EXTENSION
BEEF CATTLE RESEARCH UPDATE
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Environmental Performance of Commercial Beef Production Systems Utilizing Conventional Productivity-Enhancing Technologies

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. Productivity-enhancing technologies (PET) such as growth hormones, beta agonists, and ionophores are conventional feed technologies that improve the growth and feed efficiency of beef cattle and lower the cost of production. In some countries, conventional PETs have been banned due to concerns over food safety, animal welfare, and antimicrobial resistance. This has resulted in a growing interest in the use of non-conventional or "natural" feed additives or technologies such as fibrolytic enzymes, essential oils, probiotics, or direct-fed-microbials in beef production. Recent Canadian research evaluated the effects of using conventional PETs with or without natural feed additives on the growth performance, carcass traits and environmental footprint of heifers and steers in a commercial Canadian feedlot.[1]

In this study, a total of 768 cross-bred yearling steers (384 head, 1100 lb initial weight) and heifers (384 head, 860 lb initial weight were offered a barley grain-based basal diet and divided into implanted or non-implanted groups. Implanted steers received a Component TE-S with Tylan implant (Elanco Animal Health). Implanted heifers received a Revalor-200 implant (Merck Animal Health). Steers were then allocated to 1 of 8 diets. The experimental diets were as follows:

1) Controls, contained a non-medicated supplement of vitamins and minerals
2) Control diet with a liquid fibrolytic enzyme product (ENZ) derived from *Trichoderma reesei* (Econase RDE L, AB Vista, Associated British Foods Ltd., Marlborough, UK)
3) Control diet with a flavoring agent (OLEO) composed mainly of spices (ginger and pepper) and essential oils (oregano, thyme, and cinnamon); Oleobiotec Ruminant, Laboratoires Phodé, Terssac, France
4) Control diet with direct-fed-microbial (DFM) product (mixture of Saccharomyces cerevisiae strain BP-31702 and Lactobacillus acidophilus strain BT-1386, Sage Biosciences Inc., Edmonton, Alberta, Canada)
5) Control diet + DFM + ENZ + OLEO
6) Control diet containing feed additives including Rumensin (23 grams/ton of diet dry matter), Tylan (10 grams/ton of diet dry matter), and Optaflexx which was fed 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 (CONV)
7) CONV + DFM + ENZ
8) CONV + DFM + ENZ + OLEO

Heifers received one of the first three dietary treatments or the following:

4) Control diet with CitriStim (ADM Alliance Nutrition Inc.) a probiotic consisting of whole-cell Pichia guilliermondii yeast (CITR)
5) Control diet + OLEO + CITR
6) Control diet with melengesterol acetate (MGA) + OLEO + Zilmax (zilpaterol hydrochloride, Merck Animal Health) at 75 mg/animal/day for the last 20 days of the feeding period. Zilmax was removed from the diet of heifers 6 days prior to shipment for slaughter.
7) Control diet + containing Rumensin, Tylan, MGA + Zilmax = conventional (CONV)
8) CONV + OLEO

These data were used to estimate greenhouse gas and ammonia emissions, as well as land and water use.

In the steer study, implanting increased dry matter intake by 4.5%, average daily gain (ADG) by 18.2%, and Gain:Feed ratio by 14.2%.[2,3] Final weight was 71 lb greater (4.9% increase) and carcass weight was 46 lb greater (5.4% increase) for implanted vs. non-implanted steers. In the heifer study, implanting increased ADG by 9.7% and Gain:Feed ratio by 8.0%. Final weight was 44 lb greater (2.8% increase) and carcass weight was 29 lb greater (3.8% increase) for implanted vs. non-implanted heifers.

It was reported that the conventional diet treatment (CONV, containing monensin, tylosin, and Optflexx) in the steers increased ADG by 10.1%, Gain:Feed ratio by 7.2%, and carcass weight by 2.8% (24 lb) compared to control cattle.[2] Similar improvements were reported for heifers fed the conventional diet (containing monensin, tylosin, MGA, and Zilmax). The conventional treatment led to an 8.8% increase in ADG and a 7.9% improvement in Gain:Feed ratio; consequently, increasing carcass weight by 6% (44 lb) compared with heifers fed the control diet.

These researchers reported that the use of natural feed additives including probiotics (the whole-cell yeast, CITR or mixture of yeast and bacteria, DFM) or fibrolytic enzymes (ENZ) alone had no effect on the growth performance and carcass weight of heifers and steers. However, combining the natural feed additives with the conventional technologies did improve the productivity of cattle. Feeding conventional feed additives plus OLEO to heifers improved Gain:Feed ratio, ADG, and carcass weight relative to control heifers with no difference for CONV heifers. In the steer study, the only non-conventional product evaluated that showed potential to replace conventional technologies was OLEO. OLEO improved the Gain:Feed ratio and ADG of steers by 6.5% and 7.4% respectively, but did not differ from CONV.[2] These results suggest that the use of these natural feed additives solely to improve animal performance and carcass traits could be sex dependent.

These data illustrated that implanted and conventionally treated cattle exhibited improvements in growth and carcass traits as compared to the other treatments ($P < 0.05$). Improvements in the performance of conventional cattle illustrated that replacing conventional feed additives with natural feed additives would increase both the land and water required to satisfy the feed demand of steers and heifers by 7.9% and 10.5%, respectively. In addition, greenhouse gas emission intensity for steers and heifers increased by 5.8% and 6.7%, and ammonia emission intensity by 4.3% and 6.7%, respectively. Furthermore, eliminating the use of implants in cattle increased both land and water use by 14.6% and 19.5%, greenhouse gas emission intensity by 10.5% and 15.8%, and ammonia emission intensity by 3.4% and 11.0% for heifers and steers, respectively.

These authors concluded that these “results demonstrate that the use of conventional productivity-enhancing technologies increases animal performance while reducing the environmental impacts of beef production”. Therefore, the “removal of these conventional technologies or a replacement with natural feed additives may impact productivity as well as the environmental sustainability of feedlot cattle production”. “ Restricting the use these technologies would increase the environmental footprint of beef produced for both domestic and international markets.”

[1] Aboagye, I. A., M. R. C. Cordeiro, T. A. McAllister, M. L. May, S. J. Hannon, C. W. Booker, S. L. Parr, O. C. Schunicht, L. O. Burciaga-Robles, T. M. Grimson, E. Boonstra, G. F. Mengistu, D. L. Fulawka and K. H. Ominski. 2022. Environmental performance of commercial beef production systems utilizing conventional productivity-enhancing technologies. Transl. Anim. Sci. 6. Available at: https://doi.org/10.1093/tas/txac074.

[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

[3] Hicks, B. 2020. Beef Cattle Research Update. November, 2020. Topic: Effects of Conventional and Nonconventional Growth-Enhancing Technologies for Finishing Feedlot Beef Steers. Available at: https://extension.okstate.edu/programs/beef-extension/beef-cattle-research-updates/site-files/docs/beef-cattle-research-update-november-2020-1.pdf.