	20	28	4.0	0.09
IGF-1, ng/mL	78	57	60	9.3	0.23
NEFA, µEq/L	247	218	195	19.8	0.18

Plasma GH, IGF-1, and NEFA concentrations were not affected by treatment by time interactions. Table 3 shows the main effect of treatment on the hormone and NEFA concentrations.

Figures 1, 2, and 3 illustrate the main effect of time on plasma GH, IGF-1, and NEFA, respectively. Plasma IGF-1 concentration was greater ($P < 0.001$) on d 60 than on d 0 or 28 (Figure 1). From d 0 to d 28, plasma GH concentration decreased ($P < 0.013$); concentrations on d 28 and d 60 were similar (Figure 2). Plasma NEFA concentration decreased ($P < 0.001$) from d 0 to d 28; concentrations on d 28 and d 60 were not different. This decrease in plasma NEFA concentrations is likely the result of the grass hay diet the cows were fed prior to the initiation of the experiment. It is possible that the grass hay was not meeting the energy demands of the cows, and consequently, they were mobilizing body fat stores to meet their energy needs. Then, once the experiment began and the plane of nutrition was increased, the circulating NEFA concentrations decreased in a similar pattern to that of GH.


Plasma IGF-1, ng/mL
100
90
80
70
60
50
40
30
20
10
0
a
a
b
a,b P < 0.001
0
28
60
Day


Plasma GH, ng/mL
45
40
35
30
25
20
15
10
5
0
a
b
b
a,b P < 0.013
0
28
60
Day


Plasma NEFA, uEq/L
400
350
300
250
200
150
100
50
0
a
b
b
a,b P < 0.001
0
28
60
Day

FIGURES 1, 2, 3

Implications

This experiment suggests that, when total dietary fat concentrations are equal to or below 5.1%, supplemental fat from either DDGS or corn oil does not impact growth performance or plasma GH, IGF-1, or NEFA concentrations in open beef cows.

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