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Oregon Beef Council Report

Beef Cattle Sciences

Feeding immunostimulant ingredients to optimize health and performance of receiving cattle [1]

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Synopsis

Research is still required to identify nutritional strategies that enhance performance, health and physiological variables of high-stress receiving cattle

Summary

One hundred and eight Angus × Hereford steers, originating from 7 cow-calf ranches and weaned on d -3, were obtained from an auction yard on d -2 and road-transported (500 miles; 12-h) to an experimental feedlot facility. Upon arrival on d -1, shrunk weight was recorded and steers were grouped with free-choice access to grass hay, mineral supplement, and water. On d 0, steers were ranked by source and shrunk weight, and assigned to 1 of 18 pens (6 steers/pen). Pens were allocated to: 1) no *immunomodulatory ingredient* supplementation (CON), 2) supplementation with Omnigen-AF (OMN; 22 g/steer daily, as-fed basis; Phibro Animal Health, Teaneck, NJ) from d 0 to 30, or 3) 2 oral capsules of Stocker Immune Primer on d 0 + 15 g/steer daily (as-fed basis) of Stocker Preconditioned Premix (Ramaekers Nutrition; Santa Cruz, CA) from d 7 to 30 (IPF). From d 0 to 80, steers had free-choice access to grass hay, water, and received a corn-based concentrate. Feed intake was recorded from each pen and steers assessed for bovine respiratory disease (BRD) signs daily. Steers were vaccinated against BRD pathogens on d 0 and 21. Final shrunk weight was recorded on d 81, and blood samples were collected on d 0, 3, 7, 10, 14, 21, 31, 42, 56, and 73. Steer average daily gain and final weight were greater ($P \leq 0.05$) in CON vs. OMN and IPF (2.71, 1.67, and 2.35 lbs/d; 704, 621, and 677 lbs; respectively), and ($P < 0.01$) in IPF vs. OMN. No treatment effects were detected ($P \geq 0.76$) for BRD incidence (66 ± 4%) and feed intake, whereas feed efficiency was greater ($P < 0.01$) in OMN vs. CON. Plasma haptoglobin concentrations tended ($P = 0.10$) to be greater in CON vs. IPF on d 3, were greater ($P = 0.04$) in IPF vs. CON on d 7, and tended ($P = 0.10$) to be less in OMN vs. IPF and CON on d 21. Collectively, the *immunomodulatory feed* ingredients evaluated herein impacted innate immune responses, but failed to mitigate BRD incidence and improve performance of receiving cattle.

Introduction

Feedlot receiving is one of the most critical phases within the beef production cycle, when cattle are exposed to a multitude of stress and health challenges that directly impact animal welfare and productivity throughout the feeding period (Cooke, 2017). Receiving cattle not only already experienced road transport, but are immediately subjected to stress caused by commingling with different animals and exposure to novel diets and environments, which are all known to directly impair their immune system. Accordingly, incidence of bovine respiratory

1. This document is part of the Oregon State University – 2017 Oregon Beef Council Report. Please visit the Beef Cattle Sciences website at http://beefcattle.ans.oregonstate.edu.\
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diseases (**BRD**) is extremely elevated during the initial 30 days of feedlot receiving, with clinical symptoms observed in up to 60% of receiving cattle (U.S. average) despite efforts associated with stress minimization and vaccination against BRD pathogens (Kirkpatrick et al., 2008).

The BRD complex is the most costly disease of feedlot cattle in the US, and costs the national beef industry approximately $ 1 billion annually. These economic losses include, besides cattle mortality, costs associated with reduced performance of morbid cattle and purchase of antibiotics (Loerch and Fluharty, 1999). With the increased regulations and pubic/consumer concern regarding antibiotic use in beef production systems, strategies that naturally enhance cattle immune function and boost vaccine efficacy are warranted to reduce BRD incidence and optimize productivity in feedlot cattle. Such strategies include the use of immunostimulant feed ingredients into receiving diets, which are based on nutritional and scientifically-sound compounds, but that still require proper validation in feeder cattle. One example is Omnigen-AF® (Prince Agri Products, Quincy, IL) a feed ingredient based on yeast and vitamins that has been shown to optimize health and milk production of early-lactating dairy cows. Another example are the Livestock Stress Formulas from Ramaekers Nutrition (Santa Cruz, CA), which are based on bioactive peptides and oligosaccharides that are naturally-occurring in colostrum, and that have been used by commercial feedyards with encouraging field results. Therefore, research is warranted to fully evaluate the potential of these ingredients to optimize health and productivity of receiving cattle, with thorough evaluation of immune parameters, vaccine efficacy, BRD incidence, and performance traits during feedlot receiving.

Hence, this experiment evaluated the impacts of immunostimulant ingredients (Omnigen-AF® or Livestock Stress Formulas) on performance, health and physiological variables of receiving cattle

Materials and Methods

This experiment was conducted at the Oregon State University – Eastern Oregon Agricultural Research Center (EOARC; Union, OR). Animals utilized were cared for in accordance with acceptable practices and experimental protocols reviewed and approved by the Oregon State University, Institutional Animal Care and Use Committee.

One hundred and eight recently-weaned Angus x Hereford steers were purchased from a commercial auction yard (Producers Livestock Marketing Association: Vale, OR). Steers were originated from 7 cow-calf operations located in Eastern and Central Oregon. On the day of purchase (day -2 of the experiment, 9/14/2016), steers were loaded into a commercial livestock trailer and transported for 500 miles (12 h) to stimulate the stress of a long-haul. On day -1 of the experiment, steers were unloaded at the EOARC Union, tagged, arrival shrunk body weight was recorded, and calves were maintained as a single group with free-choice hay, water, and mineral supplement for 24 h.

On day 0 of the experiment, steers were ranked according to source and body weight, and allocated to an 18-pen drylot (6 steers/pen, with steers from at least 3 different sources within pen). Pens were randomly assigned to receive 1 of 3 treatments:

- Control: No immunostimulant supplementation (**CON**).
- Omnigen-AF®: Supplementation with Omnigen-AF® (22 g/steer daily; Prince Agri Products, Quincy, IL) from day 0 to 30 of the experiment (**OMN**).
- Livestock Stress Formulas: Two capsules of Stocker Immune Primer Release with trace minerals (Ramaekers Nutrition; Santa Cruz, CA) on day 0, in addition to 15 g/steer daily of the Stocker Preconditioned Premix (Ramaekers Nutrition) from day 7 to 30 of the experiment (**LSF**).

On day 0, steers were vaccinated against Clostridium (One Shot Ultra 7; Zoetis, Florham Park, NJ), parainfluenza virus, infectious bovine rhinotracheitis virus, bovine viral diarrhea Types 1 and 2 viruses, and *Mannheimia haemolytica* (Bovi-Shield Gold One Shot; Zoetis), and administered an anthelmintic (Dectomax; Zoetis). On day 21, steers were re-vaccinated against bovine rhinotracheitis virus, bovine viral diarrhea Types 1 and 2 viruses, parainfluenza3 virus and bovine respiratory syncytial virus (Bovi-Shield Gold 5; Zoetis), and *Clostridium* (One Shot Ultra 7; Zoetis).

Steers received a free-choice receiving diet based on mixed alfalfa-grass hay, cracked corn, and soybean meal with a forage:concentrate ratio of 75:25 from day 0 to 7, 60:40 from day 8 to 18, and 40:60 from day 18 to day 30, and 30:70 from day 31 to 80. Feed intake was recorded daily by measuring offer and refusals from each pen.

Steer body weight and blood samples were collected on days 0, 3, 7, 10, 14, 21, 31, 42, 56, 70, and 80 of the experiment. Steer shrunk body weight was also collected on day 81 for average daily gain calculation, using shrunk weight on day -1 as initial weight. Blood samples were analyzed for plasma haptoglobin concentrations.

Steers were observed daily for bovine respiratory disease (**BRD**) symptoms, and treated with an antimicrobial when clinical symptoms are observed. In addition, steers from the LSF group received 2 capsules of Stocker Immune Primer Release with trace minerals concurrently with each antimicrobial administration. Incidence of respiratory treatments, morbidity, and mortality were recorded daily

Statistical analysis

Pen was considered the experimental unit. All data were analyzed using the MIXED procedure of SAS (SAS Inst., Inc.; version 9.3) and Satterthwaite approximation to determine the denominator df for the tests of fixed effects. Significance was set at $P \leq 0.05$, and tendencies were determined if $P > 0.05$ and ≤ 0.10.

Results

As designed, initial body weight (day -1) was similar ($P = 0.99$) among treatments (Table 1). However, average daily gain during the 80-day receiving period was greater ($P \leq 0.05$) in CON cattle compared with LSF and OMN cattle, and also greater for LSF vs. OMN cattle (Table 1). Consequently, CON cattle were the heaviest ($P \leq 0.05$), followed by LSF cattle, and OMN cattle were lighter at the end of the receiving period (Table 1). It is important to note, however, that body weight was similar ($P \geq 0.85$) among all treatment groups until day 56 of the experiment, but growth rates differed significantly ($P \leq 0.05$) among all treatment groups from day 56 to the end of the receiving period (Figure 1).

No differences in feed intake were detected ($P \geq 0.77$) between treatments during the experiment. It is also important to note that feed intake remained similar ($P \geq 0.94$) between treatments after day 56 (Figure 2). Therefore, treatment differences detected on body weight after day 56 should not be associated with a drop in feed intake, but with reduced ($P \leq 0.05$) feed efficiency during this period (Table 1).

Accordingly, feed efficiency during the entire 80-day feeding period was less ($P < 0.01$) in OMN vs. CON cattle (Table 1). On the other hand, the decreased average daily gain of LSF cattle was not sufficient to negatively impact their overall feed efficiency calculation, which was similar ($P = 0.30$) compared with CON cattle and greater ($P = 0.03$) compared with OMN cattle (Table 2).

No treatment differences were detected ($P \geq 0.55$) for health parameters, including incidence of BRD symptoms (Figure 2), number of antimicrobial treatments required per sick animal, as well as % of cattle that needed to be treated with antimicrobials more than once (Table 2). No treatment differences were also detected ($P = 0.36$) for mortality during the experiment (Table 2). Note that incidence of BRD was substantial during this experiment, particularly during the initial 28-days of receiving. Plasma concentrations of haptoglobin did not differ ($P = 0.74$) among treatments (Figure 4), but peaked on day 3 of the experiment denoting the substantial physiological stress and inflammation that steers were exposed to upon feedlot entry.

Conclusions

Hence, this experimental model fully represented the stress and health challenges that commercial feeder cattle experience during feedlot receiving, resulting in elevated BRD incidence and morbidity. However, none of the treatments evaluated herein were capable of mitigating these challenges, and actually reduced overall 80-day receiving performance compared with steers not receiving any immunomodulatory supplement. Hence, research is still required to identify nutritional strategies that enhance performance, health and physiological variables of high-stress receiving cattle.

Acknowledgements

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Literature Cited

Cooke, R. F. 2017. Prof. Anim. Sci. 33:1-11

Kirkpatrick et al. 2008. J. Am. Vet. Med. Assoc. 233:136–142.

Loerch and Fluharty. 1999. J. Anim. Sci. 77:1113–1119

Table 1. Growth and intake parameters during the initial 80-day receiving period. Values with different superscripts are statistically different ($P \leq 0.05$)

Item	CON	LSF	OMN	SEM	*P*-value
Initial body weight (day -1), lbs	482	484	484	17	0.99
Final body weight (day 80), lbs	704[a]	677[b]	621[c]	10	< 0.01
Average daily gain (day 0 to 80), lbs/day	2.71[a]	2.35[b]	1.67[c]	0.13	< 0.01
Feed intake, lbs of dry matter/day					
Hay	7.01	6.74	6.82	0.55	0.93
Concentrate	10.21	10.18	10.32	0.13	0.77
Total	17.23	16.92	17.14	0.65	0.94
Feed efficiency (lbs gain/lbs feed intake)					
Overall (day -1 to 80)	0.173[a]	0.152[a]	0.107[b]	0.014	< 0.01
Day 56 to 80	0.229[a]	0.176[b]	0.050[c]	0.027	< 0.01

Table 2. Health parameters during the initial 56 days of the experiment.

Item	CON	LSF	OMN	SEM	*P*-value
Incidence of BRD symptoms, %	69.4	61.1	69.4	9.1	0.76
Treated calves that required re-pull, %	13.1	23.3	27.3	9.9	0.59
Number of treatments required	1.13	1.32	1.31	0.13	0.55
Mortality, %	2.8	5.5	0.0	2.7	0.36

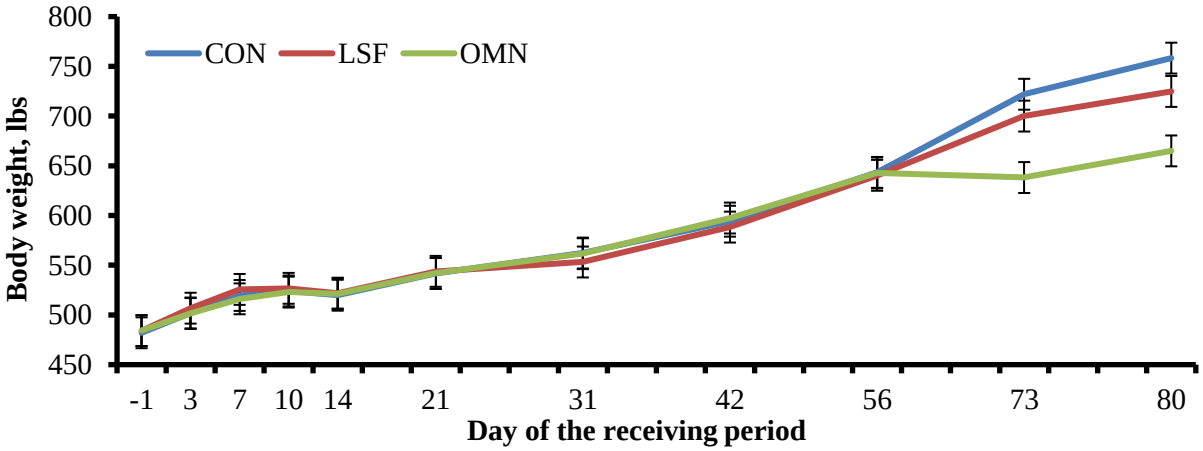

Figure 1. Growth rate during the 80-day receiving period. From day 56 to 80, body weight gain was less ($P \leq 0.05$) in LSF and OMN compared with CON steers, and also less ($P \leq 0.05$) in OMN compared with LSF steers.

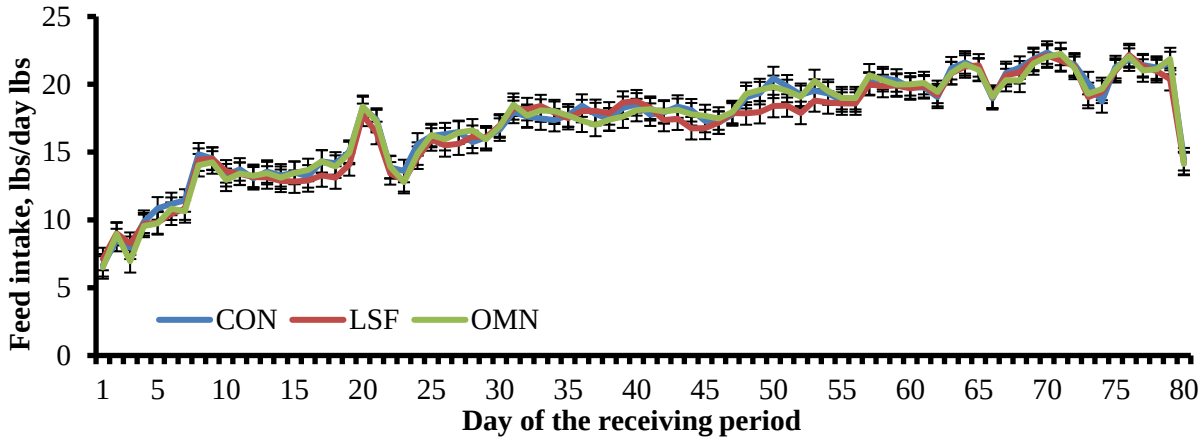

Figure 2. Feed intake (hay + concentrate) during the 80-day receiving period. No treatment differences were detected (P = 0.94).

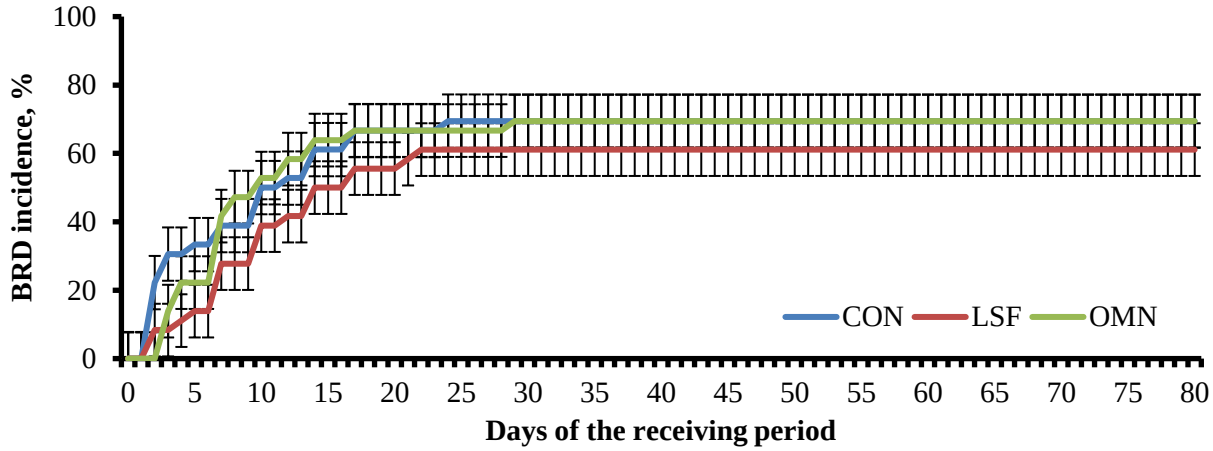

Figure 3. Cumulative incidence of BRD symptoms that required antimicrobial treatment during the experiment. No treatment differences were detected (P = 0.59).

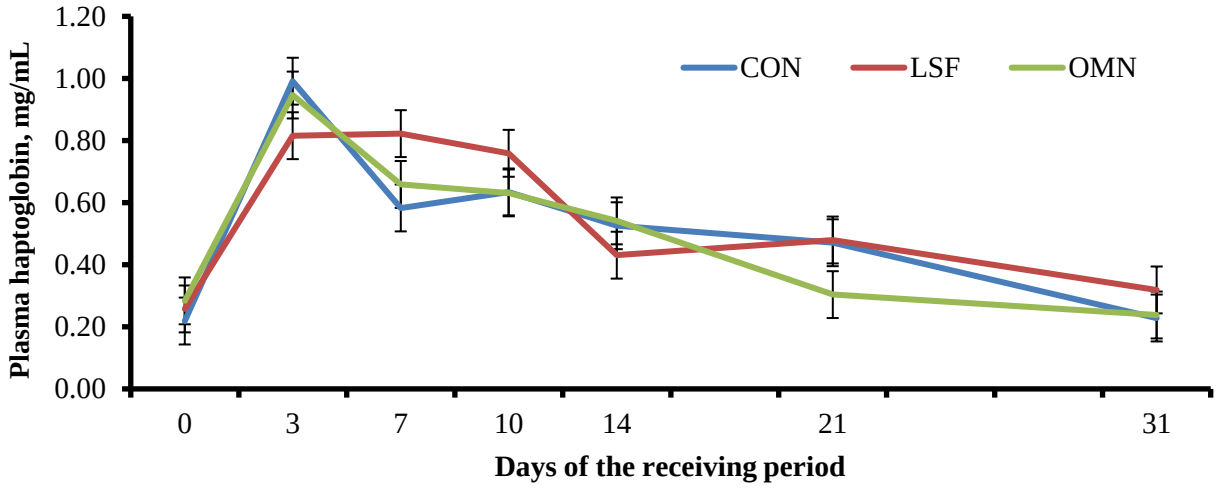

Figure 4. Plasma haptoglobin concentrations during the first 31-days of the experiment. No treatment differences were detected (P = 0.74).

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Beef Cattle Sciences

Development of an enhanced cattle embryo transfer medium to improve pregnancy rates in embryo transfer recipients [1]

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Synopsis

Recipient conception rates improve when cows receive embryos strawed in a newly designed, synthetic enhanced transfer medium (ETM). The new transfer medium can be easily merged into current procedures and would be an applicable strategy for improving conception rates in embryo transfers.

Summary

The specific aim of this research was to evaluate strategies for improving conception rates in embryo transfer recipients that would be compatible with transfer procedures presently used by the industry. The average conception rate for cows used as recipients in nonsurgical transfers with fresh embryos is 61% so there is room to improve this percentage. The period between collecting and transferring the embryos offers a window of time where embryos could be incubated briefly (< 2 h) in a culture medium that enhances or stimulates their development prior to transfer. Alternatively, embryos could be strawed in a similar medium thereby transferring both embryo and modified medium to the recipient's uterus. The first experiment was a "proof of concept" undertaking where embryos were incubated immediately after collection in a modified culture medium containing 0 or 100 µg/ml plasmin for 16 h. Although the difference was not significant because the number of transfers was low (n = 48), the conception rate was 12% greater in recipients receiving embryos incubated for 16 h in medium containing 100 vs. 0 µg/ml plasmin. Incubating embryos for 16 h would be difficult to integrate into current transfer procedures, so in the second experiment conception rates were evaluated in recipients receiving embryos incubated for 2 h in medium containing a higher dose of plasmin, 200 vs. 0 µg/ml. The higher plasmin dose for the shorter time had no effect on conception rate and, in fact, conception rates were identical (52%). The third experiment compared conception rates in embryos strawed in either the conventional transfer medium or a new, modified embryo transfer medium containing 200 µg/ml plasminogen. Conception rates were greater in recipients receiving embryos strawed in the new plasminogen-containing medium (52%) compared to the conventional medium (38%), however the difference was not statistically significant. As the strategy where strawing embryos in the new medium seems the most applicable for the cattle industry,

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