Effect of CottonFlo™ and FuzZpellet™ on Feedlot Performance, Carcass Merit, and Feeding Behavior in Feedlot Cattle

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Story in Brief

The objectives of these experiments were to evaluate: 1) the effects of CottonFlo and FuzZpellet on feedlot performance and carcass characteristics in feedlot heifers, and 2) the effects of CottonFlo and FuzZpellet on feeding behavior in steers fed a high-grain diet. Our data suggest that CottonFlo included at 15% of the diet dry matter or FuzZpellet included at 15 or 25% of the diet dry matter can replace dry rolled corn, roughage, and fat in high-grain finishing diets without adverse effects on cattle performance. Heifers fed 15% FuzZpellet had 6.3% greater average daily gain and were 4.7% more efficient than control heifers. With the exception of greater hot carcass weight in heifers fed FuzZpellet, source of cottonseed had no effect on carcass merit. The presence or physical nature of the cotton linters seemed to contribute to the stimulation of chewing, and feeding whole cottonseed resulted in greater chewing time than CottonFlo or FuzZpellet. Interestingly, steers fed 15% CottonFlo or FuzZpellet spent less time eating and more time ruminating, such that total chewing time was not different among treatments, with the exception of the steers fed whole cottonseed.

Key Words: Carcass Merit, Cattle, Cotton By-Products, Feedlot Performance

Introduction and Justification

Feeding management of feedlot cattle is an efficiency driven business in which cost of gain is the primary target. Purchasing and handling of roughage represents a major cost to the feedlot industry; roughage is an expensive source of energy compared with cereal grains. In addition, handling animal fat (e.g., tallow) requires energy for heating. Products such as CottonFlo™ and FuzZpellet™ provide fiber, fat, and protein in one package, and therefore have great potential for reducing costs of handling and storing commodities. In fact, feeding full-fat oil seeds has been shown to increase milk fat content of conjugated linoleic acid (CLA; Chouinard et al., 2001), and there is recent interest in increasing the CLA content of intramuscular fat in beef (Mir et al., 2000; Beaulieu et al., 2002). Conjugated linoleic acids are components of ruminant fat that bring a new and exciting twist to the concept of redesigning foods to more closely reflect consumer demands, because of their purported health benefits. Biomedical studies with animal models have demonstrated that the beneficial effects of CLA include: anti-carcinogenic capabilities, modulation of the immune system, anti-obesity effects, anti-diabetic properties, and anti-atherogenesis (Whigham et al., 2000). Therefore, increasing CLA in ruminant muscle fat could have a major impact on the beef cattle industry.

Delinted cottonseed has been shown to improve lactational response in dairy cows, resulting in a 3% greater value for milk (Kutches et al., 1987). In addition, pelleted cottonseed has been shown to numerically increase dry matter intake, milk production, and 4% fat-correct milk compared with whole cottonseed (Bernard and Amos, 1985). Little or no information is available on the effects of including these commodities in the diets of feedlot cattle, although the potential exists for these products to improve efficiency and health of beef cattle and their products while reducing costs associated with the handling of commodities. The objectives of this experiment were to evaluate: 1) the effects of CottonFlo and FuzZpellet on feedlot performance and carcass characteristics in feedlot heifers, and 2) the effects of CottonFlo and FuzZpellet on feeding behavior in steers fed a high-grain diet.

Materials and Methods

Performance Experiment. One-hundred and fifty crossbred yearling heifers (avg initial BW = 318 ± 11.8 kg) were delivered to the Willard Sparks Beef Cattle Research Center near Stillwater, OK. On arrival, heifers were individually weighed and ear tagged. Subsequently, heifers were horn tipped as needed, implanted with Synovex-Plus (Fort Dodge Animal Health, Fort Dodge, IA), vaccinated with IBR-PI3-BVD-BRSV, vaccinated with a seven-way clostridial preparation, and treated for control of external and internal parasites. Heifers were blocked by initial body weight into six weight blocks. Body weights (unshrunk) were measured on two consecutive days following arrival (d 0 and 1) to determine initial weight. Within block, heifers were assigned randomly to five pens of 5 heifers/pen. The number of replications for each treatment was six.

Treatments included: 1) control (CON); 2) CottonFlo 15% (CF15); 3) FuzZpellet 15% (FP15); 4) CottonFlo 25% (CF25); and 5) FuzZpellet 25% (FP25). Diets and nutrient composition are shown in Table 1. The control diet contained 78.5% rolled corn, 7.5% cottonseed hulls, 3.0% fat, and 11.0% supplement, and was formulated to meet or exceed NRC (1996) nutrient requirements. Monensin (30 g/ton of diet) and tylosin (10 g/ton of diet) were fed. Heifers were gradually adapted to their finishing diet by offering 65, 75, and 85% concentrate diets for seven days each. Feed refused was weighed every 28 d. In addition, diet samples were collected, and DM content of the diets and dietary ingredients was determined. Diet and ingredient samples were composited by 28-d periods, dried in a forced-air oven, and ground in a Wiley mill to pass a 1-mm screen. Interim unshrunk BW was determined at 28-d intervals. Heifers were harvested at a commercial facility. Hot carcass weight, external fat, internal fat, longissimus muscle area, marbling score, yield grade, quality grade, and liver scores were determined.

Data were analyzed as a randomized complete block design using the GLM procedure of SAS (1998). The model included terms for treatment and block.

Animal Behavior/Metabolism Experiment. Six ruminally and duodenally cannulated yearling crossbred steers were randomly allotted to one of six treatments in a 6 x 6 Latin square design experiment. Steers were gradually adapted to a 92.5% concentrate diet by offering 60, 70, and 80% concentrate diets for seven days each. Following the adaptation period, each steer received a different treatment in each period and received every treatment once over the course of the trial. Treatments included: 1) CON; 2) CF15; 3) FP15; 4) CF25; 5) FP25; and 6) whole cottonseed 25% (WCS). Diets were the same as those used in the performance experiment (Table 1). The whole cottonseed diet contained 70% corn, 25% whole cottonseed and 5% supplement. The supplement was the same as for the FP25 treatment.

Diets and Supplements. Diets were weighed out daily and fed to steers on an individual basis. Samples of the diet were taken at feeding and frozen (-20°C). Any orts were weighed, recorded, and subsampled at the end of each experimental period. Diet and orts samples were allowed to air dry and ground in a Wiley mill to pass a 1-mm screen. Experimental periods were 28 d in length. Days 1 through 19 were a diet adaptation period and d 20 through 28 were the sampling period.

Behavioral Data. Total chewing, eating, and ruminating times were recorded on d 20 of each period. The chewing activity of individual steers was observed and recorded every 5 min during 24 h.

Ruminal Samples. On d 27, ruminal fluid samples were collected before feeding (0 h) and at 3, 6, 9, 12, 18, 21, and 24 h after feeding to determine pH, VFA, ammonia-N, and Co concentrations. Ruminal fluid samples were collected from the ventral rumen, strained through cheesecloth, analyzed for pH, and frozen (-20° C) immediately.

Statistical Analysis. Data were analyzed using the MIXED procedure of SAS (1998). The model included terms for steer, period, and treatment.

Results and Discussion

Performance Experiment. Overall average daily gain (ADG) and feed efficiency (F:G) were adjusted using hot carcass weight divided by a common dressing percentage. Average daily gain was greater ($P=0.005$) for heifers fed 15% FuzZpellet than for heifers fed CottonFlo; heifers fed the control diet were intermediate (Table 2). No difference ($P>0.10$) was observed in overall dry matter intake (DMI) among treatments. Similar to ADG, F:G ($P=0.04$) was greatest for heifers fed FuzZpellet, intermediate for CON heifers and heifers fed CF15, and lowest for heifers fed CF25. Calculated net energy for gain was 1.39, 1.35, 1.26, 1.49, and 1.44 Mcal/kg of DM for CON, CF15, CF25, FP15, and FP25, respectively.

Hot carcass weights were greatest ($P=0.001$) for heifers fed FuzZpellet, intermediate for CON heifers and heifers fed CF15, and lowest for heifers fed CF25 (Table 3). No other differences ($P>0.10$) were observed among treatments for carcass characteristics. These data suggest that CottonFlo (15%) and FuzZpellet (15 and 25%) can replace dry rolled corn, cottonseed hulls, and cottonseed meal in finishing diets fed to feedlot cattle.

Behavior/Metabolism Experiment. During the metabolism experiment, steers fed CON and FuzZpellet had greater ($P=0.04$) DMI than steers fed CottonFlo; steers fed WCS were intermediate (Table 4). Steers fed CON or WCS spent more ($P=0.04$) minutes per day eating than CF15 or FP15 steers. When expressed as min/lb of DMI, steers fed CF15 or FP15 spent less ($P=0.03$) time eating than steers fed CF25; all other treatments were intermediate. Steers fed WCS spent more ($P<0.01$) time ruminating than steers on all remaining treatments. Similarly, min/day spent chewing was greater ($P<0.01$) for steers fed WCS compared with steers fed cotton byproducts or the control diet. Ruminal pH did not differ ($P=0.18$) among treatments.

Table 1. Composition of experimental diets, % of DM

Ingredient	Control	CottonFlo 15%	CottonFlo 25%	FuzZpellet 15%	FuzZpellet 25%

Rolled corn	78.50	78.50	70.00	78.50	70.00
Cottonseed Hulls	7.50	---	---	---	---
CottonFlo	---	15.0	25.0	---	---
FuzZpellet	---	---	---	15.0	25.0
Fat	3.00	---	---	---	---
Wheat midds	---	2.40	3.28	.40	2.96
Cottonseed meal	8.50	2.00	---	4.00	---
Limestone, 38%	1.25	1.25	1.25	1.25	1.25
Urea	.78	.38	---	.38	.32
Potassium chloride	.14	.14	.14	.14	.14
Salt	.25	.25	.25	.25	.25
Rumensin 80	.018	.018	.018	.018	.018
Tylan 40	.013	.013	.013	.013	.013
Vitamin A 30,000	.011	.011	.011	.011	.011
Availa Zn 100	.030	.030	.030	.030	.030
Zinc sulfate	.003	.002	.001	.003	.002
Manganous oxide	.004	.004	.004	.004	.004
Copper sulfate	.002	.002	.002	.002	.002
Nutrient composition, DM basis					
NEm, Mcal/cwt	97.4	100.7	102.0	100.7	101.7
NEg, Mcal/cwt	62.4	66.2	67.6	66.3	67.5
Fat, %	6.5	6.6	8.4	6.1	7.7
NDF, %	6.5	8.8	12.6	9.7	14.4
CP, %	13.5	13.5	13.5	13.5	13.5
K, %	.60	.63	.70	.63	.68
Ca, %	.54	.54	.56	.54	.55

P, %	.33	.38	.40	.36	.37

Table 2. Effect of CottonFlo® vs FuzZpellet® on feedlot performance

	Treatments[a]						
	CON	CF15	CF25	FP15	FP25	SEM[b]	P>F
Heifers	29	30	30	30	30		
Pens	6	6	6	6	6		
Weight, lb							
Initial	698	704	698	703	703	4.77	.77
28-d	804	792	785	797	791	6.25	.24
56-d	905^{c}	892^{cd}	877^{d}	902^{cd}	889^{cd}	7.01	.04
84-d	976^{cd}	968^{de}	947^{e}	991^{c}	972^{cd}	8.45	.01
112-d	1036^{c}	1038^{c}	1010^{d}	1060^{c}	1041^{c}	9.74	.001
140-d	1124^{de}	1118^{de}	1100^{e}	1150^{c}	1137^{cd}	10.54	.02
Final (d 150)	1145^{de}	1156^{cde}	1129^{e}	1184^{c}	1169^{cd}	10.84	.01
Carcass adjusted	1197^{de}	1197^{de}	1168^{e}	1234^{c}	1226^{cd}	11.92	.001
ADG, lb/d							
0-28	3.81^{c}	3.14^{d}	3.11^{d}	3.35^{cd}	3.16^{d}	.19	.06
28-56	3.62	3.55	3.28	3.77	3.47	.16	.17
56-84	2.51^{d}	2.72^{de}	2.52^{c}	3.19^{c}	2.97^{cd}	.13	.001
84-112	2.18	2.52	2.23	2.47	2.47	.13	.25
112-140	3.12^{cd}	2.86^{d}	3.25^{c}	3.18^{c}	3.40^{c}	.12	.03
0-150	2.99^{de}	3.01^{de}	2.88^{e}	3.19^{c}	3.10^{cd}	.07	.002
Carcass adjusted	3.33^{cde}	3.28^{de}	3.14^{e}	3.54^{c}	3.49^{cd}	.08	.005
DMI, lb/d							
0-28	18.9	18.3	17.9	18.4	18.7	.46	.57
28-56	20.1^{c}	18.9^{de}	18.3^{e}	19.5^{cd}	19.7^{cd}	.41	.04

56-84	18.2	18.4	18.9	19.0	19.2	.43	.51
84-112	19.4	20.5	20.1	19.9	20.3	.45	.45
112-140	20.3	20.9	21.5	21.2	21.4	.63	.63
0-150	19.4	19.6	19.6	19.8	20.0	.37	.82
F:G, lb/lb							
0-28	5.04	5.95	6.00	5.63	5.90	.34	.40
28-56	5.62	5.40	5.60	5.21	5.78	.19	.29
56-84	7.33	6.98	7.60	6.04	6.65	.43	.14
84-112	9.46	8.30	9.11	8.32	8.36	.66	.62
112-140	6.65	7.54	6.68	6.99	6.32	.51	.52
0-150	6.51	6.53	6.83	6.20	6.48	.18	.14
Carcass adjusted	5.84[de]	5.98[de]	6.28[e]	5.58[c]	5.77[cd]	.13	.04
NEg, Mcal/kg	1.39	1.35	1.26	1.49	1.44	-	-

[a] CON = Control; CF15 = 15% CottonFlo; CF25 = 25% CottonFlo; FP15 = 15% FuzZpellet; FP25 = 25% FuzZpellet.
[b] Standard error of the least squares means.
[c,d,e]Means within rows lacking common superscripts differ ($P<0.05$).

Table 3. Effect of cottonseed byproducts on carcass characteristics

	Treatments[a]						
	CON	CF15	CF25	FP15	FP25	SEM[b]	Pr>F
Heifers	29	30	30	30	30		
HCW, lb	748[de]	748[de]	730[e]	771[c]	766[cd]	7.45	0.001
Dressing %	62.7	62.1	62.0	62.6	63.0	0.30	0.18
REA, in2	11.7	11.7	11.7	12.5	12.6	0.39	0.24
12th-rib fat, in	0.55	0.57	0.55	0.55	0.57	0.02	0.99
KPH, %	2.53	2.82	2.50	2.45	2.51	0.10	0.12
Marbling score[c]	485	488	465	489	483	11.0	0.54

Yield Grade	3.59	3.66	3.43	3.45	3.28	0.18	0.64

[a]CON = Control; CF15 = 15% CottonFlo; CF25 = 25% CottonFlo; FP15 = 15% FuzZpellet; FP25 = 25% FuzZpellet
[b] Standard error of the least squares means.
[c,d,e]Means within rows lacking common superscripts differ (P<0.05).

Table 4. Chewing responses by steers

	Treatments[a]							
Item	CON	CF15	CF25	FP15	FP25	WCS	SEM	P>F
DM intake, lbs	21.0[a]	16.7b[c]	15.8[c]	19.5[ab]	20.5[a]	18.6[abc]	1.5	0.04
Eating								
min/day	172.1[a]	108.9[b]	152.8[ab]	111.4[b]	146.4[ab]	153.9[a]	25.5	0.04
min/lb DMI	8.02[abc]	6.54[b]	10.03[c]	5.59[b]	7.21[ab]	8.31[abc]	1.34	0.03
Ruminating								
min/day	143.6[a]	160.9[a]	131.5[a]	157.7[a]	145.1[a]	239.2[b]	21.5	<0.01
min/lb DMI	7.11[a]	9.95[a]	8.04[a]	8.28[a]	7.20[a]	12.86[b]	1.07	<0.01
Chewing								
min/day	314.9[a]	270.1[a]	284.5[a]	269.3[a]	291.7[a]	393.4[b]	35.7	<0.01
min/lb DMI	15.1[ab]	16.5[ab]	18.1b[c]	13.9[a]	14.4[ab]	21.2[c]	1.76	<0.01
Ruminal pH	5.58	5.50	5.58	5.52	5.74	5.74	0.17	0.18

[a]CON = Control; CF15 = 15% CottonFlo; CF25 = 25% CottonFlo; FP15 = 15% FuzZpellet; FP25 = 25% FuzZpellet, WCS = 25% whole cottonseed.
[b,c,d]Means within rows lacking common superscripts differ (P<0.05).

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