Whole soybeans and lubabegron in finishing diets: Effects on steer performance and carcass traits

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Moderate whole-soybean inclusion was more practical than high inclusion. Steers fed 12.5% whole soybeans maintained overall gain closer to those fed 0% whole soybeans, whereas 25% whole soybeans reduced average daily gain and tended to reduce feed efficiency without reducing dry matter intake. Within the 25% whole-soybean diet, lubabegron supplementation tended to improve gain and increased carcass dressing percentage, but it should complement — not replace — careful diet formulation.

Summary

This study evaluated increasing whole-soybean inclusion and the response to lubabegron supplementation in finishing steers. Increasing whole soybeans reduced average daily gain without affecting dry matter intake, with a more pronounced reduction at 25% than at 12.5% inclusion. Within the 25% whole-soybean diet, lubabegron tended to improve gain and increased dressing percentage without increasing intake. These results support moderate whole-soybean inclusion in balanced finishing diets and indicate that lubabegron may improve selected performance and carcass outcomes when high levels of whole soybeans are fed.

Introduction

Feeding whole soybeans can provide dietary protein and lipids in cattle diets. For North Dakota cattle feeders, using whole soybeans directly in finishing diets may create an additional market for soybean growers while replacing part of the corn and supplemental protein source normally used in the ration. The energy value of the diet is expected to increase as soybean lipid replaces carbohydrate; however, more fat does not always result in more gain.

High concentrations of dietary lipid — particularly unsaturated fatty acids — can inhibit ruminal microorganisms, alter fiber digestion and change nutrient use. The response depends on the amount and source of lipid and on the remainder of the diet. Adequate effective fiber, a suitable balance of rumen-degradable and metabolizable protein, and appropriate grain and forage proportions remain important when whole soybeans are added (NASEM, 2016). In the present diets, predicted fat increased from 3.01% to 5.25% and 7.57% of dry matter as whole soybeans increased from 0% to 12.5% and 25%, respectively.

Lubabegron (Experior®; Elanco US Inc., Greenfield, Indiana) is a beta-adrenergic agonist/antagonist approved by the U.S. Food and Drug Administration for reducing ammonia gas emissions per pound of live weight and hot carcass weight when fed during the final 14 to 91 days on feed (FDA, 2018). Research also has reported improvements in average daily gain, feed efficiency and hot carcass weight when lubabegron was fed during the final 56 days (Kube et al., 2021). Whether similar performance responses occur when cattle receive a high level of whole soybeans is not well established. Therefore, the objectives were to determine the effects of increasing levels of whole-soybean inclusion on finishing steer diets and to evaluate the effects of lubabegron supplementation in the 25% whole-soybean diet on intake, growth, efficiency and carcass traits.

Experimental Procedures

A total of 130 crossbred beef steers, averaging approximately 952 lb at the start of the finishing period, were assigned to 16 pens in a completely randomized design at the NDSU Carrington Research Extension Center. Pens contained seven to nine steers each, and four pens were assigned to each treatment. The treatments were 0% whole soybeans (WSB), 12.5% WSB, 25% WSB and 25% WSB plus lubabegron. The first three treatments were used to evaluate the WSB dose response. The fourth treatment received the same 25% WSB basal diet and was used only for the direct lubabegron

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comparison. One steer was removed before final body weight and carcass data were collected, leaving 31, 33, 33 and 32 steers in the four treatments, respectively. The pen — not the individual animal — was the experimental unit.

The three basal diets were formulated to provide similar crude protein while WSB replaced soybean meal and portions of the energy ingredients (Table 1). The diets were fed for 162 days. Lubabegron was included in the designated 25% WSB treatment during the final 56 days, followed by a seven-day withdrawal interval before harvest. Feed delivery was recorded daily. Bunks were managed to remain practically clean and no measurable refusals were present; consequently, dry matter supplied was used as pen dry matter intake.

Steers were weighed on two consecutive days at the beginning of the experiment, at the start of lubabegron feeding and at the end of the experiment. These weights defined a 99-day prelubabegron period, a 63-day terminal period that included 56-day lubabegron supplementation and seven-day withdrawal, and the complete 162-day feeding period. Average daily gain was calculated from period-specific body weights, and gain-to-feed ratio was calculated as gain divided by dry matter intake. Hot carcass weight, dressing percentage, marbling score, ribeye area, backfat thickness and yield and quality grades were collected at harvest.

Continuous responses were analyzed using the MIXED procedure of SAS with treatment as a fixed effect and one observation per pen. Planned contrasts evaluated linear and quadratic responses among 0%, 12.5% and 25% WSB without lubabegron and the direct comparison between 25% WSB with and without lubabegron. Statistical significance was declared at $P \leq 0.05$ and tendencies at $0.05 < P \leq 0.10$.

WSB = whole soybeans; NDF = neutral detergent fiber. The 25% WSB + lubabegron treatment received the same basal diet as the 25% WSB treatment. Nutrient composition was predicted using the 2016 Beef Cattle Nutrient Requirements Model (NASEM, 2016).

Table 1. Ingredient and predicted nutrient composition of finishing diets containing increasing levels of whole soybeans (dry matter basis).

Item	0% WSB	12.5% WSB	25% WSB
Ingredient composition, % of diet DM			
Corn silage	30.00	30.00	30.00
Soybean hulls	11.80	13.70	10.00
Corn grain	37.50	32.00	32.00
Whole soybeans	0.00	12.50	25.00
Soybean meal	17.70	8.80	0.00
Limestone	1.50	1.50	1.50
Vitamin and mineral supplement	1.35	1.35	1.35
Salt	0.15	0.15	0.15
Predicted nutrient composition			
Net energy for maintenance, Mcal/lb	0.83	0.84	0.87
Net energy for gain, Mcal/lb	0.55	0.56	0.58
Crude protein, % DM	16.30	16.26	16.28
Fat, % DM	3.01	5.25	7.57
Physically effective NDF, % DM	12.41	14.16	16.00

Results and Discussion

Initial body weight and body weight at the start of lubabegron feeding did not differ among treatments ($P = 0.993$ and $P = 0.789$, respectively; Figure 1), indicating that pens were comparable at both reference points. During the 99-day period before lubabegron feeding, average daily gain decreased linearly from 3.66 to 3.46 and 3.18 lb/day as WSB increased from 0% to 12.5% and 25% of diet dry matter ($P = 0.001$). Gain-to-feed ratio also decreased linearly during this period (0.159, 0.146 and 0.143; $P = 0.005$), whereas dry matter intake did not change linearly ($P = 0.321$). Because these responses occurred before lubabegron was fed, they reflect the WSB diets rather than the feed additive.

Across the complete 162-day period, average daily gain was 3.50, 3.42 and 3.12 lb/day for 0%, 12.5% and 25% WSB, respectively, and decreased linearly as WSB inclusion increased ($P = 0.007$; Figure 1A). Overall dry matter intake averaged 24.93, 25.51 and 23.73 lb/day and was not affected by level of WSB inclusion ($P = 0.182$; Figure 1B). Gain-to-feed ratio tended to decrease linearly (0.141, 0.134 and 0.132; $P = 0.065$; Figure 1C) with increasing WSB inclusion. Thus, the lower gain at 25% WSB was not simply caused by cattle eating less feed. The 12.5% WSB treatment remained numerically close to the control, whereas performance declined more clearly at 25% WSB.

The diets were formulated to contain almost identical crude protein, and the predicted energy value increased as WSB inclusion increased. Nevertheless, the cattle did not convert the high-WSB diet into additional gain. The study did not directly measure ruminal fermentation or nutrient digestibility, so the mechanisms responsible for the decreased gain cannot be identified. However, the response is consistent

with the practical concern that high unsaturated-lipid intake can alter rumen microbial activity and nutrient utilization. Whole soybeans should therefore be evaluated as part of the complete ration rather than only as a source of additional energy. Dietary lipid level, effective fiber, protein supply and the ingredients displaced by WSB all should be considered.

Within the direct 25% WSB comparison, lubabegron tended to increase average daily gain during the 63-day terminal period from 3.04 to 3.42 lb/day (P = 0.088), an increase of approximately 12%. Terminal dry matter intake was similar (26.12 vs. 26.55 lb/day; P = 0.675), and terminal gain-to-feed ratio increased numerically from 0.117 to 0.129 but was not statistically different (P =

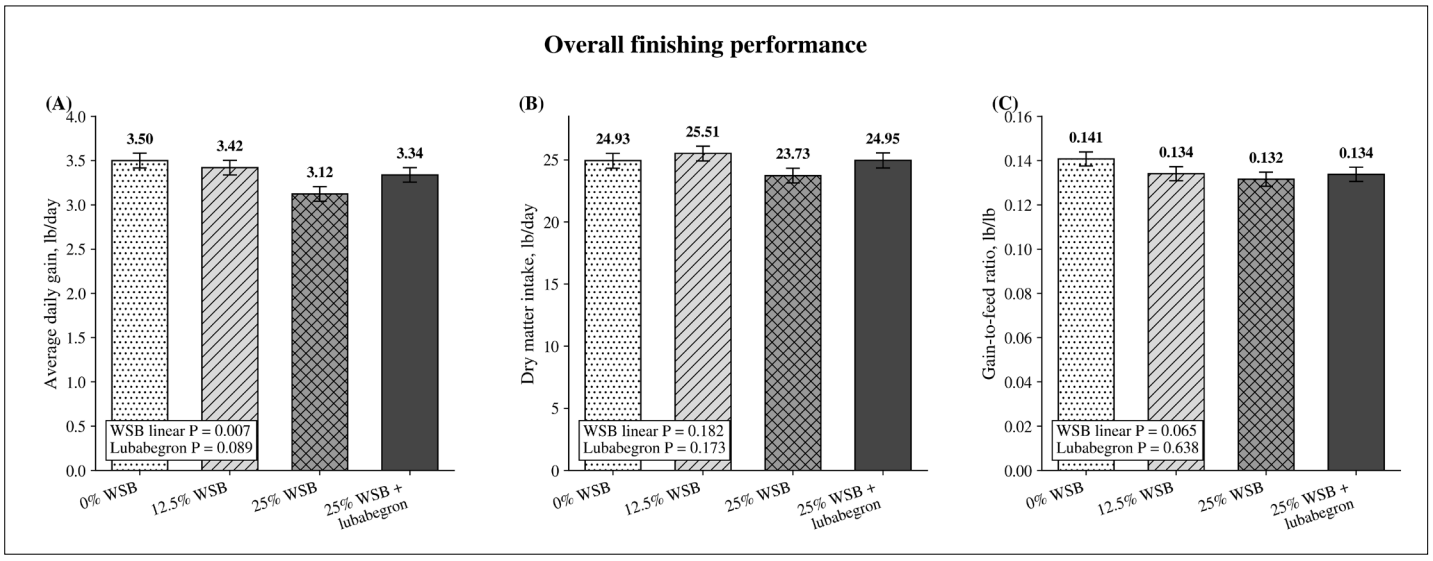

Figure 1. Overall (A) average daily gain, (B) dry matter intake, and (C) gain-to-feed ratio of steers fed diets containing 0%, 12.5%, or 25% whole soybeans (WSB), or 25% WSB plus lubabegron, for 162 days. Values are pen least-squares means ± SEM; n = 4 pens per treatment. For the linear contrast among 0%, 12.5%, and 25% WSB without lubabegron, *P*-values were 0.007, 0.182, and 0.065 for panels A, B, and C, respectively. For the comparison between the 25% WSB diets without and with lubabegron, P-values were 0.089, 0.173, and 0.638 for panels A, B, and C, respectively.

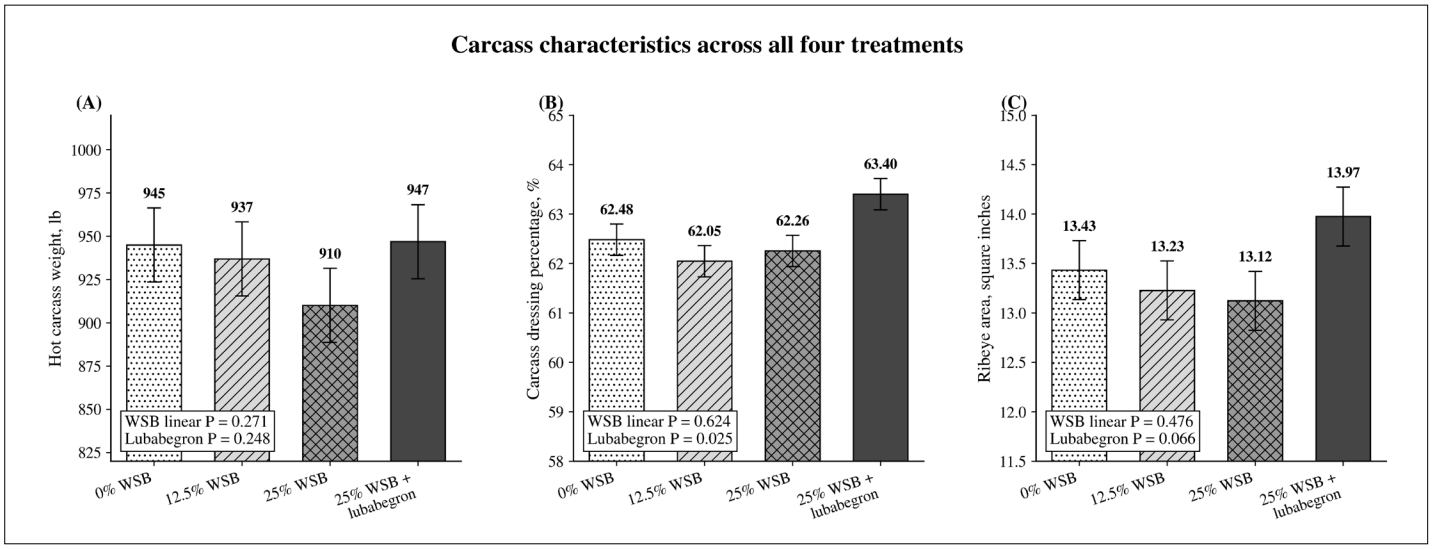

Figure 2. (A) Hot carcass weight, (B) carcass dressing percentage, and (C) ribeye area of steers fed diets containing 0%, 12.5%, or 25% whole soybeans (WSB), or 25% WSB plus lubabegron. Values are pen least-squares means ± SEM; n = 4 pens per treatment. For the linear contrast among 0%, 12.5%, and 25% WSB without lubabegron, *P*-values were 0.271, 0.624, and 0.476 for panels A, B, and C, respectively. For the comparison between the 25% WSB diets without and with lubabegron, P-values were 0.248, 0.025, and 0.066 for panels A, B, and C, respectively.

0.144). Overall average daily gain also tended to increase from 3.12 to 3.34 lb/day with lubabegron (P = 0.089; Figure 1A). These responses indicate that the possible gain benefit was not driven by greater feed intake.

Lubabegron increased dressing percentage from 62.26% to 63.40% within the 25% WSB diet (P = 0.025; Figure 2B). Ribeye area also tended to increase from 13.12 to 13.97 square inches (P = 0.066; Figure 2C). Hot carcass weight was 910 and 947 lb for 25% WSB without and with lubabegron, respectively, but the direct contrast was not significant (P = 0.248; Figure 2A). Marbling score, backfat thickness and calculated yield grade were not affected by lubabegron ($P \geq 0.386$).

Lubabegron supplementation produced consistent positive responses within the 25% WSB diet. In addition to increasing dressing percentage, lubabegron tended to improve average daily gain and ribeye area and resulted in a numerical increase in hot carcass weight. Some of these responses did not reach statistical significance, which may be related to the limited number of experimental units available in this study. Future studies with more pens per treatment are warranted to confirm the magnitude and consistency of these responses when lubabegron is supplemented in diets containing high levels of whole soybeans.

In conclusion, whole soybeans can provide a locally available source of protein and energy for finishing cattle, but more was not necessarily better. Under the conditions of this study, 12.5% WSB provided the more balanced practical response, while 25% WSB reduced gain and tended to reduce feed efficiency without reducing intake. Lubabegron improved dressing percentage and tended to improve gain within the 25% WSB diet. It may improve the value recovered during the terminal feeding period, but it should be viewed as a management tool used with a well-balanced diet, not as a substitute for appropriate formulation.

Acknowledgments

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