Effect of yeast and enzyme alternatives in field pea and co-product-based natural beef production

D.G. Landblom[1], C.J. Wachenheim[2], and T.A. Petry[3]

[1]NDSU-Dickinson Research Extension Center, Dickinson, North Dakota 58601
[2]NDSU-Agribusiness and Applied Economics Department, Fargo, North Dakota 58105
[3]NDSU Extension Service, Fargo, North Dakota 58105

Introduction:

The cattle feeding industry has experienced significant growth in "natural beef" as cattle producers respond to increasing consumer concerns over the use of growth promoting hormones and antibiotics used in cattle feeding. Increasing cattle feeding in North Dakota suggests that the quantity of field peas and co-products fed to cattle in both "conventional" and "Natural Beef" production systems will increase as well. In natural beef feeding systems, alternatives to antibiotics and growth hormones have the potential to be replaced with phosphorylated mannan oligosaccharides (MOS) and fibrolytic enzymes that in separate research investigations have been shown to reduce stress, enhance immune response, enhance ruminal degradation of fiber, and increase feed intake, average daily gain, and feed efficiency. Cellulase enzymes derived from the microbial world have been investigated extensively with respect to enzyme production, industrial utilization, in simple stomached animals, and to a lesser extent in beef cattle.

While growth hormone implants and antibiotics are used extensively by the cattle feeding industry to increase muscle accretion, alter rumen volatile fatty acid production, and improve gain and feed efficiency, the consuming public is becoming increasingly more concerned about the use of hormones and antibiotics, and buying habits are changing as evidenced by meat sale increases for natural and organically grown meat. Although these increases in consumer preference pale when compared to total beef sales in the United States, it is important to take this consumer message seriously. Mannan oligosaccharides and enzymes have been evaluated in separate investigations, but the two preparations have not been used in conjunction with each other as alternatives for growth hormone and antibiotics. The research question is to determine whether comparable animal response can be realized when using mannan oligosaccharide and fibrolytic enzymes (cellulase and xylanase activity) as alternatives for conventional growth hormone implants and ionophore antibiotics.

Project Objectives:

1. Compared to a conventional field pea/co-product based medicated receiving and backgrounding diets, evaluate similar receiving and backgrounding diets formulated with either mannan oligosaccharide, fibrolytic enzymes (xylanase and cellulose activity), or a combination of the two additives as substitutes for conventional growth hormones and antibiotics on animal performance and efficiency.

2. Evaluate carryover effect of treatments applied during backgrounding on subsequent finishing performance and carcass closeout values.

3. Develop feedlot reference group comparison budgets, based on feeding efficiencies and carcass value, for conventional and natural beef production systems.

Materials and Methods:

Eighty spring-born crossbred steers averaging 616 pounds were weaned the first week of November and fed in an 84 day receiving-backgrounding study using a complete randomized design consisting of four treatments and four pen replicates per treatment. The investigation was conducted using sixteen 32' X 112' pens at the Dickinson Research Extension Center's feedlot located two miles south and three miles west of Manning, North Dakota. Each feedlot pen was equipped with continuous steel fence, anti-siphoning frost-free water fountains, slotted sheet metal windbreak, and tree windbreak oriented northwest of the feedlot.

Treatments-

1. Control - hormone Implant (trenbelone acetate – Revelor-IS®) and medicated diet (Monensin sodium – Rumensin®)

2. Natural - fibrolytic enzyme (Fibrozyme®10 gm/head/day) (no hormone implant; no ionophore medication)
3. Natural - mannan oligosaccharide (Bio-MOS®10 gm/head/day) (no hormone implant; no ionophore medication)
4. Natural – Bio-MOS® plus Fibrozyme® (10 gm/head/day each) (no hormone implant; no ionophore medication)

Diets –

Mannan Oligosaccharide and fibrolytic enzyme preparations were blended with cracked corn, shredded beet pulp, corn oil, and molasses (Table 1) as a carrier and top-dressed over chopped hay at the rate of 1 pound per head per day to provide 10 grams per head per day of each additive. The field pea-co-product receiving-backgrounding feeds were prepared as a pelleted complete feed (Table 2) top-dressed over medium quality alfalfa-bromegrass hay (CP - 9.1%; ADF – 35.0%; NDF – 5939%; TDN – 57.4; NEg Kcal/lb – 0.31).

Ultrasound evaluation –

Live animal estimates of body composition at the end of the 84d feeding period using ultrasound procedures as outlined by the Ultrasound Guidelines Council (UGC) to determine economically important body composition for fat depth, ribeye area, and percent intramuscular fat (Table 3).

Economic analysis for reference feedlots –

Economies associated with this research are important for the potential end user and upon completion of data collection NDSU agricultural economists will prepare comparative treatment budgets for 500, 1,000 and 5,000 head feedlot groups. Sensitivity analysis will consider the effect of changes in the price of peas and net premium for natural beef. Complete economic analysis and comparative budgets will be prepared after the steers are finished carcass closeouts have been received.

Statistical Analysis –

Receiving, backgrounding, and finishing data will be analyzed using pen as the experimental unit and carcass closeout data will be analyzed using individual animal as the experimental unit. Statistical analysis was conducted using PROC GLM procedures of SAS (2003).

Results:

Eighty-four day backgrounding performance, feed efficiency, and partial feeding economics are shown in Table 3. Control steers that were implanted with Revelor-IS® and fed diets similar to the experimental diets with the exception that Rumensin® medication was added gained an average 0.69 pound faster ($P < 0.01$) than steers fed a microbial additive and enzyme. Average daily feed intake did not differ between treatments ($P = 0.85$). Feed required per pound of gain favored the control group of steers; however, the advantage measured was not statistically different ($P = 0.198$). Feed cost per pound of gain was $0.3803, $0.4684, $0.4554, and $0.4880 for the control, Bio-MOS, Fibrozyme, and the combination of Bio-MOS and Fibrozyme, respectively. These data highlight the value of field peas and co-product ingredients in conventional and natural feeding programs.

Marketing analysis comparing conventional and natural production resulted in net losses for naturally reared steers. Compared to conventional implanted steers fed Rumensin® medication, losses per head among naturally reared steers were -$29.59, -$24.78, and -$36.68 for Bio-MOS, Fibrozyme, and Bio-MOS + Fibrozyme, respectively. These data clearly show that producers growing cattle for natural markets will need substantial premiums to offset natural rearing inefficiencies.

The subsequent carryover effect of natural backgrounding on finishing performance, carcass closeout, and system economic analysis will be summarized in the Center's 2008 annual report.

Table 1. Conventional and natural topdressed supplement ingredient composition.

	Control	Bio-MOS®	Fibrozyme®	Fibrozyme + Bio-MOS®
Cracked Corn, %	46.0	44.9	44.9	43.8
Beef Pulp, %	46.0	44.9	44.9	43.8
Corn Oil, %	3.0	3.0	3.0	3.0
Molasses, %	5.0	5.0	5.0	5.0
Bio-MOS, %	---	2.2	---	2.2
Fibrozyme, %	---	---	2.2	2.2

Table 2. Pelleted field pea and fiber-based ingredient composition and nutrient analysis.

	Control Conventional – Medicated (Control)	Natural Natural – Non-Medicated
Ingredients:		
Soybean Hull, %	30.753	30.80
Field Peas, %	20.00	20.00
Corn, %	15.00	15.00
Barley Malt Sprouts, %	10.00	10.00
Wheat Midds, %	10.00	10.00
Distillers Dried Grain w/ Solubles, %	8.00	8.00
Decoquinate-6%, %	0.54	---
Monensin (80 gm/lb), %	0.40	---
Other, %[a]	6.20	6.20
Analysis:		
Crude Protein, %	15.10	15.1
TDN, %	70.20	70.25
Undegradable Intake Protein, %	5.10	5.11
Fat, %	2.65	2.65
Fiber, %	15.57	15.58
Acid Detergent Fiber, %	18.03	18.05
Calcium	0.42	0.42
Phosphorus	0.39	0.39
NEm, Mcal/lb.	0.785	0.785
NEg, Mcal/lb.	0.525	0.525

[a]Beet Molasses, 5.0%; Calcium Carbonate, 0.50%; Salt, 0.50%; Dicalcium Phosphate 21%, 0.10%; Feedlot Trace Mineral Premix, 0.075%; Feedlot Vitamin Premix, 0.025%.

Table 3. Eighty-four day backgrounding performance.

	Conventional	Natural				
	Control – Medicated	Bio-MOS®	Fibrozyme®	Fibrozyme + Bio-MOS®	SEM	P-Value
Growth:						
No. Steers	20	20	20	20		
Days Fed	84	84	84	84		
Start Wt, lb.	626.2	614.3	611.9	612.4	6.97	0.432
Final 84d Wt., lb.[a]	932.7[w]	861.0[x]	866.1[x]	857.6[x]	10.2	<0.0001
Gain, lb.[a]	306.5[w]	246.7[x]	254.[x]	245.2[x]	7.58	<0.0001
ADG, lb.[a]	3.65[w]	2.94[x]	3.03[x]	2.92[x]	0.09	<0.0001
Feed & Efficiency:						
Feed/Hd/Day, lb.	22.11	20.92	20.75	20.83	1.25	0.850
Fiber-Based Pellet Feed/Hd/Day, lb.	10.46	10.51	10.51	10.51	0.0279	0.426
Hay/Hd/Day, lb.	10.65	9.41	9.24	9.32	1.26	0.835
Natural Suppl. Carrier/Hd/Da, lb.	1.00	1.00	1.00	1.00	0.0018	0.426
Feed:Gain, lb.	6.06	7.12	6.86	7.11	0.371	0.198
Feed Cost & Efficiency:						
Feed Cost/Hd, $	116.65	115.69	115.93	119.71	2.318	0.603
Feed Cost/Day, $	1.388	1.377	1.380	1.425	0.0275	0.603
Feed Cost/Lb. Gain, $	0.3803	0.4684	0.4554	0.4880	0.0088	<0.0001
Feeding Economics:						
Steer Wt. W/(3% Shrink)	904.7	835.2	840.1	831.9		
Steer Sale Value, $[b]	$857.20	$826.65	$831.70	$823.58		
Less Feed Cost/Head, $	-$116.65	-$115.69	-$115.93	-$119.71		
Less Yardage @ $0.30/d	-$25.20	-$25.20	-$25.20	-$25.20		
Net, $	$715.35	$685.76	$690.57	$678.67		
Difference Versus Control, $	---	-$29.59	-$24.78	-$36.68		

[a]Means in a row with unlike superscripts differ significantly (P<0.0001).

bFrom Stockmen's Livestock Exchange report dated April 12, 2007: 900 lb. steers were $94.75; +or - 840 lb. steers were $99.00.