EXTENSION
BEEF CATTLE RESEARCH UPDATE
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Effects of Conventional and Nonconventional Growth-Enhancing Technologies for Finishing Feedlot Beef Steers

Over the last several years, increasing consumer awareness related to animal welfare, food safety, and environmental impacts of animal production industries has led to growth in the organic and natural beef demand. However, research simulations showed that withdrawing growth-enhancing technologies (growth implants, ionophores, MGA, and in-feed hormones, and beta agonists) from the US beef production system would require an increase of 11.8% for the beef cattle population, a 10.6% increase in feed production, a 10.0% increase in land area, a 4.2% increase in water use, and would promote a 9.8% increase in carbon emissions to produce the same amount of beef.[1]

Recent Canadian research evaluated conventional (tylosin, monensin, growth implants, and beta agonists) and non-conventional (direct-fed microbials, fibrolytic enzymes, and flavoring agents) growth-enhancing technologies on the performance of finishing beef feedlot steers in two experiments.[2] In both experiments, steers were fed barley-based finishing diets.

In Experiment. 1 (screening study), 384 crossbred beef steers (1100 lb initial weight) were randomly assigned to 8 feedlot pens equipped with a system for measurement of individual feed intake. Steers were assigned to 1 of 8 diets with or without growth implants (Component TE-S with Tylan, Elanco Animal Health). The experimental diets were as follows:

1) NMD = non-medicated diet
2) NMD + DFM = NMD + direct-fed-microbial (DFM) product (mixture of Saccharomyces cerevisiae strain BP-31702 and Lactobacillus acidophilus strain BT-1386, Sage Biosciences Inc., Edmonton, Alberta, Canada)
3) NMD + ENZ = NMD + a liquid fibrolytic enzyme (ENZ) product derived from Trichoderma reesei (Econase RDE L, AB Vista, Associated British Foods Ltd., Marlborough, UK)
4) NMD + OLEO = NMD + and Oleobiotec Ruminant [OLEO; flavoring agent composed mainly of spices (ginger and pepper) and essential oils (oregano, thyme and cinnamon); Laboratoires Phodé, Terssac, France]
5) NMD + DFM +ENZ + OLEO
6) CVD = medicated diet containing Rumensin (23 grams/ton of diet dry matter), and Tylan (10 grams/ton of diet dry matter). Cattle in this group were also fed ractopamine hydrochloride (Optaflexx, Elanco Animal Health) at a target intake of 0.18 mg/lb of body weight per day (~250 mg) day for the last 28 days of the feeding period, followed by a 24-hour withdrawal.
7) CVD + DFM + ENZ
8) CVD + DFM + ENZ + OLEO

In Experiment. 2, 960 crossbred beef steers (939 lb initial weight) were randomly allocated to 1 of 4 treatments (12 pens per treatment). Individual intakes were not measured in these pens. These treatments were selected based on the screening results in Experiment 1.

1) NAT = non-medicated diet (no antibiotics, ionophores, growth implants, or beta agonists)
2) NAT + OLEO
3) CONV = medicated diet containing Rumensin (23 grams/ton of diet dry matter) and Tylan (10 grams/ton of diet dry matter)
4) CONV + HI/BA = medicated diet with a growth implant (Revalor-200; Merck Animal Health) and Optaflexx at a target intake of 0.18 mg/lb of body weight per day for the last 28 days last 28 days of the feeding period, followed by a 24-hour withdrawal.

In both experiments, carcass-adjusted average daily gain (ADG) was calculated as follows: Carcass-adjusted ADG = [(Carcass weight/0.60) − initial weight/days on feed. Gain efficiency (G:F) was calculated by dividing ADG by dry mater intake (DMI).

These researchers reported that in Experiment 1 that the conventional diet (containing Rumensin, Tylan and Optaflexx) improved carcass-adjusted ADG by 12.9% and carcass-adjusted G:F by 11.1% compared with the non-medicated diet (without the use of growth-enhancing technologies) with no effect on carcass yield grade or quality grade. The only non-conventional product evaluated that showed potential to replace conventional technologies was OLEO. The NMD+OLEO diet improved ADG and G:F compared with the NMD diet and was not different from the CVD diet.

The effects of the growth implant on the steers in Experiment 1 are shown in Table 1. Implanted steers had greater dry matter intake (DMI), final weight, carcass weights, (all $P < 0.001$) and improved carcass-adjusted ADG and G:F (both at a $P < 0.001$ level), compared with nonimplanted steers. The growth implant did not affect yield grade but did reduce quality grades (data not shown in table).

Table 1. Effect of growth implant on performance of feedlot steers (Exp.1)

	Implant Treatment[1]		
Item	-	+	P-value
No. of steers	192	192	
Days on feed	91	91	
Initial weight, lb	1096	1100	0.09
Final weight, lb	1444	1515	<0.001
DMI, lb/day	26.75	27.94	<0.001
Carcass-adjusted ADG, lb/day	3.75	4.56	<0.001
Carcass-adjusted G:F	0.137	.161	<0.001
Carcass weight, lb	862	908	<0.001

1 − = no growth implant; + = implanted with Component TE-S
Adapted from Ribeiro et al. 2020

The effects of conventional and non-conventional technologies on performance of the steers in Experiment 2 are shown in Table 2. Final weights, carcass adjusted ADG and G:F, and carcass weight were greater ($P < 0.001$) for conventional steers implanted and fed Optaflexx compared to the other treatments. In addition, conventional steers had improved G:F compared to the two natural treatments. In this experiment, the conventional production system (had no effect on carcass yield grade or quality grade compared with the natural production system. In contrast to Experiment 1, the inclusion of Oleobiotec (NAT+OLEO) did not improve ADG or G:F ratio compared with the natural production system.

Table 2. Effect of conventional and non-conventional technologies on performance of beef feedlot steers (Experiment 2)

	Treatment				
Item	NAT	NAT+OLEO	CONV	CONV+HI/BA	P-value
Initial weight, lb	931	931	931	931	0.290
Final weight, lb	1356^{b}	1363^{b}	1365^{b}	1451^{a}	<0.001
DMI, lb/day	22.89^{a}	22.89^{a}	21.98^{b}	23.28^{a}	<0.001
Carcass-adjusted ADG, lb/day	2.62^{b}	2.73^{b}	2.71^{b}	3.40^{a}	<0.001
Carcass-adjusted G:F	0.115^{c}	0.119^{c}	0.124^{b}	0.147^{a}	<0.001
Carcass weight, lb	785^{b}	794^{b}	794^{b}	851^{a}	<0.001

$^{a–c}$Means in the same row not sharing a common superscript are significantly different ($P < 0.05$).
Adapted from Ribeiro et al. 2020

These researchers concluded that this study confirmed the positive effect of conventional growth-enhancing technologies on the growth performance of finishing feedlot steers, with minimal effect on

carcass quality. In addition, the non-conventional technologies direct-fed-microbial and fibrolytic enzymes did not show any improvement when compared with control steers. The OLEO (flavoring agents) treatment showed potential to improve steer performance in natural beef systems in their screening study (Experiment 1). But, in the more replicated small pen study (Experiment 2), this finding was not reproduced.

In conclusion, eliminating conventional growth-enhancing technologies reduced feed efficiency and growth performance, consequently undermining the sustainability of beef production systems (results in increased land use, feed production needed, water use, manure production, and carbon emissions to produce the same amount of beef).

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[1] Capper, J. L., and D. J. Hayes. 2012. The environmental and economic impact of removing growth-enhancing technologies from U.S. beef production. J. Anim. Sci. 90:3527-3537.

[2] Ribeiro, G. O., M. L. May, S. L. Parr, O. C. Schunicht, L. O. Burciaga-Robles, S. J. Hannon, T. M. Grimson, C. W. Booker, and T. A. McAllister. 2020. Effects of conventional and nonconventional growth-enhancing technologies for finishing feedlot beef steers. Appl. Anim. Sci. 36:524-536.