Effects of Feeding Low Phytate Corn Varieties on Growth Performance, Feed Efficiency, Serum Phosphorus Level, *Longissimus Dorsi* Fatty Acid Composition and Carcass Characteristics of Finishing Beef Cattle

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SUMMARY

One hundred and four crossbred beef steers and 76 beef heifers were used in a randomized block design to examine the impact of low phytate corn on growth performance, carcass characteristics, serum phosphorus, *Longissimus* muscle cholesterol and meat fatty acids profile. Cattle were assigned to one of two genetically similar varieties of corn containing different levels of phytate in a 129-day finishing trial with four pens per treatment.

Growth performance was not affected ($P > 0.05$) by treatment nor were carcass characteristics. Serum phosphorus and fatty acid profile were not affected by treatment ($P > 0.05$) but *Longissimus* muscle cholesterol content and fat content tended to be lower ($P < 0.10$; $P < 0.05$) for steers fed low phytate corn grain.

Key words: Phytate, Growth Performance, Finishing Cattle

INTRODUCTION

Phosphorus pollution of surface and ground water is a major concern of Environmental Protection Agency. Consequently, limits to manure application are moving from a nitrogen-based to a phosphorus-based standard. This change could dramatically increase the amount of land requirement to sustain a feedyard unless fecal phosphorus excretion is reduced. Excretion might be reduced by improving digestibility and/or reducing nutrient concentration in the diet to reduce nutrients in manure.

Phosphorus from phytate (myo-inositol 1,2,3,4,5,6 hexakis phosphate) accounts for 50 to 80 % of the P in seeds (Harland et al., 1996). Phytic acid accumulates in seeds during ripening (Ravindran, 1996). Phytic acid prevalence can be influenced by cultivar. Phytates are well known for their anti-nutritional properties in monogastrics (Adeola, 1996; Harter – Dennis et al., 2001). In ruminants most of the P from phytate is thought to be released by phytases produced by the rumen micro-flora (Yankee et al., 1998). However, recent cattle experiments have shown that barley with a reduced phytate concentration improved growth performance and reduced phytate P in excreta (Taylor et al., 2001). The objective of this trial was to examine effects of two corn varieties differing in phytate concentrations in feedlot performance.

MATERIALS AND METHODS

Two genetically similar lines of corn, with different concentrations of phytate, were incorporated into rations an fed to a finishing cattle in a trial at the Eastern Colorado Research Center feedlot, 24.5 miles from Akron, CO starting January 2, 2001.

A randomized block design with 4 pens per treatment was used to evaluate growth performance and carcass characteristics using 104 beef steers and 76 beef heifers.

Treatments consisted of the corn grain produced by Pioneer X3138 (low phytate content) and the corn grain from Pioneer 3335,the parental hybrid of the low phytate hybrid. Both grains were used as the same proportion of the rations. Three pens of steers and one pen of heifers per treatment were fed each diet.

Steers and heifers weaned before the trial consisted of British x Continental crossbreds from three ranches in Colorado. Steers and heifers were blocked by weight, stratified by breed and assigned to pens. Pens then were randomly assigned to treatment.

Cattle were weighed twice at the beginning (January 2 and 3, 2001) and at the end of the trial (May 10 and 11, 2001). Weights were taken every 28 days at approximately at the same time, in the morning, before being fed.

All the cattle were implanted with Revalor IS® (Intervet, Millsboro, DE) for the steers and with Revalor H® for the heifers on the first day of the trial. Vaccination consisted of Ultrabac® and Somubac®

Cattle were fed once daily in the morning so that cattle had free choice access to the feed. The finishing ration and supplement composition are shown in Tables 1 and 2. On day 84, jugular blood samples were randomly sampled from 5 animals per pen from each pen. Blood samples were cooled and centrifuged at 1300-x g for 20 minutes, serum was removed and stored in plastic vials and frozen at –20°C until analyzed. Serum P concentrations were analyzed using flame atomic absorption spectophotometry (Sigma Diagnostics; St. Louis, MO).

At the end of the trial cattle were shipped to Excel® (Fort Morgan, CO) for processing. Hot carcass weight; yield grade and quality grade data were collected at time of harvest. A *Longissimus* muscle sample was obtained by shaving the rib eye (approximate weight 50 g) these samples were stored in plastic bags, chilled on ice for transport and frozen at –40°C until analyzed. Lipid percentage was determined by ether extract and total *Longissimus* muscle cholesterol was determined using the enzymatic method of Allain et al. (1974) as modified by Sale et al., (1984). Fat extracted from Longissimus muscle samples were methylated (Bligh E. and Dyer, 1959) and analyzed by gas chromatography using a Hewlett Packard (Avondale, PA) Model 5890 A Series II gas chromatograph (Kramer K. et al, 1997) to determine relative concentrations of long chained fatty acids profile. Performance, blood serum levels, *Longissimus* muscle cholesterol, fatty acid profile and carcass data were analyzed using the GLM procedure of SAS® using pen means with replicate included as class variable.

RESULTS AND DISCUSSION

Feed intake was not affected ($P > 0.05$) by phytate concentration of the corn hybrid; results are shown in Table 3. Similarly, average daily gain and feed efficiency during periods within the trial or over the total trial were not affected by corn variety ($P > 0.05$) (Table 4). Off weight test and hot carcass did not differ significantly ($P > 0.05$). Lipid content of the *Longissimus* muscle was less ($P < 0.03$) for cattle fed low phytate corn grain even though marbling scores did not differ. This could reflect a sampling error. Similarly, cholesterol content of the *Longissimus* muscle tended ($P < 0.10$) to be less for cattle fed the low phytate corn grain, an effect noted in previous studies with steers, swine and poultry (Fred Owens, personal communication).

Serum P concentrations, and fatty acids profiles were not affected by treatment ($P > 0.05$) (Table 5). None of the carcass measurements were significantly altered by phytate content of the corn grain fed (Table 4).

IMPLICATIONS

Using a low phytate corn variety in feedlot diets did not affect performance or carcass characteristics. The use of a low phytate corn variety in cattle finishing diets may be another tool for addressing environmental concerns. The impact of feeding low phytate corn on lipid and cholesterol needs further study.

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Table 1. Ration Composition (% Dry Matter) of Finishing Diet.

Ingredients	Pioneer X3138	Pioneer 3335
Whole Corn	86.9	86.9
Alfalfa Hay	3.0	3.0
Millet Hay	3.0	3.0
Supplement	7.1	7.1

Table 2. Supplement Composition (% Dry Matter) for Both Treatments.

Ingredients	**%**
Wheat Midds	18.81
Urea	13.10
Salt	3.36
Dehydrated Alfalfa	5
Calcium Carbonate	16
Sunflower Meal	37.48
Potassium chloride 50	3.15
Ferrous Sulfate	0.056
AM Sulfate	1.91
Manganese Sulfate 32%	0.04
Copper Sulfate 25.2%	0.027
Niacin 99%	0.143
Vit. E 125 IU/lb	0.053
Selenium .06%	0.2907
Tylan-100	0.06
Farr. AGD 40/4	0.05
New Beef Trace	0.218
Rumensin 80G	0.208

Table 3. Effects of Low Phytate Corn Varieties on Growth Performance of Beef Cattle.

Item	**Pioneer X3138**	**Pioneer 3335**	**SEM**
Number head (pens)	89(4)	89(4)	
Initial Weight, lbs	754	758	
Feed Intake as fed, lbs			
0-28 days	16.36	15.76	0.29
29-56 days	17.45	17.71	0.37
57-84 days	19.19	19.28	031
84-112 days	19.30	19.58	0.44
112-129 days	18.16	18.10	0.24
0-129 days	18.09	18.13	0.31
Average Daily Gain, lbs			
0-28 days	3.03	2.81	0.28
29-56 days	2.66	2.93	0.13
57-84 days	3.19	3.09	0.16
84-112 days	3.25	3.71	0.26
112-129 days	3.91	3.60	0.25
0-129 days	3.18	3.22	0.04
Feed Efficiency, Gain/ Feed			
0-28 days	5.40	5.10	0.51
29-56 days	5.94	5.51	0.38
57-84 days	7.18	7.22	0.34
84-112 days	8.75	8.19	0.47
112-129 days	8.58	8.95	0.24
0-129 days	6.72	6.47	0.15
Final Weight, lbs.	1164	1173	12.24

Table 4. Effects of Low Phytate Corn Varieties on Carcass Characteristics.

Item	Pioneer X3138	Pioneer 3335	SEM
Unshrunk Dressing Percentage	60.36	60.28	0.36
Hot Carcass Weight, lbs.	702	707	6.06
Rib Eye Area, sq. in.	13.67	13.76	0.23
Fat Thickness, in.	0.44	0.42	0.06
KPH, %	1.82	1.87	0.04
Skeletal Maturity	151	153	1.99
Marbling[a]	413	421	23.59
Lean Maturity	155	152	1.77
% Choice or better	60	62	13.0
Yield Grade	2.24	2.21	0.21

[a]Select $^{+}$: 350-399, Choice^{-}: 400-499, Choice: 500-599.

Table 5. Serum P Level, Cholesterol Level, Lipid Percentage and Fatty Acid Composition of *Longissimus dorsi* by Treatment.

Item	Pioneer X3138	Pioneer 3335	SEM
% DM	29.8	30.2	1.9
Cholesterol (Mg/100 g Wet Wt.)	80.4[b]	85.9[a]	2.3
Lipid % Wet Wt	11.10[d]	16.45[c]	0.30
Myristic (14:1)	3.61	3.91	0.50
Palmitic (16:0)	28.96	26.95	0.56
Stearic (18:0)	9.21	9.00	0.39
Oleic (18:1)	25.82	24.76	1.39
Linoleic (18:2)	2.04	2.15	0.04
Serum P (mg/dL)	5.3847	5.1394	0.83